

## SWP730-VB Datasheet

### N-Channel 500V (D-S)Power MOSFET

| PRODUCT SUMMARY            |                        |       |
|----------------------------|------------------------|-------|
| V <sub>DS</sub> (V)        | 500                    |       |
| R <sub>DS(on)</sub> (Ω)    | V <sub>GS</sub> = 10 V | 0.660 |
| Q <sub>g</sub> (Max.) (nC) | 81                     |       |
| Q <sub>gs</sub> (nC)       | 20                     |       |
| Q <sub>gd</sub> (nC)       | 36                     |       |
| Configuration              | Single                 |       |

#### FEATURES

- Lower Gate Charge Q<sub>g</sub> Results in Simpler Drive Requirements
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage
- Compliant to RoHS Directive 2002/95/EC



| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                                   |                         |       |          |
|---|-----------------------------------|-------------------------|-------|----------|
| PARAMETER   | SYMBOL                            | LIMIT                   | UNIT  |          |
| Drain-Source Voltage  | V <sub>DS</sub>                   | 500                     | V     |          |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 20                    |       |          |
| Continuous Drain Current  | V <sub>GS</sub> at 10 V           | T <sub>C</sub> = 25 °C  | 13    |          |
|   |                                   | T <sub>C</sub> = 100 °C | 8.1   |          |
| Pulsed Drain Current <sup>a</sup>   | I <sub>DM</sub>                   | 50                      | A     |          |
| Linear Derating Factor  |                                   | 2.0                     | W/°C  |          |
| Single Pulse Avalanche Energy <sup>b</sup>                                | E <sub>AS</sub>                   | 560                     | mJ    |          |
| Avalanche Current <sup>a</sup>  | I <sub>AR</sub>                   | 13                      | A     |          |
| Repetitive Avalanche Energy <sup>a</sup>                                  | E <sub>AR</sub>                   | 25                      | mJ    |          |
| Maximum Power Dissipation   | T <sub>C</sub> = 25 °C            | P <sub>D</sub>          | 250   | W        |
| Peak Diode Recovery dV/dt <sup>c</sup>                                    | dV/dt                             | 9.2                     | V/ns  |          |
| Operating Junction and Storage Temperature Range                          | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 150           | °C    |          |
| Soldering Recommendations (Peak Temperature)                              | for 10 s                          | 300 <sup>d</sup>        |       |          |
| Mounting Torque   | 6-32 or M3 screw                  | 10                      |       | lbf · in |
|   |                                   | 1.1                     | N · m |          |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting T<sub>J</sub> = 25 °C, L = 5.7 mH, R<sub>g</sub> = 25 Ω, I<sub>AS</sub> = 14 A, dV/dt = 7.6 V/ns (see fig. 12a).
- I<sub>SD</sub> ≤ 14 A, dI/dt ≤ 250 A/μs, V<sub>DD</sub> ≤ V<sub>DS</sub>, T<sub>J</sub> ≤ 150 °C.
- 1.6 mm from case.

| THERMAL RESISTANCE RATINGS         |            |      |      |      |
|------------------------------------|------------|------|------|------|
| PARAMETER                          | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient        | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greasd Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)   | $R_{thJC}$ | -    | 0.50 |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                       |   |   |  |       |           |               |    |    |
|---|-----------------------|---|---|--|-------|-----------|---------------|----|----|
| PARAMETER   | SYMBOL                | TEST CONDITIONS   |   | MIN.   | TYP.  | MAX.      | UNIT          |    |    |
| <b>Static</b>   |                       |   |   |  |       |           |               |    |    |
| Drain-Source Breakdown Voltage  | $V_{DS}$              | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$   |   | 500  | -     | -         | V             |    |    |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$   | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$   |   | -  | 0.55  | -         | V/°C          |    |    |
| Gate-Source Threshold Voltage   | $V_{GS(th)}$          | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$   |   | 2.0  | -     | 4.0       | V             |    |    |
| Gate-Source Leakage   | $I_{GSS}$             | $V_{GS} = \pm 20\text{ V}$  |   | -  | -     | $\pm 100$ | nA            |    |    |
| Zero Gate Voltage Drain Current   | $I_{DSS}$             | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$  |   | -  | -     | 25        | $\mu\text{A}$ |    |    |
|   |                       | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$   |   | -  | -     | 250       |               |    |    |
| Drain-Source On-State Resistance  | $R_{DS(on)}$          | $V_{GS} = 10\text{ V}$  | $I_D = 8.4\text{ A}^b$                      | -  | 0.660 | -         | $\Omega$      |    |    |
| Forward Transconductance  | $g_{fs}$              | $V_{DS} = 50\text{ V}, I_D = 8.4\text{ A}$  |   | 8.1  | -     | -         | S             |    |    |
| <b>Dynamic</b>  |                       |   |   |  |       |           |               |    |    |
| Input Capacitance   | $C_{iss}$             | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}, \text{ see fig. 5}$   |   | -  | 1910  | -         | pF            |    |    |
| Output Capacitance  | $C_{oss}$             |   |   | -  | 290   | -         |               |    |    |
| Reverse Transfer Capacitance  | $C_{rss}$             |   |   | -  | 11    | -         |               |    |    |
| Output Capacitance  | $C_{oss}$             | $V_{GS} = 0\text{ V}$   | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$ | -  | 2730  | -         | pF            |    |    |
|   |                       |   | $V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$ | -  | 82    | -         |               |    |    |
| Effective Output Capacitance  | $C_{oss\text{ eff.}}$ | $V_{DS} = 0\text{ V to } 400\text{ V}^c$  |   | -  | 160   | -         | pF            |    |    |
| Total Gate Charge   | $Q_g$                 | $V_{GS} = 10\text{ V}$  |   | -  | -     | 81        | nC            |    |    |
| Gate-Source Charge  | $Q_{gs}$              |   |   | $I_D = 14\text{ A}, V_{DS} = 400\text{ V}, \text{ see fig. 6 and 13}^b$                    |       | -         |               | -  | 20 |
| Gate-Drain Charge   | $Q_{gd}$              |   |   | $I_D = 14\text{ A}, V_{DS} = 400\text{ V}, \text{ see fig. 6 and 13}^b$                    |       | -         |               | -  | 36 |
| Turn-On Delay Time  | $t_{d(on)}$           | $V_{GS} = 10\text{ V}$  |   | -  | 15    | -         | ns            |    |    |
| Rise Time   | $t_r$                 |   |   | $V_{DD} = 250\text{ V}, I_D = 14\text{ A}, R_g = 7.5\text{ }\Omega, \text{ see fig. 10}^b$ |       | -         |               | 39 | -  |
| Turn-Off Delay Time   | $t_{d(off)}$          |   |   | $V_{DD} = 250\text{ V}, I_D = 14\text{ A}, R_g = 7.5\text{ }\Omega, \text{ see fig. 10}^b$ |       | -         |               | 39 | -  |
| Fall Time   | $t_f$                 |   |   | $V_{DD} = 250\text{ V}, I_D = 14\text{ A}, R_g = 7.5\text{ }\Omega, \text{ see fig. 10}^b$ |       | -         |               | 31 | -  |
| <b>Drain-Source Body Diode Characteristics</b>                              |                       |   |   |  |       |           |               |    |    |
| Continuous Source-Drain Diode Current                                       | $I_S$                 | MOSFET symbol showing the integral reverse p - n junction diode  |   | -  | -     | 13        | A             |    |    |
| Pulsed Diode Forward Current <sup>a</sup>                                   | $I_{SM}$              |   |   | -  | -     | 56        |               |    |    |
| Body Diode Voltage  | $V_{SD}$              | $T_J = 25\text{ }^\circ\text{C}, I_S = 14\text{ A}, V_{GS} = 0\text{ V}^b$  |   | -  | -     | 1.5       | V             |    |    |
| Body Diode Reverse Recovery Time  | $t_{rr}$              | $T_J = 25\text{ }^\circ\text{C}, I_F = 14\text{ A}, T_J = 125\text{ }^\circ\text{C}, dI/dt = 100\text{ A}/\mu\text{s}^b$                              |   | -  | 370   | 550       | ns            |    |    |
| Body Diode Reverse Recovery Charge  | $Q_{rr}$              |   |   | -  | 4.4   | 6.5       | $\mu\text{C}$ |    |    |
| Body Diode Reverse Recovery Current   | $I_{RRM}$             |   |   | -  | 21    | 31        | A             |    |    |
| Forward Turn-On Time  | $t_{on}$              | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )   |   |  |       |           |               |    |    |

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DS}$ .

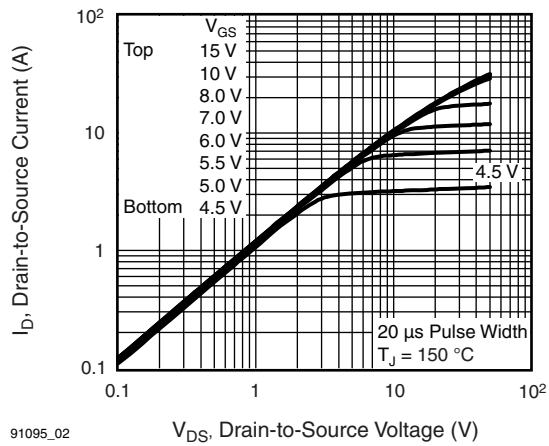
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



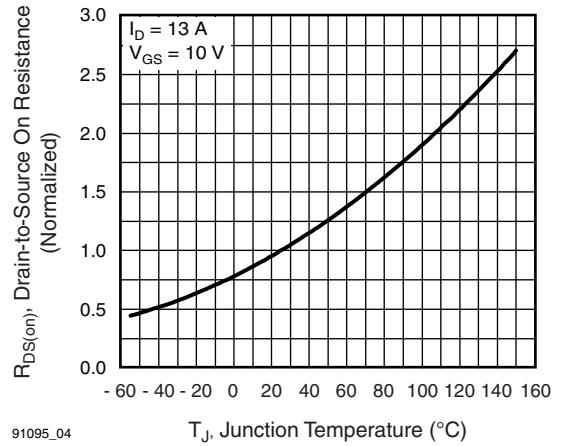
**Fig. 1 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 2 - Typical Output Characteristics**



**Fig. 4 - Normalized On-Resistance vs. Temperature**



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Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



91095\_07

Fig. 7 - Typical Source-Drain Diode Forward Voltage



91095\_06

Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



91095\_08

Fig. 8 - Maximum Safe Operating Area



Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms



Fig. 12c - Maximum Avalanche Energy vs. Drain Current



Fig. 13a - Basic Gate Charge Waveform

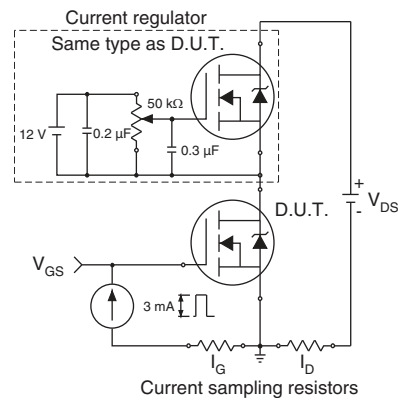


Fig. 13b - Gate Charge Test Circuit

**Peak Diode Recovery dV/dt Test Circuit**



**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

TO-220AB



| DIM. | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN.        | MAX.  | MIN.   | MAX.  |
| A    | 4.24        | 4.65  | 0.167  | 0.183 |
| b    | 0.69        | 1.02  | 0.027  | 0.040 |
| b(1) | 1.14        | 1.78  | 0.045  | 0.070 |
| c    | 0.36        | 0.61  | 0.014  | 0.024 |
| D    | 14.33       | 15.85 | 0.564  | 0.624 |
| E    | 9.96        | 10.52 | 0.392  | 0.414 |
| e    | 2.41        | 2.67  | 0.095  | 0.105 |
| e(1) | 4.88        | 5.28  | 0.192  | 0.208 |
| F    | 1.14        | 1.40  | 0.045  | 0.055 |
| H(1) | 6.10        | 6.71  | 0.240  | 0.264 |
| J(1) | 2.41        | 2.92  | 0.095  | 0.115 |
| L    | 13.36       | 14.40 | 0.526  | 0.567 |
| L(1) | 3.33        | 4.04  | 0.131  | 0.159 |
| Ø P  | 3.53        | 3.94  | 0.139  | 0.155 |
| Q    | 2.54        | 3.00  | 0.100  | 0.118 |

ECN: X15-0364-Rev. C, 14-Dec-15  
DWG: 6031

**Note**

- M\* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM



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