

| Specification                                                |                                        | Symbol                                                                                                                                                                                                                                                                                                                                                                                               | Condition / Comment                                                                                                                                             |                                                                                                                                                                               | HTS 440-1200 SCR                                     |            | Unit                                                                                            |
|--------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------|
| ABSOLUTE MAXIMUM RATINGS                                     | Maximum Operating Voltage              | $V_{O(max)}$                                                                                                                                                                                                                                                                                                                                                                                         | $I_{off} < 400 \mu ADC$ , $T_{case} = 70^{\circ}C$                                                                                                              |                                                                                                                                                                               | 44                                                   |            | kVDC                                                                                            |
|                                                              | Minimum Operating Voltage              | $V_{O(min)}$                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                 |                                                                                                                                                                               | 2000                                                 |            | VDC                                                                                             |
|                                                              | Maximum Isolation Voltage              | $V_I$                                                                                                                                                                                                                                                                                                                                                                                                | Between HV switch and control / GND, continuously                                                                                                               |                                                                                                                                                                               | $\pm 50$                                             |            | kVDC                                                                                            |
|                                                              | Max. Housing Insulation Voltage        | $V_{INS}$                                                                                                                                                                                                                                                                                                                                                                                            | Between switch and housing surface, 3 minutes                                                                                                                   |                                                                                                                                                                               | $\pm 70$                                             |            | kVDC                                                                                            |
|                                                              | Maximum Turn-On Peak Current           | $I_{P(max)}$                                                                                                                                                                                                                                                                                                                                                                                         | $T_{case} = 25^{\circ}C$                                                                                                                                        | $t_p < 200 \mu s$ , duty cycle $< 1\%$<br>$t_p < 1 ms$ , duty cycle $< 1\%$<br>$t_p < 10 ms$ , duty cycle $< 1\%$<br>$t_p < 100 ms$ , duty cycle $< 1\%$                      | 12000<br>6000<br>4080<br>2400                        |            | ADC                                                                                             |
|                                                              | Max. Non-Repetitive Peak Current       | $I_{P(nr)}$                                                                                                                                                                                                                                                                                                                                                                                          | $T_{case} = 25^{\circ}C$                                                                                                                                        | Half sine single pulse, $t_p < 200 \mu s$<br>Half sine single pulse, $t_p < 20 \mu s$                                                                                         | 24000<br>48000                                       |            | ADC                                                                                             |
|                                                              | Max. Coutinuous Load Current           | $I_L$                                                                                                                                                                                                                                                                                                                                                                                                | $T_{case} = 25^{\circ}C$                                                                                                                                        |                                                                                                                                                                               | 3.26                                                 |            | ADC                                                                                             |
|                                                              | Max. Rate-of-Rise of OFF-State Voltage | $dv/dt$                                                                                                                                                                                                                                                                                                                                                                                              | @ $V_{O(max)}$ , exponential waveform                                                                                                                           |                                                                                                                                                                               | 150                                                  |            | kV/ $\mu s$                                                                                     |
|                                                              | Max. Continuous Power Dissipation      | $P_{d(max)}$                                                                                                                                                                                                                                                                                                                                                                                         | $T_{case} = 25^{\circ}C$                                                                                                                                        | Standard devices & FC, forced air 4 m/s                                                                                                                                       | 100                                                  |            | Watt                                                                                            |
|                                                              | Linear Derating                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Above $25^{\circ}C$                                                                                                                                             | Standard devices & FC, forced air 4 m/s                                                                                                                                       | 3.3                                                  |            | W/K                                                                                             |
|                                                              | Operating Temperature Range            | $T_O$                                                                                                                                                                                                                                                                                                                                                                                                | Standard devices & options CF, GCF, ILC. (Option DLC)                                                                                                           |                                                                                                                                                                               | -40...75                                             |            | $^{\circ}C$                                                                                     |
|                                                              | Storage Temperature Range              | $T_S$                                                                                                                                                                                                                                                                                                                                                                                                | Switches with option ILC may require frost protection!                                                                                                          |                                                                                                                                                                               | -50...90                                             |            | $^{\circ}C$                                                                                     |
|                                                              | Max. Permissible Magnetic Field        | B                                                                                                                                                                                                                                                                                                                                                                                                    | Homogeneous steady-field, surrounding the whole switch                                                                                                          |                                                                                                                                                                               | 25                                                   |            | mT                                                                                              |
|                                                              | Max. Auxilliary Voltage                | $V_{aux}$                                                                                                                                                                                                                                                                                                                                                                                            | Built-in overvoltage limiter (replaceable)                                                                                                                      |                                                                                                                                                                               | 5                                                    |            | VDC                                                                                             |
| ELECTRICAL CHARACTERISTICS                                   | Permissible Operating Voltage Range    | $V_O$                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                 |                                                                                                                                                                               | $0 \dots \pm 44$                                     |            | kVDC                                                                                            |
|                                                              | Typical Breakdown Voltage              | $V_{br}$                                                                                                                                                                                                                                                                                                                                                                                             | NOTE: $V_{br}$ is a test parameter for quality control purposes only. Not applicable in                                                                         | $I_{off} > 0.5 mA$                                                                                                                                                            | $> 48$                                               |            | kVDC                                                                                            |
|                                                              | Typical Off-State Current              | $I_{off}$                                                                                                                                                                                                                                                                                                                                                                                            | $0.8 \times V_O$ , $T_{case} = 25 \dots 70^{\circ}C$ , reduced $I_{off}$ on request                                                                             |                                                                                                                                                                               | $< 400$                                              |            | $\mu ADC$                                                                                       |
|                                                              | Typical Holding Current                |                                                                                                                                                                                                                                                                                                                                                                                                      | $T_{case} = 70^{\circ}C$                                                                                                                                        |                                                                                                                                                                               | 35                                                   |            | mADC                                                                                            |
|                                                              | Typical On-State Voltage               | $V_{sat}$                                                                                                                                                                                                                                                                                                                                                                                            | Each switching path<br>$t_p < 1 \mu s$ , duty cycle $< 1\%$                                                                                                     | $0.01 \times I_{P(max)}$<br>$0.1 \times I_{P(max)}$<br>$1.0 \times I_{P(max)}$                                                                                                | 46<br>86<br>230                                      |            | VDC                                                                                             |
|                                                              | Typical Propagation Delay Time         | $t_{d(on)}$                                                                                                                                                                                                                                                                                                                                                                                          | Resistive load, $0.1 \times I_{P(max)}$ , $0.8 \times V_{O(max)}$ , 50-50%                                                                                      |                                                                                                                                                                               | 0.4                                                  |            | $\mu s$                                                                                         |
|                                                              | Typical Output Pulse Jitter            | $t_j$                                                                                                                                                                                                                                                                                                                                                                                                | Impedance matched input, $V_{aux} / V_{ctrl} = 5.00 VDC$                                                                                                        |                                                                                                                                                                               | 1                                                    |            | ns                                                                                              |
|                                                              | Typical Turn-On Rise Time              | $t_{r(on)}$                                                                                                                                                                                                                                                                                                                                                                                          | Resistive load, 10-90%                                                                                                                                          | $0.1 \times V_{O(max)}$ , $I_L = 0.1 \times I_{P(max)}$<br>$0.8 \times V_{O(max)}$ , $I_L = 0.1 \times I_{P(max)}$<br>$0.8 \times V_{O(max)}$ , $I_L = 1.0 \times I_{P(max)}$ | 320<br>97<br>290                                     |            | ns                                                                                              |
|                                                              | Typical Turn-Off Time                  | $t_{off}, t_q$                                                                                                                                                                                                                                                                                                                                                                                       | Resistive load, 10-90%                                                                                                                                          | $0.1 \times V_{O(max)}$ , $I_L = 0.1 \times I_{P(max)}$<br>$0.8 \times V_{O(max)}$ , $I_L = 1.0 \times I_{P(max)}$                                                            | 35<br>90                                             |            | $\mu s$                                                                                         |
|                                                              | On Time                                | $t_{on}$                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                 |                                                                                                                                                                               | $35 \dots \infty$                                    |            | ns                                                                                              |
|                                                              | Internal Driver Recovery Time          | $t_{rc}$                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                 |                                                                                                                                                                               | 1000                                                 |            | $\mu s$                                                                                         |
|                                                              | Max. Continuous Switching Frequency    | $f_{(max)}$                                                                                                                                                                                                                                                                                                                                                                                          | @ $V_{aux} = 5.00 V$<br>Sw. shutdown if $f_{(max)}$ is exceeded                                                                                                 | Standard devices without HFS option<br>Standard devices with HFS supply<br>Opt. HFS + sufficient cooling option                                                               | 130<br>1000<br>1000                                  |            | Hz                                                                                              |
|                                                              | Maximum Burst Frequency                | $f_{b(max)}$                                                                                                                                                                                                                                                                                                                                                                                         | Use option HFB for $> 10$ pulses within 20 $\mu s$ or less                                                                                                      |                                                                                                                                                                               | 1                                                    |            | kHz                                                                                             |
|                                                              | Maximum Number of Pulses / Burst       | $N_{(max)}$                                                                                                                                                                                                                                                                                                                                                                                          | @ $f_{b(max)}$<br><br>Note: Option HFB requires external buffer capacitors with a voltage rating of $> 630VDC$ and a capacitance of 100nF per additional pulses | Standard<br>Option I-HFB<br>Option HFB                                                                                                                                        | 15 Use option HFB for $> 150$<br>$> 100$<br>$> 1000$ |            | Pulses                                                                                          |
|                                                              | Coupling Capacitance                   | $C_C$                                                                                                                                                                                                                                                                                                                                                                                                | HV side against control side                                                                                                                                    |                                                                                                                                                                               | $> 300$                                              |            | pF                                                                                              |
|                                                              | Control Voltage Range                  | $V_{ctrl}$                                                                                                                                                                                                                                                                                                                                                                                           | The $V_{ctrl}$ has no impact on the output pulse shape.                                                                                                         |                                                                                                                                                                               | 4... 5                                               |            | VDC                                                                                             |
|                                                              | Auxiliary Supply Voltage Range         | $V_{aux}$                                                                                                                                                                                                                                                                                                                                                                                            | The +5 V supply is not required in the HFS mode.                                                                                                                |                                                                                                                                                                               | 5                                                    |            | VDC                                                                                             |
|                                                              | Typical Auxiliary Supply Current       | $I_{aux}$                                                                                                                                                                                                                                                                                                                                                                                            | $V_{aux} = 5.00 VDC$ , $T_{case} = 25^{\circ}C$ .<br>Active current limitation above 1A.                                                                        | $0.01 \times f_{(max)}$<br>@ $f_{(max)}$                                                                                                                                      | 400<br>600                                           |            | mADC                                                                                            |
|                                                              | Fault Signal Output                    |                                                                                                                                                                                                                                                                                                                                                                                                      | Switch will be turn off, if $f > f_{(max)}$ , $V_{aux} < 4.75V$ or $T_{case} > 75^{\circ}C$<br>Fault condition is indicated by a logical "L"                    |                                                                                                                                                                               | H=4V, L=0.5V                                         |            | VDC                                                                                             |
|                                                              | Trigger Voltage Range                  | $V_{TR}$                                                                                                                                                                                                                                                                                                                                                                                             | Switching behaviour is not influenced by trigger quality                                                                                                        |                                                                                                                                                                               | $< 10$                                               |            | VDC                                                                                             |
| HOUSING                                                      | Dimensions                             | $L \times W \times H$                                                                                                                                                                                                                                                                                                                                                                                | Standard housing<br>Devices with option CF, non-isolated cooling fins<br>Devices with option DLC                                                                |                                                                                                                                                                               | Please contact the manufactured!                     |            | mm <sup>3</sup>                                                                                 |
|                                                              | Weight                                 |                                                                                                                                                                                                                                                                                                                                                                                                      | Standard housing<br>Devices with option CF, non-isolated cooling fins<br>Devices with option DLC                                                                |                                                                                                                                                                               | Please contact the manufactured!                     |            | g                                                                                               |
| FUNCTIONS                                                    | Control Signal Input                   | Pin 1 / Yellow. TTL compatible with Schmitt-Trigger characteristics. Control voltage 2-10 V (3-5 V recommended for low jitter).                                                                                                                                                                                                                                                                      |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | Logic GND / 5V Return                  | Pin 2 / Black. The ground pin is internally connected with the safety earthing terminal (threaded insert) on bottom side.                                                                                                                                                                                                                                                                            |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | 5V Auxiliary Supply                    | Pin 3 / Red. The 5 V input is used for rep rates up to the specified max. frequency $f_{(max)}$ . Higher rep rates require option HFS.                                                                                                                                                                                                                                                               |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | Fault Signal Output                    | Pin 4 / Orange. TTL output, short circuit proof. Indicating switch & driver over-heat, over-frequency, low auxiliary voltage. L = Fault.                                                                                                                                                                                                                                                             |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | Inhibit Signal Input                   | Pin 5 / Green. TTL compatible, Schmitt-Trigger characteristics for the connection of external safety circuits. L = Switch Inhibited.                                                                                                                                                                                                                                                                 |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | LED Indicators                         | GREEN: "Auxiliary power good, switch OFF". YELLOW: "Control signal received, switch ON". RED: "Fault condition, switch OFF"                                                                                                                                                                                                                                                                          |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
|                                                              | Temperature Protection                 | A) Standard switches and switches with option CF, GCF: Thermo trigger $75^{\circ}C$ , response time $< 60 s$ @ $3 \times Pd(max)$ , $\Delta T = 25K$ (50 to $75^{\circ}C$ ). Separate driver protection. B) Switches with option DLC: $65^{\circ}C$ , response time $< 3 s$ @ $3 \times Pd(max)$ , $\Delta T = 25K$ (40 to $65^{\circ}C$ ), coolant flow $> 3 l / min$ . Separate driver protection. |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |
| ORDERING TI                                                  | HTS 440-1200 SCR                       | Thyristor Switch, 44 kVDC, 1200 ADC                                                                                                                                                                                                                                                                                                                                                                  | Option LP                                                                                                                                                       | Low Pass. Input filter for increased noise immunity.                                                                                                                          |                                                      | Option CCS | Ceramic Cooling Surface. $P_{d(max)}$ can be increased by the factor 2 to 3.                    |
|                                                              |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Option S-TT                                                                                                                                                     | Soft Transition Time. Slower switching speed for simplified EMC.                                                                                                              |                                                      | Option CCF | Ceramic Flange Housing. $P_{d(max)}$ can be increased by the factor 3 to 15.                    |
|                                                              |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Option HFB                                                                                                                                                      | High Frequency Burst, Improved burst capability by driver.                                                                                                                    |                                                      | Option CF  | Copper Cooling Fins. $P_{d(max)}$ can be increased by the factor 3 to 10.                       |
|                                                              |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Option HFS                                                                                                                                                      | High Frequency Switching (two auxiliary supply inputs V1 & V2)                                                                                                                |                                                      | Option GCF | Grounded Cooling Flange (copper). $P_{d(max)}$ can be increased by the factor 3 to 15.          |
|                                                              |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Option UFTR                                                                                                                                                     | Ultra Fast Thermotriigger. Response time for shut down $< 5s$ .                                                                                                               |                                                      | Option ILC | Indirect Liquid Cooling (for water). $P_{d(max)}$ can be increased by the factor 3 to 15.       |
|                                                              |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      | Option UFTS                                                                                                                                                     | Ultra Fast Thermosensor. Response time $< 5s$ . NTC 10k / $\pm 1\%$                                                                                                           |                                                      | Option DLC | Direct Liquid Cooling (for FPE/PFC). $P_{d(max)}$ can be increased by the factor 10 to 100. 15. |
| FOR FURTHER PRODUCT OPTIONS PLEASE REFER TO THE OPTIONS PAGE |                                        |                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                 |                                                                                                                                                                               |                                                      |            |                                                                                                 |

Customized switching units are available on request. All data and specifications subject to change without notice. Please visit [www.behlke.com](http://www.behlke.com) for up-dates.

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