

Inverter Grade Thyristors (PUK Version), 620 A


TO-200AB (E-PUK)
FEATURES

- Metal case with ceramic insulator
- All diffused design
- Center amplifying gate
- Guaranteed high dV/dt
- Guaranteed high dI/dt
- International standard case TO-200AB (E-PUK)
- High surge current capability
- Low thermal impedance
- High speed performance
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912


**RoHS
COMPLIANT**
PRODUCT SUMMARY

| | |
|--------------------|------------------------------|
| Package | TO-200AB (E-PUK) |
| Diode variation | Single SCR |
| $I_{T(AV)}$ | 620 A |
| V_{DRM}/V_{RRM} | 400 V, 800 V, 1000 V, 1200 V |
| V_{TM} | 2.16 V |
| I_{TSM} at 50 Hz | 7950 A |
| I_{TSM} at 60 Hz | 8320 A |
| I_{GT} | 200 mA |
| T_C/T_{hs} | 55 °C |

TYPICAL APPLICATIONS

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

MAJOR RATINGS AND CHARACTERISTICS

| PARAMETER | TEST CONDITIONS | VALUES | UNITS |
|-------------------|-----------------|-------------|-------------------|
| $I_{T(AV)}$ | | 620 | A |
| | T_{hs} | 55 | °C |
| $I_{T(RMS)}$ | | 1180 | A |
| | T_{hs} | 25 | °C |
| I_{TSM} | 50 Hz | 7950 | A |
| | 60 Hz | 8320 | |
| I^2t | 50 Hz | 316 | kA ² s |
| | 60 Hz | 289 | |
| V_{DRM}/V_{RRM} | | 400 to 1200 | V |
| t_q | Range | 10 to 30 | µs |
| T_J | | -40 to 125 | °C |

Note

- $t_q = 10 \mu s$ to $20 \mu s$ for 400 V to 800 V devices
- $t_q = 15 \mu s$ to $30 \mu s$ for 1000 V to 1200 V devices



ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS | | | | |
|------------------------|--------------|---|---|---|
| TYPE NUMBER | VOLTAGE CODE | V_{DRM}/V_{RRM} , MAXIMUM REPETITIVE PEAK VOLTAGE V | V_{RSM} , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V | I_{DRM}/I_{RRM} MAXIMUM AT $T_J = T_J$ MAXIMUM mA |
| VS-ST303C..C | 04 | 400 | 500 | 50 |
| | 08 | 800 | 900 | |
| | 10 | 1000 | 1100 | |
| | 12 | 1200 | 1300 | |

| CURRENT CARRYING CAPABILITY | | | | | | | |
|------------------------------------|-----------|------|-----------|------|-----------|------|----------------|
| FREQUENCY | | | | | | | UNITS |
| 50 Hz | 1314 | 1130 | 2070 | 1940 | 6930 | 6270 | A |
| 400 Hz | 1260 | 1040 | 2190 | 1880 | 3440 | 2960 | |
| 1000 Hz | 900 | 700 | 1900 | 1590 | 1850 | 1540 | |
| 2500 Hz | 340 | 230 | 910 | 710 | 740 | 560 | |
| Recovery voltage V_r | 50 | | 50 | | 50 | | V |
| Voltage before turn-on V_d | V_{DRM} | | V_{DRM} | | V_{DRM} | | |
| Rise of on-state current di/dt | 50 | | - | | - | | A/ μ s |
| Heatsink temperature | 40 | 55 | 40 | 55 | 40 | 55 | $^{\circ}$ C |
| Equivalent values for RC circuit | 10/0.47 | | 10/0.47 | | 10/0.47 | | Ω/μ F |

| ON-STATE CONDUCTION | | | | | | |
|--|---------------|---|---------------------------|---|-----------|-----------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | | VALUES | UNITS |
| Maximum average on-state current at heatsink temperature | $I_{T(AV)}$ | 180 $^{\circ}$ conduction, half sine wave double side (single side) cooled | | | 620 (230) | A |
| | | | | | 55 (85) | $^{\circ}$ C |
| Maximum RMS on-state current | $I_{T(RMS)}$ | DC at 25 $^{\circ}$ C heatsink temperature double side cooled | | | 1180 | |
| Maximum peak, one half cycle, non-repetitive surge current | I_{TSM} | t = 10 ms | No voltage reapplied | Sinusoidal half wave, initial $T_J = T_J$ maximum | 7950 | A |
| | | t = 8.3 ms | | | 8320 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | | 6690 | |
| | | t = 8.3 ms | | | 7000 | |
| Maximum I^2t for fusing | I^2t | t = 10 ms | No voltage reapplied | | 316 | kA^2s |
| | | t = 8.3 ms | | | 289 | |
| | | t = 10 ms | 100 % V_{RRM} reapplied | | 224 | |
| | | t = 8.3 ms | | | 204 | |
| Maximum $I^2\sqrt{t}$ for fusing | $I^2\sqrt{t}$ | t = 0.1 to 10 ms, no voltage reapplied | | | 3160 | $kIA^2\sqrt{s}$ |
| Maximum peak on-state voltage | V_{TM} | $I_{TM} = 1255$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse | | | 2.16 | V |
| Low level value of threshold voltage | $V_{T(TO)1}$ | $(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | | 1.44 | |
| High level value of threshold voltage | $V_{T(TO)2}$ | $I > \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | | 1.48 | |
| Low level value of forward slope resistance | r_{t1} | $(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | | 0.57 | m Ω |
| High level value of forward slope resistance | r_{t2} | $I > \pi \times I_{T(AV)}$, $T_J = T_J$ maximum | | | 0.56 | |
| Maximum holding current | I_H | $T_J = 25$ $^{\circ}$ C, $I_T > 30$ A | | | 600 | mA |
| Typical latching current | I_L | $T_J = 25$ $^{\circ}$ C, $V_A = 12$ V, $R_a = 6$ Ω , $I_G = 1$ A | | | 1000 | |



| SWITCHING | | | | |
|--|---------|--|--------|------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum non-repetitive rate of rise of turned on current | dl/dt | $T_J = T_J$ maximum, $V_{DRM} = \text{Rated } V_{DRM}$ $I_{TM} = 2 \times dl/dt$ | 1000 | A/ μ s |
| Typical delay time | t_d | $T_J = 25^\circ\text{C}$, $V_{DM} = \text{Rated } V_{DRM}$, $I_{TM} = 50$ A DC, $t_p = 1$ μ s Resistive load, gate pulse: 10 V, 5 Ω source | 0.83 | μ s |
| Maximum turn-off time ⁽¹⁾ | minimum | $T_J = T_J$ maximum, $I_{TM} = 550$ A, commutating dl/dt = 40 A/ μ s $V_R = 50$ V, $t_p = 500$ μ s, dV/dt: See table in device code | 10 | |
| | maximum | | 30 | |

Note

⁽¹⁾ $t_q = 10$ μ s to 20 μ s for 400 V to 800 V devices; $t_q = 15$ μ s to 30 μ s for 1000 V to 1200 V devices

| BLOCKING | | | | |
|--|--------------------------|--|--------|------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum critical rate of rise of off-state voltage | dV/dt | $T_J = T_J$ maximum, linear to 80 % V_{DRM} , higher value available on request | 500 | V/ μ s |
| Maximum peak reverse and off-state leakage current | I_{RRM} , I_{DRM} | $T_J = T_J$ maximum, rated V_{DRM}/V_{RRM} applied | 50 | mA |

| TRIGGERING | | | | |
|---|-------------|---|--------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum peak gate power | P_{GM} | $T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$ | 60 | W |
| Maximum average gate power | $P_{G(AV)}$ | | 10 | |
| Maximum peak positive gate current | I_{GM} | $T_J = T_J$ maximum, $t_p \leq 5$ ms | 10 | A |
| Maximum peak positive gate voltage | + V_{GM} | | 20 | V |
| Maximum peak negative gate voltage | - V_{GM} | | 5 | |
| Maximum DC gate current required to trigger | I_{GT} | $T_J = 25^\circ\text{C}$, $V_A = 12$ V, $R_a = 6$ Ω | 200 | mA |
| Maximum DC gate voltage required to trigger | V_{GT} | | 3 | V |
| Maximum DC gate current not to trigger | I_{GD} | $T_J = T_J$ maximum, rated V_{DRM} applied | 20 | mA |
| Maximum DC gate voltage not to trigger | V_{GD} | | 0.25 | V |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | |
|--|--------------|---|------------------|------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUES | UNITS |
| Maximum operating junction temperature range | T_J | | -40 to 125 | $^\circ\text{C}$ |
| Maximum storage temperature range | T_{Stg} | | -40 to 150 | |
| Maximum thermal resistance, junction to heatsink | R_{thJ-hs} | DC operation single side cooled | 0.09 | K/W |
| | | DC operation double side cooled | 0.04 | |
| Maximum thermal resistance, case to heatsink | R_{thC-hs} | DC operation single side cooled | 0.020 | |
| | | DC operation double side cooled | 0.010 | |
| Mounting force, ± 10 % | | | 9800 (1000) | N (kg) |
| Approximate weight | | | 83 | g |
| Case style | | See dimensions - link at the end of datasheet | TO-200AB (E-PUK) | |



| ΔR_{thJ-hs} CONDUCTION | | | | | | |
|--------------------------------|-----------------------|-------------|------------------------|-------------|--------------------------------------|-------|
| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | | RECTANGULAR CONDUCTION | | TEST CONDITIONS | UNITS |
| | SINGLE SIDE | DOUBLE SIDE | SINGLE SIDE | DOUBLE SIDE | | |
| 180° | 0.010 | 0.010 | 0.007 | 0.007 | T _J = T _J max. | K/W |
| 120° | 0.012 | 0.012 | 0.012 | 0.013 | | |
| 90° | 0.015 | 0.015 | 0.016 | 0.017 | | |
| 60° | 0.022 | 0.022 | 0.023 | 0.023 | | |
| 30° | 0.036 | 0.036 | 0.036 | 0.037 | | |

Note

- The table above shows the increment of thermal resistance R_{thJ-hs} when devices operate at different conduction angles than DC

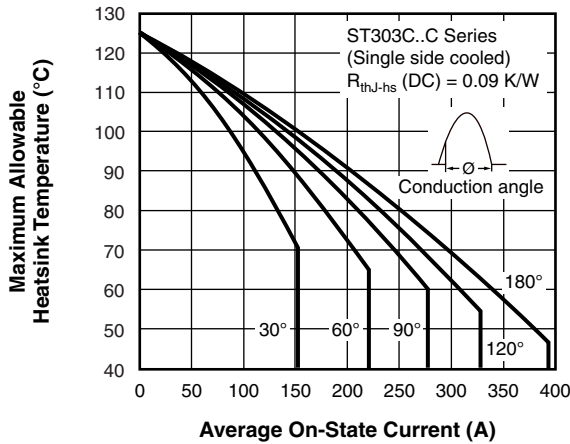


Fig. 1 - Current Ratings Characteristics

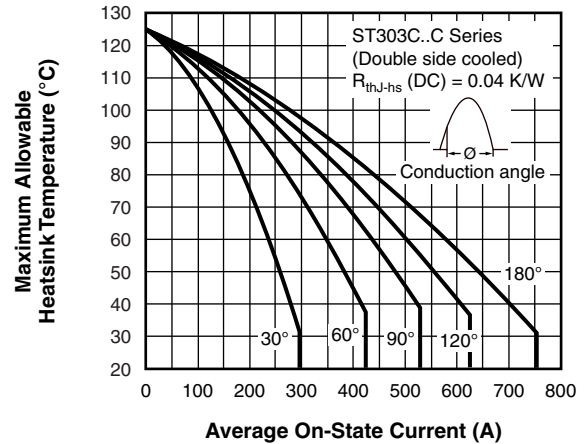


Fig. 3 - Current Ratings Characteristics

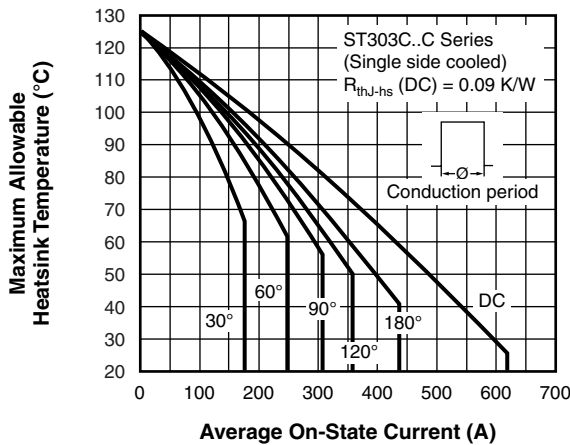


Fig. 2 - Current Ratings Characteristics

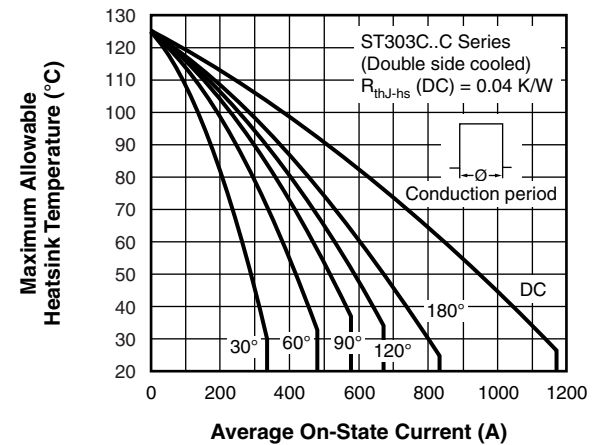


Fig. 4 - Current Ratings Characteristics

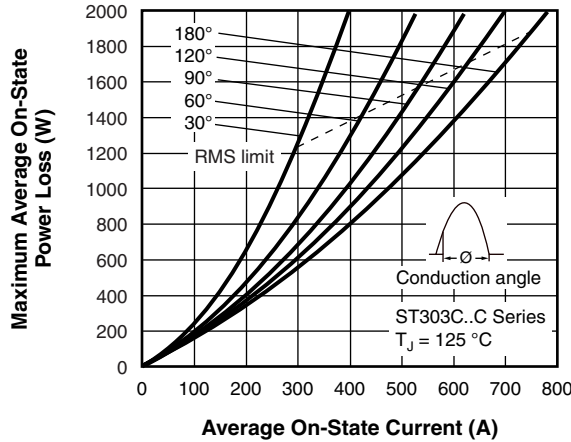


Fig. 5 - On-State Power Loss Characteristics

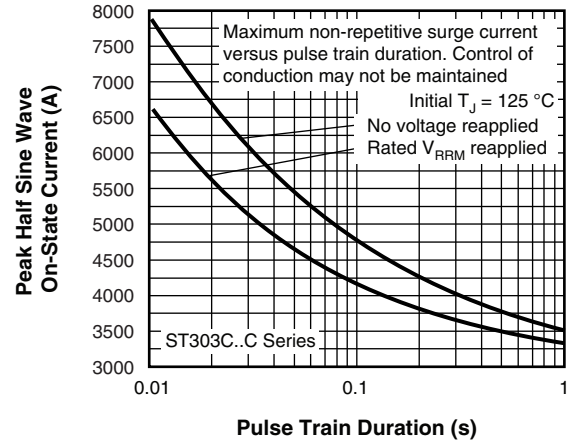


Fig. 8 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled



Fig. 6 - On-State Power Loss Characteristics

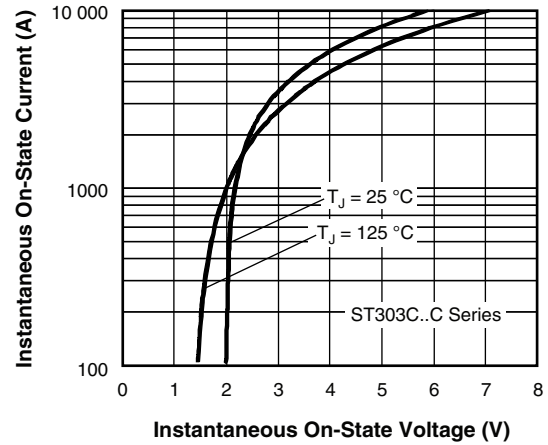


Fig. 9 - On-State Voltage Drop Characteristics

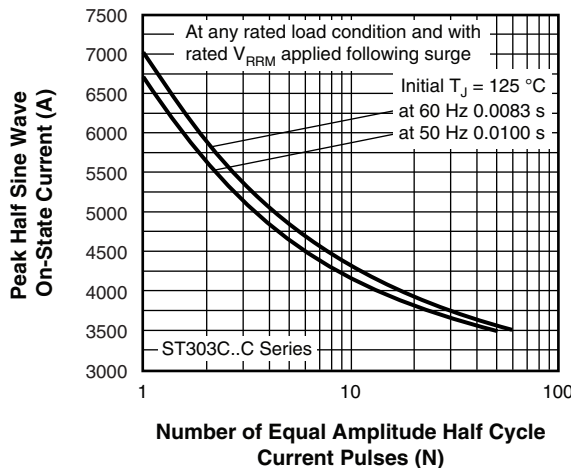


Fig. 7 - Maximum Non-Repetitive Surge Current Single and Double Side Cooled

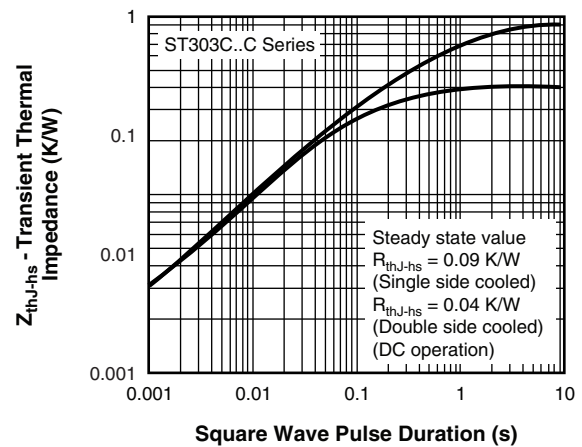


Fig. 10 - Thermal Impedance Z_{thJ-hs} Characteristics

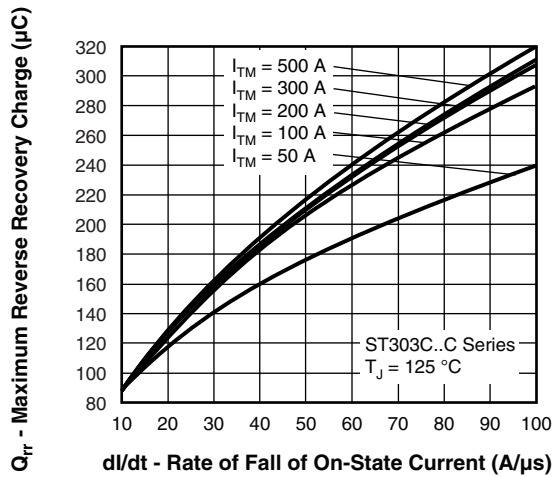


Fig. 11 - Reverse Recovered Charge Characteristics

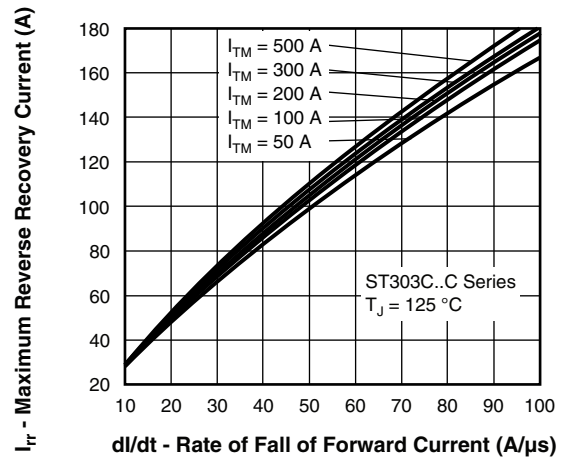


Fig. 12 - Reverse Recovered Current Characteristics

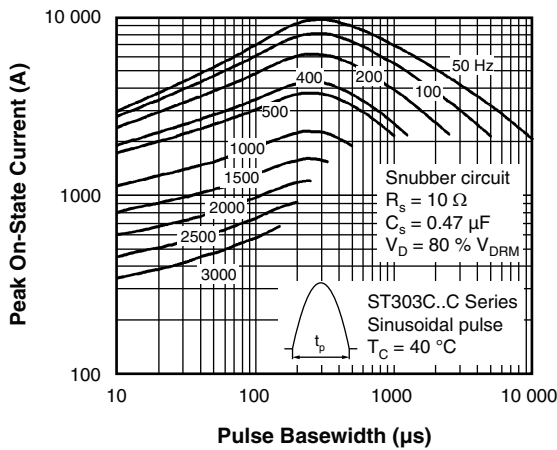


Fig. 13 - Frequency Characteristics

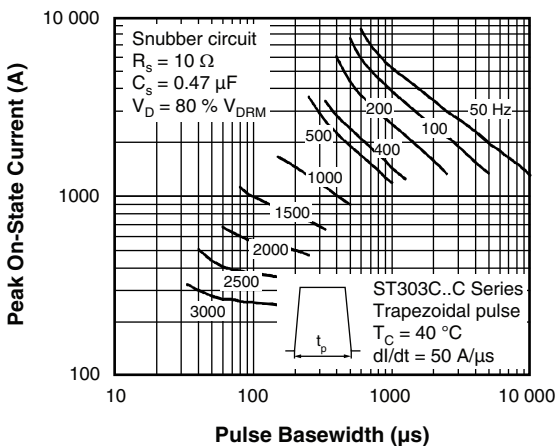
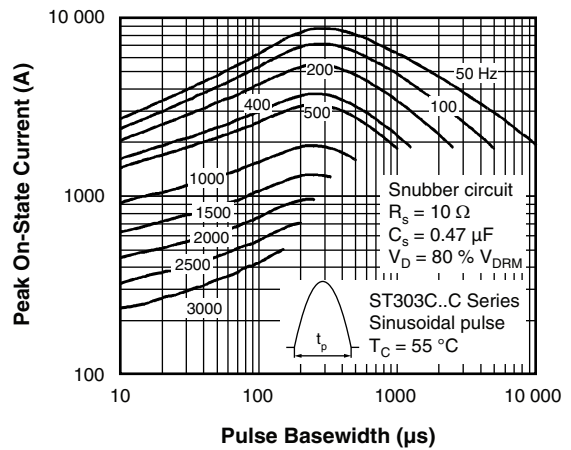
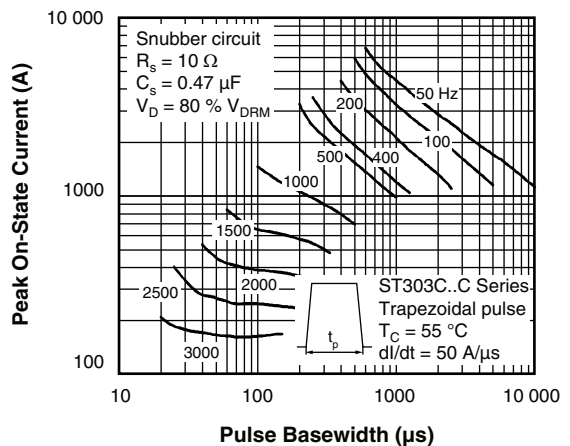


Fig. 14 - Frequency Characteristics



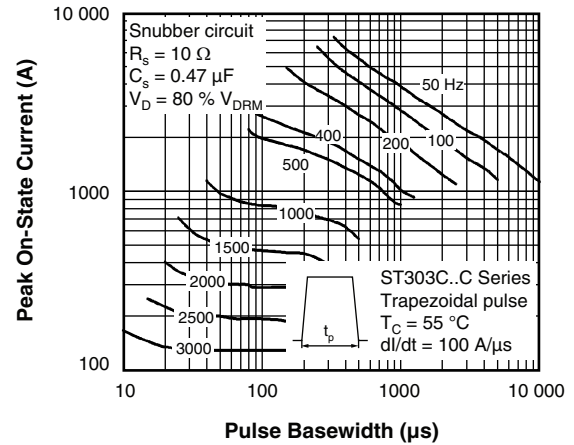
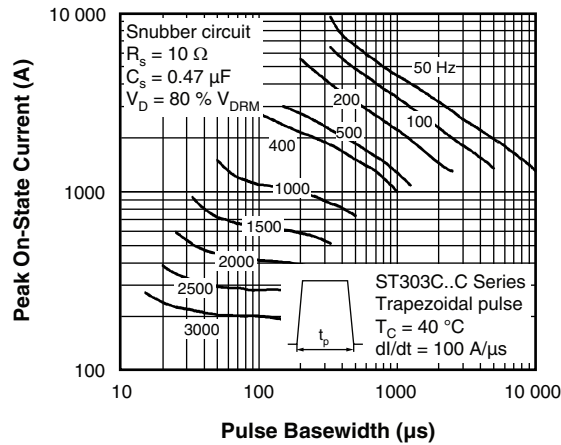


Fig. 15 - Frequency Characteristics

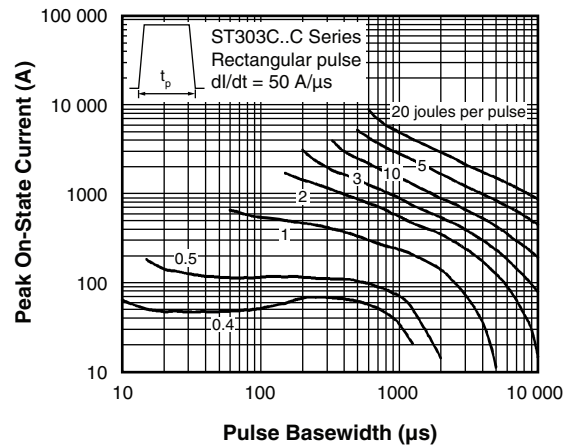
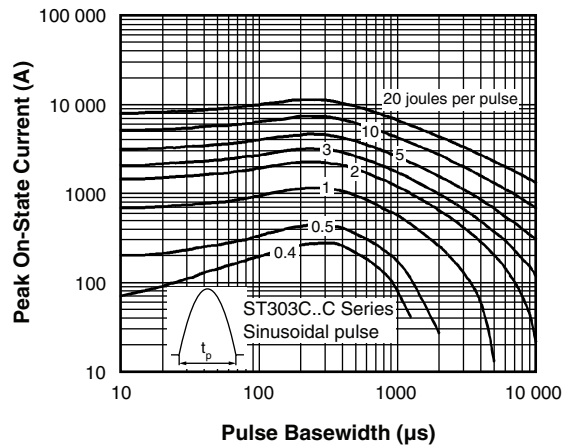


Fig. 16 - Maximum On-State Energy Power Loss Characteristics

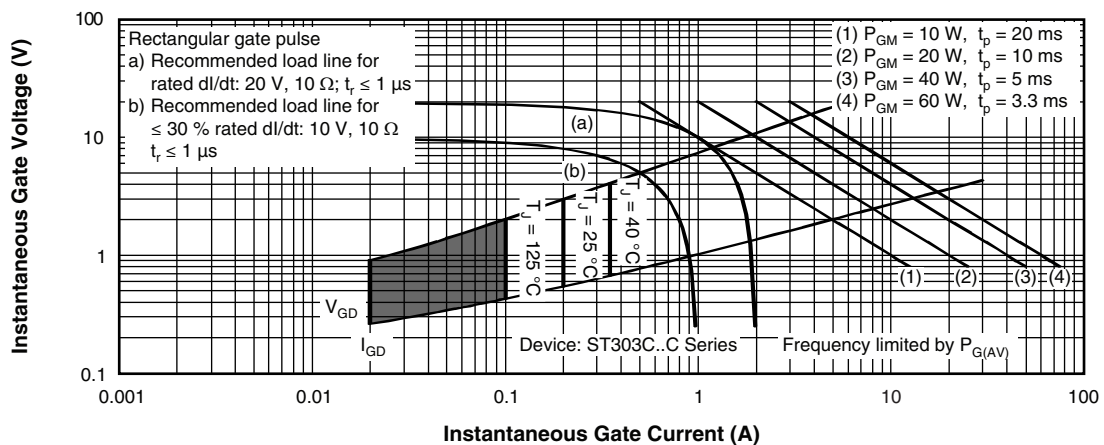


Fig. 17 - Gate Characteristics



ORDERING INFORMATION TABLE

| | | | | | | | | | | | |
|-------------|------------|-----------|-----------|----------|----------|-----------|----------|----------|----------|----------|----------|
| Device code | VS- | ST | 30 | 3 | C | 12 | C | H | K | 1 | - |
| | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ |

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = Fast turn-off
- 5** - C = Ceramic PUK
- 6** - Voltage code x 100 = V_{RRM}
(see Voltage Ratings table)
- 7** - C = PUK case TO-200AB (E-PUK)
- 8** - Reapplied dV/dt code (for t_q test condition)
- 9** - t_q code
- 10** - 0 = Eyelet terminals
(gate and aux. cathode unsoldered leads)
1 = Fast-on terminals
(gate and aux. cathode unsoldered leads)
2 = Eyelet terminals
(gate and aux. cathode soldered leads)
3 = Fast-on terminals
(gate and aux. cathode soldered leads)
- 11** - Critical dV/dt:
 - None = 500 V/ μ s (standard value)
 - L = 1000 V/ μ s (special selection)

| dV/dt - t_q combinations available | | | | | | |
|---|----|--------------------|----|-----|------------|-----|
| | | dV/dt (V/ μ s) | | | | |
| | | 20 | 50 | 100 | 200 | 400 |
| t_q (μ s) up to 800 V | 10 | CN | DN | EN | FN* | HN |
| | 12 | CM | DM | EM | FM | HM |
| | 15 | CL | DL | EL | FL* | HL |
| | 20 | CK | DK | EK | FK* | HK |
| t_q (μ s) only for 1000 V/1200 V | 15 | CL | - | - | - | - |
| | 18 | CP | DP | - | - | - |
| | 20 | CK | DK | EK | FK* | HK |
| | 25 | CJ | DJ | EJ | FJ* | HJ |
| | 30 | - | DH | EH | FH | HH |

* Standard part number.
All other types available only on request.

| LINKS TO RELATED DOCUMENTS | |
|----------------------------|---|
| Dimensions | http://www.vishay.com/doc?95075 |

TO-200AB (E-PUK)

DIMENSIONS in millimeters (inches)

Anode to gate
 Creepage distance: 11.18 (0.44) minimum
 Strike distance: 7.62 (0.30) minimum



Quote between upper and lower pole pieces has to be considered after application of mounting force (see thermal and mechanical specification)



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