

# SPS

## KA5L0380R

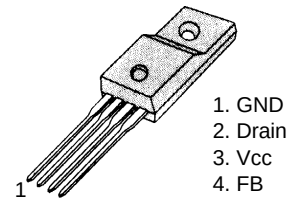
The SPS product family is specially designed for an off-line SMPS with minimal external components. The SPS consist of high voltage power SENSEFET® and current mode PWM IC.

Included PWM controller features integrated fixed frequency oscillator, under voltage lock-out, leading edge blanking, optimized gate turn-on/turn-off driver, thermal shutdown protection, over voltage protection, and temperature compensated precision current sources for loop compensation and fault protection circuitry. Compared to discrete MOSFET and PWM controller or RCC solution, a SPS can reduce total component count, design size, weight and at the same time increase efficiency, productivity, and system reliability.

It has a basic platform well suited for cost-effective design in either a flyback converter or a forward converter.

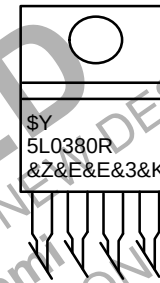
### Features

- Precision Fixed Operating Frequency (50 kHz)
- Low Start-Up Current (Typ. 100 mA)
- Pulse By Pulse Current Limiting
- Over Current Protection
- Over Voltage Protection (Min. 25 V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode
- This is a Pb-Free Device



TO-220F-4L  
CASE 340BK

### MARKING DIAGRAM



|         |                        |
|---------|------------------------|
| \$Y     | = onsemi Logo          |
| 5L0380R | = Specific Device Code |
| &Z      | = Assembly Plant Code  |
| &E      | = Designates Space     |
| &3      | = 3-Digit Date Code    |
| &K      | = Lot Code             |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

# KA5L0380R

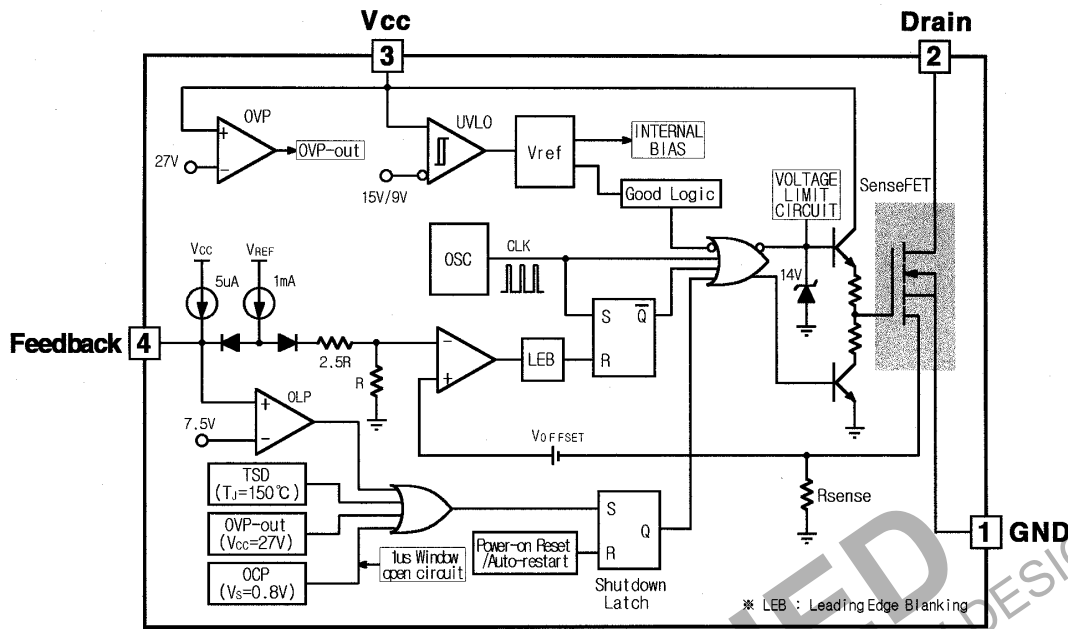


Figure 1. Block Diagram

## ABSOLUTE MAXIMUM RATINGS

| Rating                                                 | Symbol         | Value            | Unit                |
|--------------------------------------------------------|----------------|------------------|---------------------|
| Drain-Source (GND) Voltage (Note 1)                    | $V_{DSS}$      | 800              | V                   |
| Drain-Gate Voltage ( $R_{GS} = 1 \text{ M}\Omega$ )    | $V_{DGR}$      | 800              | V                   |
| Gate-Source (GND) Voltage                              | $V_{GS}$       | $\pm 30$         | V                   |
| Drain Current Pulsed (Note 2)                          | $I_{DM}$       | 12               | A <sub>DC</sub>     |
| Single Pulsed Avalanche Energy (Note 3)                | $E_{AS}$       | 95               | mJ                  |
| Avalanche Current (Note 4)                             | $I_{AS}$       | -                | A                   |
| Continuous Drain Current ( $T_C = 25^\circ\text{C}$ )  | $I_D$          | 3.0              | A <sub>DC</sub>     |
| Continuous Drain Current ( $T_C = 100^\circ\text{C}$ ) | $I_D$          | 2.1              | A <sub>DC</sub>     |
| Supply Voltage                                         | $V_{CC}$       | 30               | V                   |
| Analog Input Voltage Range                             | $V_{FB}$       | -0.3 to $V_{SD}$ | V                   |
| Total Power Dissipation                                | $P_D$ (wt H/S) | 35               | W                   |
|                                                        | Derating       | 0.28             | W/ $^\circ\text{C}$ |
| Operating Temperature                                  | $T_{OPR}$      | -25 to +85       | $^\circ\text{C}$    |
| Storage Temperature                                    | $T_{STG}$      | -55 to +150      | $^\circ\text{C}$    |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- $T_J = 25^\circ\text{C}$  to  $150^\circ\text{C}$
- Repetitive rating: Pulse width limited by maximum junction temperature.
- $L = 51 \text{ mH}$ , starting  $T_J = 25^\circ\text{C}$
- $L = 13 \mu\text{H}$ , starting  $T_J = 25^\circ\text{C}$

# KA5L0380R

## ELECTRICAL CHARACTERISTICS (SFET PART) ( $T_a = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic                               | Symbol       | Test Condition                                                                                                                                    | Min | Typ  | Max  | Unit          |
|----------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|---------------|
| Drain-Source Breakdown Voltage               | $BV_{DSS}$   | $V_{GS} = 0\text{ V}, I_D = 50\text{ }\mu\text{A}$                                                                                                | 800 | –    | –    | V             |
| Zero Gate Voltage Drain Current              | $I_{DSS}$    | $V_{DS} = \text{Max.}, \text{Rating}, V_{GS} = 0\text{ V}$                                                                                        | –   | –    | 250  | $\mu\text{A}$ |
|                                              |              | $V_{DS} = 0.8\text{ Max.}, \text{Rating}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$                                                           | –   | –    | 1000 | $\mu\text{A}$ |
| Static Drain-Source On Resistance (Note 5)   | $R_{DS(ON)}$ | $V_{GS} = 10\text{ V}, I_D = 0.5\text{ A}$                                                                                                        | –   | 4    | 5    | $\Omega$      |
| Forward Transconductance (Note 5)            | $g_{fs}$     | $V_{DS} = 50\text{ V}, I_D = 0.5\text{ A}$                                                                                                        | 1.5 | 2.5  | –    | S             |
| Input Capacitance                            | $C_{iss}$    | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                                                                                     | –   | 779  | –    | pF            |
| Output Capacitance                           | $C_{oss}$    |                                                                                                                                                   | –   | 75.6 | –    |               |
| Reverse Transfer Capacitance                 | $C_{rss}$    |                                                                                                                                                   | –   | 24.9 | –    |               |
| Turn Off Delay Time                          | $t_{d(on)}$  | $V_{DD} = 0.5 BV_{DSS}, I_D = 1.0\text{ A}$<br>(MOSFET switching time are essentially independent of operating temperature)                       | –   | 40   | –    | ns            |
| Rise Time                                    | $t_r$        |                                                                                                                                                   | –   | 95   | –    |               |
| Turn Off Delay Time                          | $t_{d(off)}$ |                                                                                                                                                   | –   | 150  | –    |               |
| Fall Time                                    | $t_f$        |                                                                                                                                                   | –   | 60   | –    |               |
| Total Gate Charge (Gate-source + Gate-drain) | $Q_g$        | $V_{GS} = 10\text{ V}, I_D = 1.0\text{ A}, V_{DS} = 0.5 BV_{DSS}$<br>(MOSFET switching time are essentially independent of operating temperature) | –   | –    | 34   | nC            |
| Gate-Source Charge                           | $Q_{gs}$     |                                                                                                                                                   | –   | 7.2  | –    |               |
| Gate-Drain (Miller) Charge                   | $Q_{gd}$     |                                                                                                                                                   | –   | 12.1 | –    |               |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

5. Pulse test: Pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

# KA5L0380R

## ELECTRICAL CHARACTERISTICS (CONTROL PART) ( $T_a = 25^\circ\text{C}$ unless otherwise noted)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|----------------|-----|-----|-----|------|
|-----------|--------|----------------|-----|-----|-----|------|

### REFERENCE SECTION

|                                        |                    |                                                     |      |      |      |                      |
|----------------------------------------|--------------------|-----------------------------------------------------|------|------|------|----------------------|
| Output Voltage (Note 6)                | $V_{ref}$          | $T_a = 25^\circ\text{C}$                            | 4.80 | 5.00 | 5.20 | V                    |
| Temperature Stability (Note 6, Note 7) | $V_{ref}/\Delta T$ | $-25^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$ | –    | 0.3  | 0.6  | mV/ $^\circ\text{C}$ |

### OSCILLATOR SECTION

|                                            |                     |                                                     |    |         |          |     |
|--------------------------------------------|---------------------|-----------------------------------------------------|----|---------|----------|-----|
| Initial Accuracy                           | $F_{OSC}$           | $T_a = 25^\circ\text{C}$                            | 45 | 50      | 55       | kHz |
| Frequency Change with Temperature (Note 7) | $\Delta F/\Delta T$ | $-25^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$ | –  | $\pm 5$ | $\pm 10$ | %   |

### PWM SECTION

|                    |           |   |    |    |    |   |
|--------------------|-----------|---|----|----|----|---|
| Maximum Duty Cycle | $D_{max}$ | – | 74 | 77 | 80 | % |
|--------------------|-----------|---|----|----|----|---|

### FEEDBACK SECTION

|                         |             |                                                                  |     |     |     |               |
|-------------------------|-------------|------------------------------------------------------------------|-----|-----|-----|---------------|
| Feedback Source Current | $I_{FB}$    | $T_a = 25^\circ\text{C}, 0\text{ V} \leq V_{fb} \leq 3\text{ V}$ | 0.7 | 0.9 | 1.1 | mA            |
| Shutdown Delay Current  | $I_{delay}$ | $T_a = 25^\circ\text{C}, 5\text{ V} \leq V_{fb} \leq V_{SD}$     | 4   | 5   | 6   | $\mu\text{A}$ |

### OVER CURRENT PROTECTION SECTION

|                         |                   |                       |      |      |      |   |
|-------------------------|-------------------|-----------------------|------|------|------|---|
| Over Current Protection | $I_L(\text{max})$ | Max. Inductor current | 1.89 | 2.15 | 2.41 | A |
|-------------------------|-------------------|-----------------------|------|------|------|---|

### UVLO SECTION

|                           |             |               |     |    |     |   |
|---------------------------|-------------|---------------|-----|----|-----|---|
| Start Threshold Voltage   | $V_{th(H)}$ | –             | 8.4 | 9  | 9.6 | V |
| Minimum Operating Voltage | $V_{th(L)}$ | After turn on | 14  | 15 | 16  | V |

### TOTAL STANDBY CURRENT SECTION

|                                              |           |                        |   |     |      |    |
|----------------------------------------------|-----------|------------------------|---|-----|------|----|
| Start Current                                | $I_{ST}$  | $V_{CC} = 14\text{ V}$ | – | 0.1 | 0.17 | mA |
| Operating Supply Current (Control Part Only) | $I_{OPR}$ | $V_{CC} \leq 28$       | – | 7   | 12   | mA |

### SHUTDOWN SECTION

|                                                 |           |                            |     |     |     |                  |
|-------------------------------------------------|-----------|----------------------------|-----|-----|-----|------------------|
| Shutdown Feedback Voltage                       | $V_{SD}$  | $V_{fb} \geq 6.5\text{ V}$ | 6.9 | 7.5 | 8.1 | V                |
| Thermal Shutdown Temperature ( $T_J$ ) (Note 6) | $T_{SD}$  | –                          | 140 | 160 | –   | $^\circ\text{C}$ |
| Over Voltage Protection                         | $V_{OVP}$ | $V_{CC} \geq 24\text{ V}$  | 25  | 27  | 29  | V                |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. These parameters, although guaranteed, are not 100% tested in production.

7. These parameters, although guaranteed, are tested in EDS (wafer test) process.

## TYPICAL PERFORMANCE CHARACTERISTICS (SFET part)

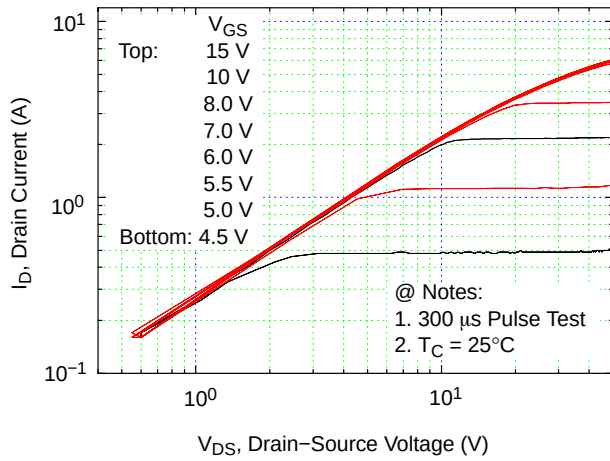


Figure 2. Output Characteristics

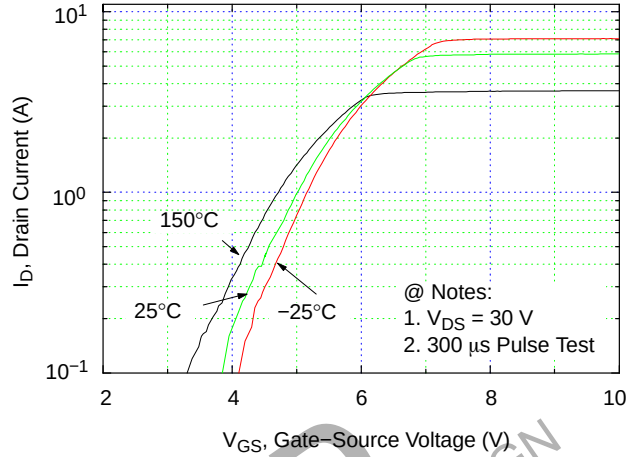


Figure 3. Transfer Characteristics

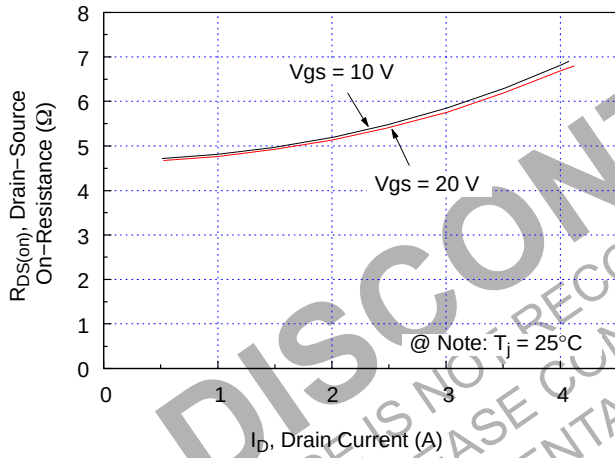


Figure 4. On-Resistance vs. Drain Current

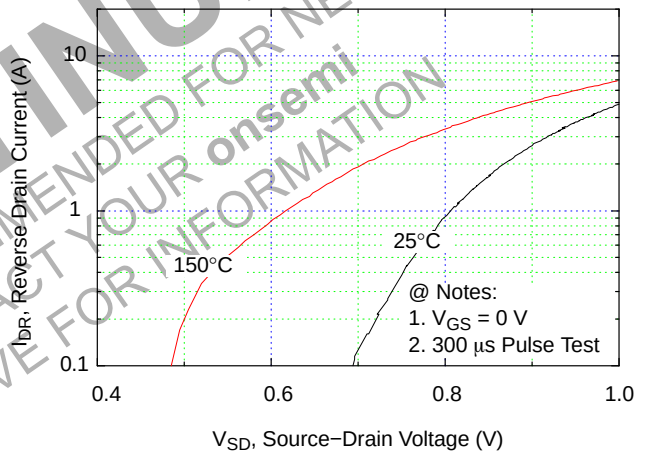


Figure 5. Source-Drain Diode Forward Voltage

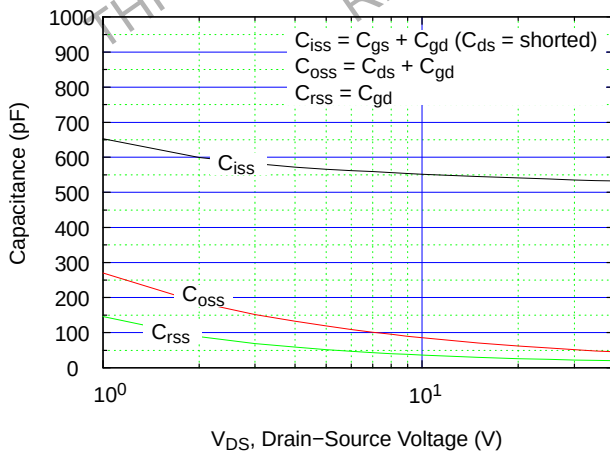


Figure 6. Capacitance vs. Drain-Source Voltage

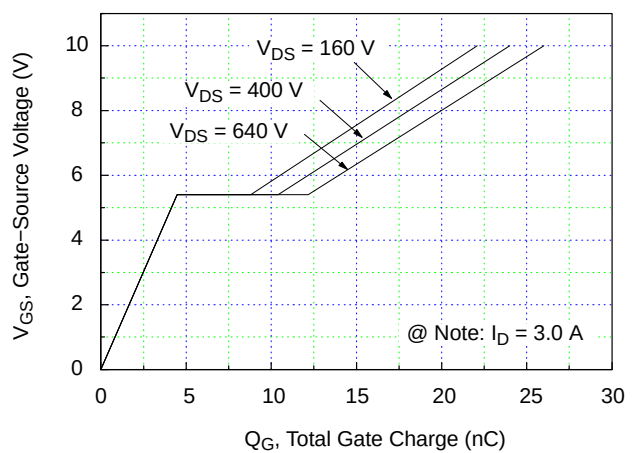


Figure 7. Gate Charge vs. Gate-Source Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

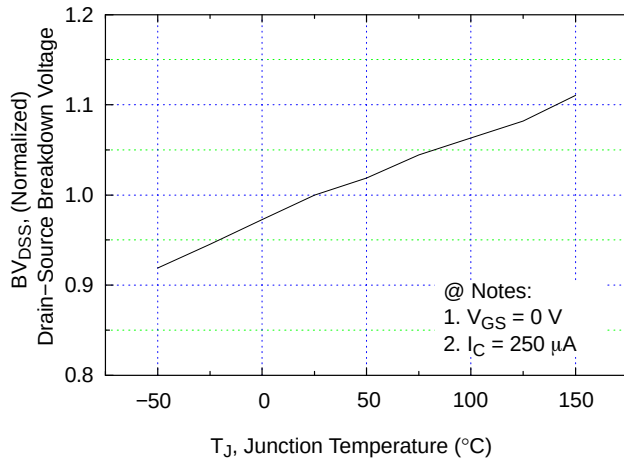


Figure 8. Breakdown Voltage vs. Temperature

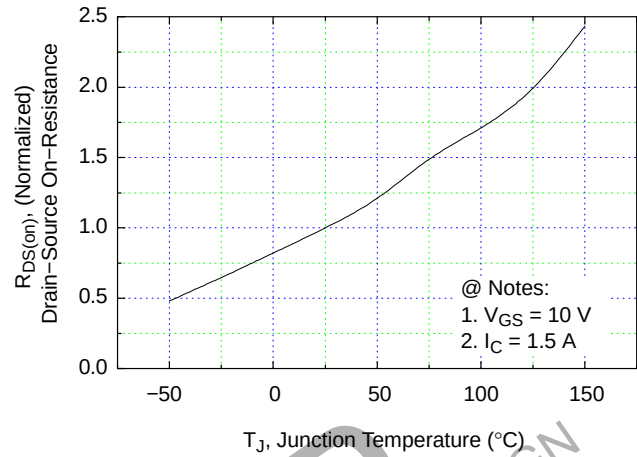


Figure 9. On-Resistance vs. Temperature

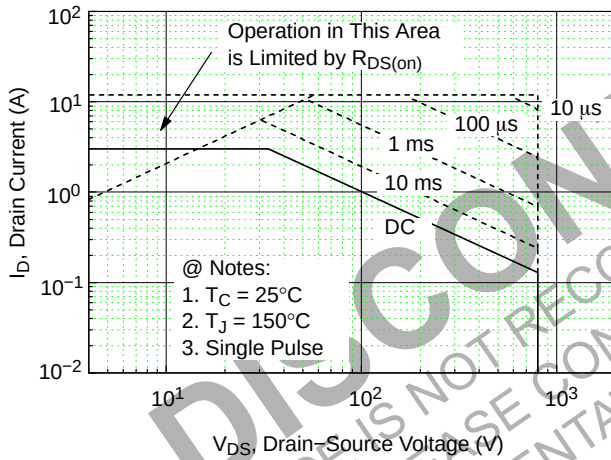


Figure 10. Max. Safe Operating Area

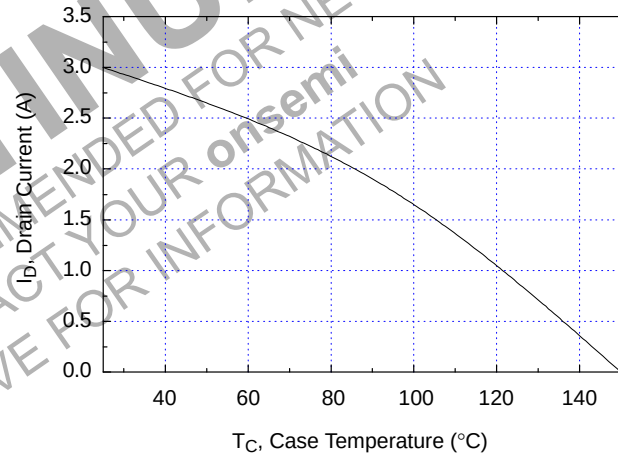


Figure 11. Max. Drain Current vs. Case Temperature

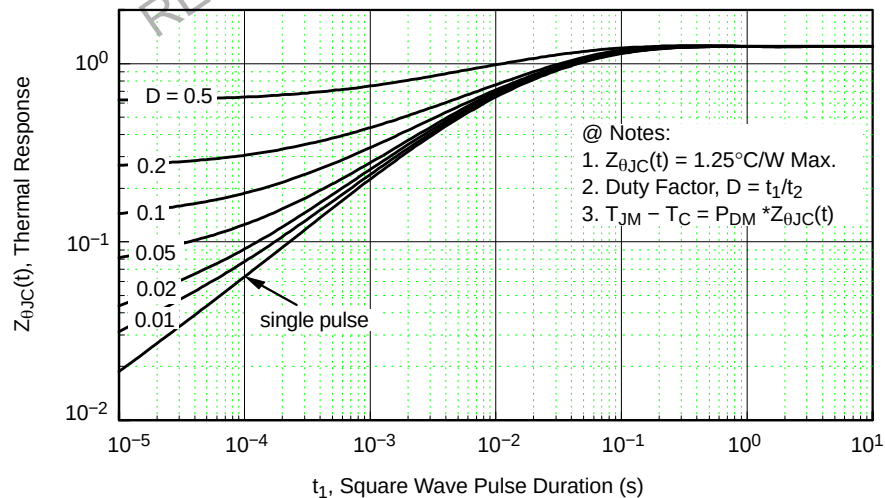


Figure 12. Thermal Response

## TYPICAL PERFORMANCE CHARACTERISTICS (Control part)

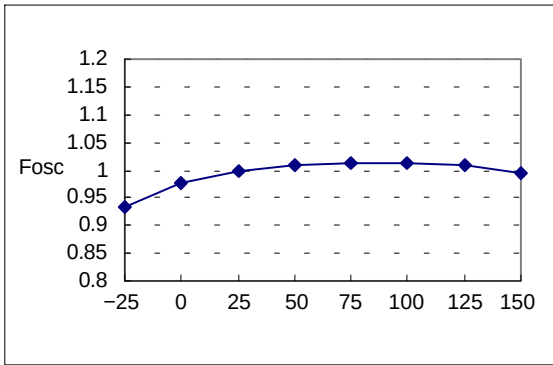


Figure 13. Operating Frequency

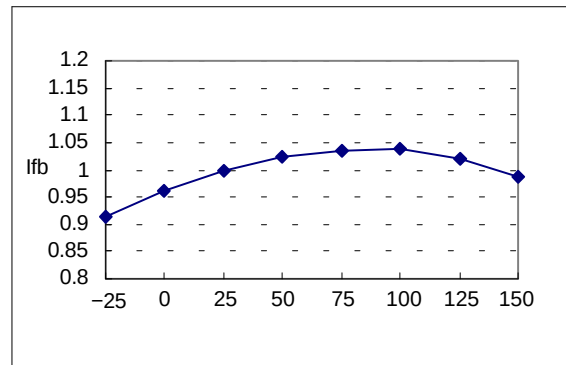


Figure 14. Feedback Source Current

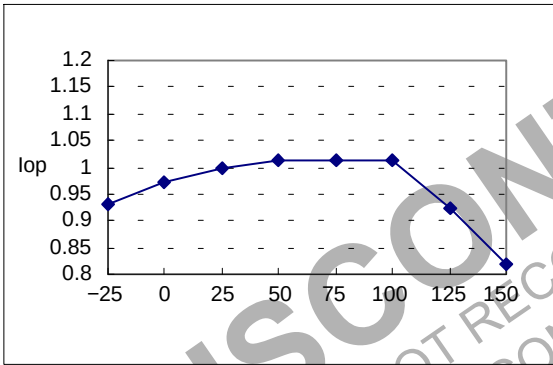


Figure 15. Operating Current

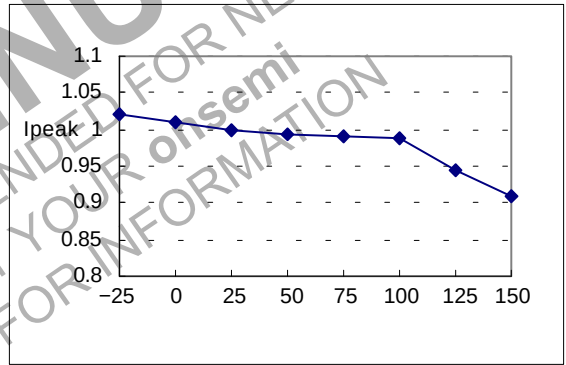


Figure 16. Max Inductor Current

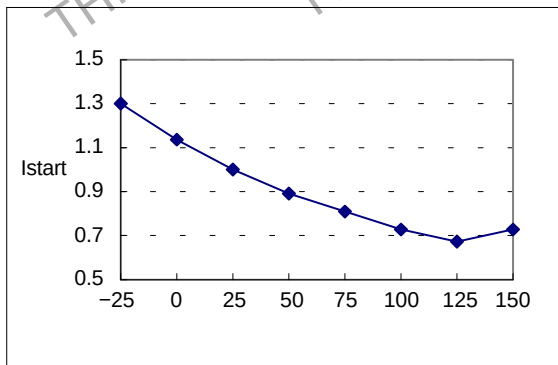


Figure 17. Start Up Current

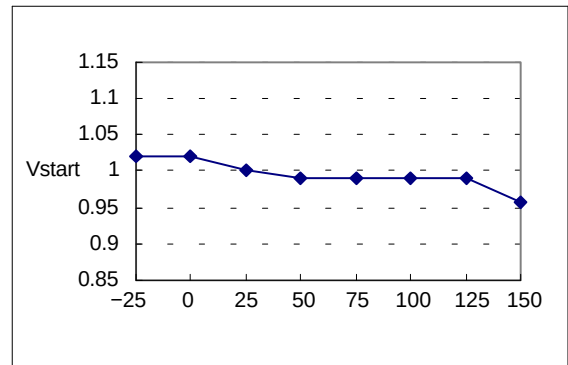


Figure 18. Start Threshold Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

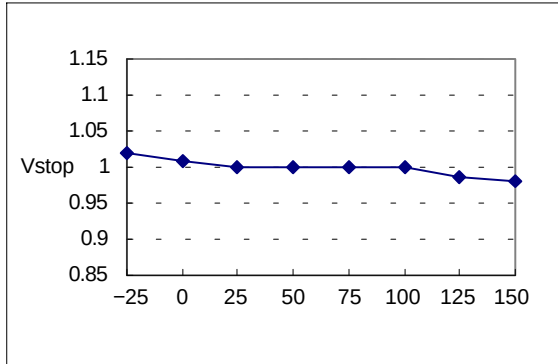
(These characteristic graphs are normalized at  $T_a = 25^\circ\text{C}$ )

Figure 19. Stop Threshold Voltage

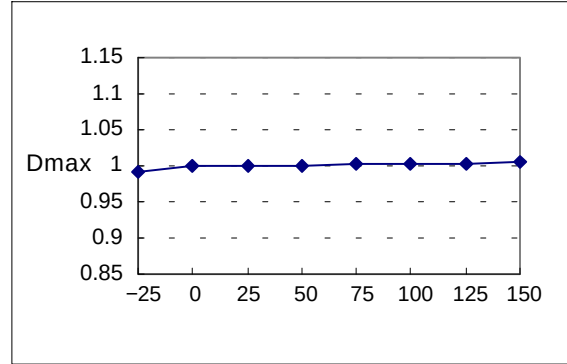


Figure 20. Maximum Duty Cycle

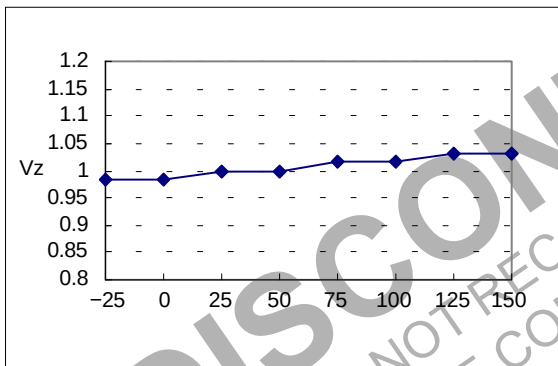


Figure 21. Vcc Zener Voltage

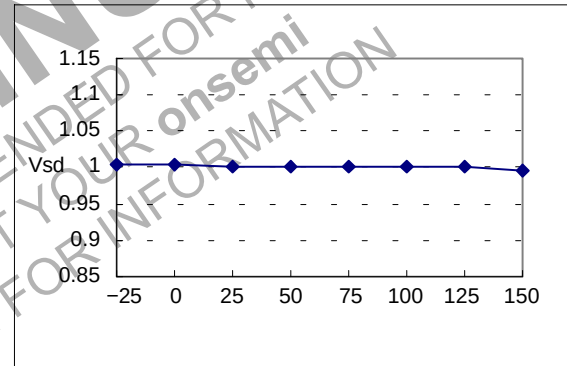


Figure 22. Shutdown Feedback Voltage

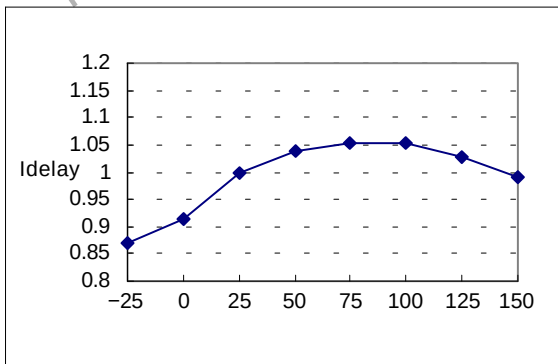


Figure 23. Shutdown Delay Current

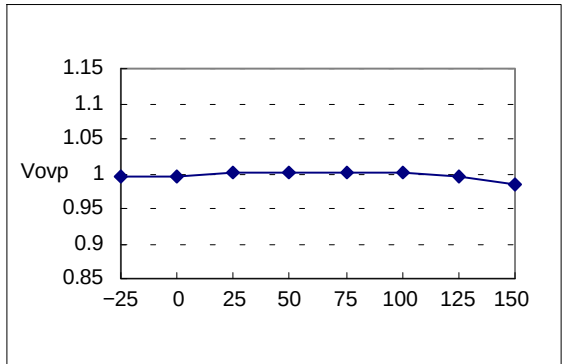


Figure 24. Over Voltage Protection

## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

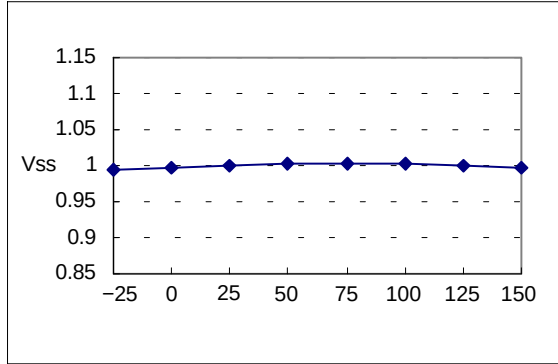
(These characteristic graphs are normalized at  $T_a = 25^\circ\text{C}$ )

Figure 25. Soft Start Voltage

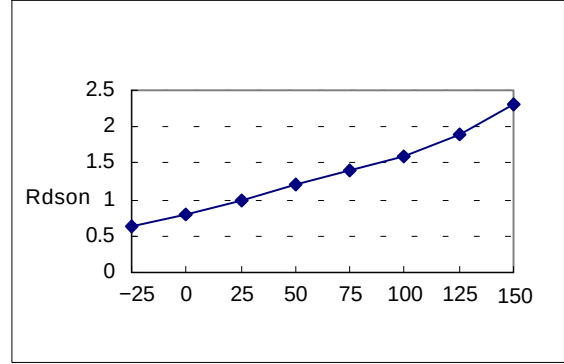


Figure 26. Drain Source Turn-On Resistance

**DISCONTINUED**  
THIS DEVICE IS NOT RECOMMENDED FOR NEW DESIGN  
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REPRESENTATIVE FOR INFORMATION

## KA5L0380R

### ORDERING INFORMATION

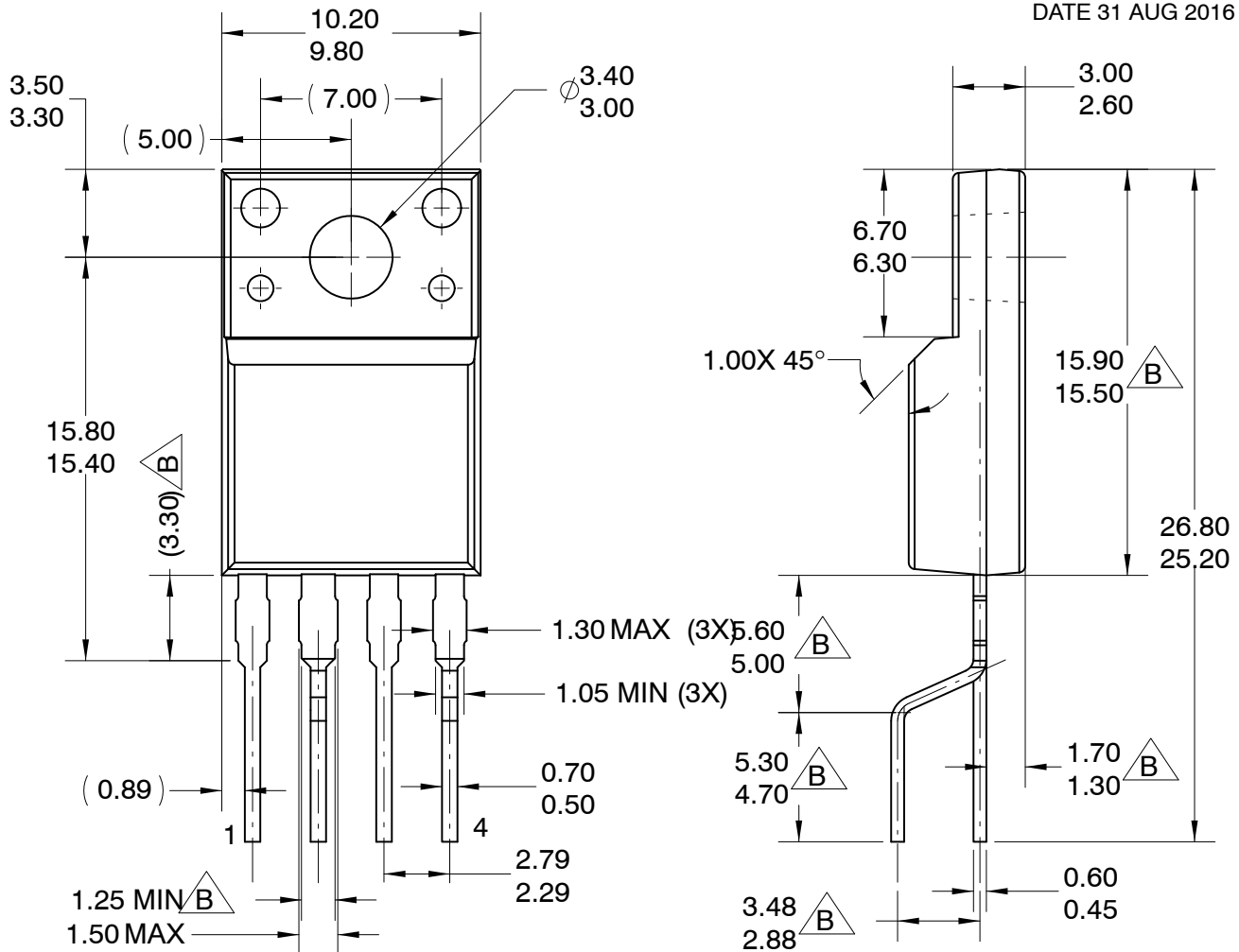
| Device    | Operating Temperature Range | Package                 | Packing Method |
|-----------|-----------------------------|-------------------------|----------------|
| KA5L0380R | -25 to +85°C                | TO-220F-4L<br>(Pb-Free) | Tube           |

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TO-220 FULLPAK 4LD LF  
CASE 340BK  
ISSUE O

DATE 31 AUG 2016



NOTES:

- A. EXCEPT WHERE NOTED CONFORMS TO SC91A.
- B. DOES NOT COMPLY EIAJ STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. PIN 2 CONNECTS TO DAP.

|                  |                       |                                                                                                                                                                                     |
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