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# KA5x03xx-SERIES

KA5H0365R, KA5M0365R, KA5L0365R  
KA5H0380R, KA5M0380R, KA5L0380R  
Fairchild Power Switch(FPS)

## Features

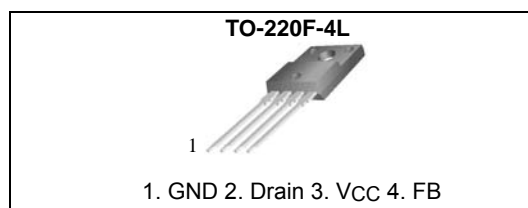
- Precision Fixed Operating Frequency (100/67/50kHz)
- Low Start-up Current(Typ. 100uA)
- Pulse by Pulse Current Limiting
- Over Current Protection
- Over Voltage Protection (Min. 25V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode

## Applications

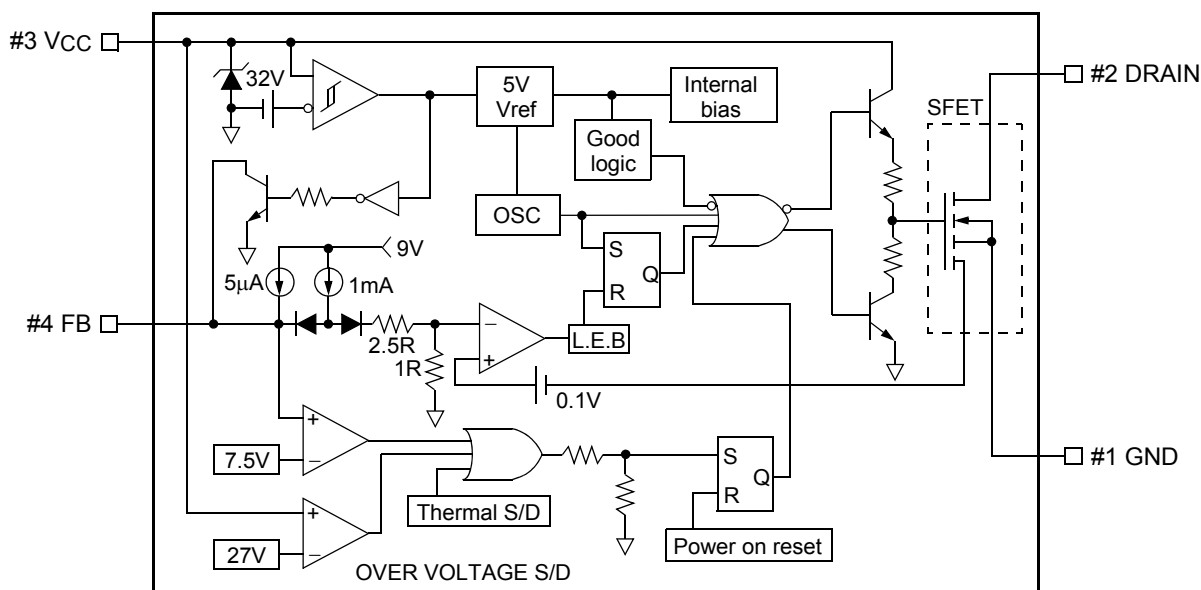
- SMPS for VCR, SVR, STB, DVD & DVCD
- SMPS for Printer, Facsimile & Scanner
- Adaptor for Camcorder

## Description

The Fairchild Power Switch(FPS) product family is specially designed for an off-line SMPS with minimal external components. The Fairchild Power Switch(FPS) consists of a high voltage power SenseFET and a current mode PWM IC. Included PWM controller integrates the fixed frequency oscillator, the under voltage lock-out, the leading edge blanking, the optimized gate turn-on/turn-off driver, the thermal shutdown protection, the over voltage protection, and the temperature compensated precision current sources for the loop compensation and the fault protection circuitry. Compared to a discrete MOSFET and a PWM controller or an RCC solution, a Fairchild Power Switch(FPS) can reduce the total component count, design size and weight and at the same time increase efficiency, productivity, and system reliability. It has a basic platform well suited for the cost effective design in either a flyback converter or a forward converter



## Internal Block Diagram



Rev.1.0.7

## Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

| Characteristic                                   | Symbol              | Value                   | Unit |
|--|---------------------|-------------------------|------|
| <b>KA5H0365R, KA5M0365R, KA5L0365R</b>           |                     |                         |      |
| Drain-Gate Voltage (R <sub>GS</sub> =1MΩ)        | V <sub>DGR</sub>    | 650                     | V    |
| Gate-Source (GND) Voltage                        | V <sub>GS</sub>     | ±30                     | V    |
| Drain Current Pulsed <sup>(1)</sup>              | I <sub>DM</sub>     | 12.0                    | ADC  |
| Continuous Drain Current (T <sub>C</sub> =25°C)  | I <sub>D</sub>      | 3.0                     | ADC  |
| Continuous Drain Current (T <sub>C</sub> =100°C) | I <sub>D</sub>      | 2.4                     | ADC  |
| Single Pulsed Avalanche Energy <sup>(2)</sup>    | E <sub>AS</sub>     | 358                     | mJ   |
| Maximum Supply Voltage                           | V <sub>CC,MAX</sub> | 30                      | V    |
| Analog Input Voltage Range                       | V <sub>FB</sub>     | -0.3 to V <sub>SD</sub> | V    |
| Total Power Dissipation                          | PD                  | 75                      | W    |
|  | Derating            | 0.6                     | W/°C |
| Operating Junction Temperature.                  | T <sub>J</sub>      | +150                    | °C   |
| Operating Ambient Temperature.                   | T <sub>A</sub>      | -40 to +85              | °C   |
| Storage Temperature Range.                       | T <sub>STG</sub>    | -55 to +150             | °C   |
| <b>KA5H0380R, KA5M0380R, KA5L0380R</b>           |                     |                         |      |
| Drain-Gate Voltage (R <sub>GS</sub> =1MΩ)        | V <sub>DGR</sub>    | 800                     | V    |
| Gate-Source (GND) Voltage                        | V <sub>GS</sub>     | ±30                     | V    |
| Drain Current Pulsed <sup>(1)</sup>              | I <sub>DM</sub>     | 12.0                    | ADC  |
| Continuous Drain Current (T <sub>C</sub> =25°C)  | I <sub>D</sub>      | 3.0                     | ADC  |
| Continuous Drain Current (T <sub>C</sub> =100°C) | I <sub>D</sub>      | 2.1                     | ADC  |
| Single Pulsed Avalanche Energy <sup>(2)</sup>    | E <sub>AS</sub>     | 95                      | mJ   |
| Maximum Supply Voltage                           | V <sub>CC,MAX</sub> | 30                      | V    |
| Analog Input Voltage Range                       | V <sub>FB</sub>     | -0.3 to V <sub>SD</sub> | V    |
| Total Power Dissipation                          | PD                  | 75                      | W    |
|  | Derating            | 0.6                     | W/°C |
| Operating Junction Temperature.                  | T <sub>J</sub>      | +150                    | °C   |
| Operating Ambient Temperature.                   | T <sub>A</sub>      | -40 to +85              | °C   |
| Storage Temperature Range.                       | T <sub>STG</sub>    | -55 to +150             | °C   |

**Note:**

1. Repetitive rating: Pulse width limited by maximum junction temperature
2. L = 51mH, starting T<sub>J</sub> = 25°C
3. L = 13μH, starting T<sub>J</sub> = 25°C

## Electrical Characteristics (SenseFET Part)

(Ta = 25°C unless otherwise specified)

| Parameter   | Symbol  | Condition  | Min. | Typ. | Max. | Unit |
|---|---------|--|------|------|------|------|
| <b>KA5H0365R, KA5M0365R, KA5L0365R</b>              |         |  |      |      |      |      |
| Drain-Source Breakdown Voltage                      | BVDSS   | VGS=0V, ID=50μA  | 650  | -    | -    | V    |
| Zero Gate Voltage Drain Current                     | IDSS    | VDS=Max. Rating, VGS=0V  | -    | -    | 50   | μA   |
|   |         | VDS=0.8Max. Rating, VGS=0V, TC=125°C   | -    | -    | 200  | μA   |
| Static Drain-Source on Resistance <sup>(Note)</sup> | RDS(ON) | VGS=10V, ID=0.5A   | -    | 3.6  | 4.5  | Ω    |
| Forward Transconductance <sup>(Note)</sup>          | gfs     | VDS=50V, ID=0.5A   | 2.0  | -    | -    | S    |
| Input Capacitance                                   | Ciss    | VGS=0V, VDS=25V, f=1MHz  | -    | 720  | -    | pF   |
| Output Capacitance                                  | Coss    |  | -    | 40   | -    |      |
| Reverse Transfer Capacitance                        | Crss    |  | -    | 40   | -    |      |
| Turn On Delay Time                                  | td(on)  | VDD=0.5BVDSS, ID=1.0A<br>(MOSFET switching time is essentially independent of operating temperature)       | -    | 150  | -    | nS   |
| Rise Time   | tr      |  | -    | 100  | -    |      |
| Turn Off Delay Time                                 | td(off) |  | -    | 150  | -    |      |
| Fall Time   | tf      |  | -    | 42   | -    |      |
| Total Gate Charge (Gate-Source+Gate-Drain)          | Qg      | VGS=10V, ID=1.0A, VDS=0.5BVDSS (MOSFET switching time is essentially independent of operating temperature) | -    | -    | 34   | nC   |
| Gate-Source Charge                                  | Qgs     |  | -    | 7.3  | -    |      |
| Gate-Drain (Miller) Charge                          | Qgd     |  | -    | 13.3 | -    |      |
| <b>KA5H0380R, KA5M0380R, KA5L0380R</b>              |         |  |      |      |      |      |
| Drain-Source Breakdown Voltage                      | BVDSS   | VGS=0V, ID=50μA  | 800  | -    | -    | V    |
| Zero Gate Voltage Drain Current                     | IDSS    | VDS=Max. Rating, VGS=0V  | -    | -    | 250  | μA   |
|   |         | VDS=0.8Max. Rating, VGS=0V, TC=125°C   | -    | -    | 1000 | μA   |
| Static Drain-Source on Resistance <sup>(Note)</sup> | RDS(ON) | VGS=10V, ID=0.5A   | -    | 4.0  | 5.0  | Ω    |
| Forward Transconductance <sup>(Note)</sup>          | gfs     | VDS=50V, ID=0.5A   | 1.5  | 2.5  | -    | S    |
| Input Capacitance                                   | Ciss    | VGS=0V, VDS=25V, f=1MHz  | -    | 779  | -    | pF   |
| Output Capacitance                                  | Coss    |  | -    | 75.6 | -    |      |
| Reverse Transfer Capacitance                        | Crss    |  | -    | 24.9 | -    |      |
| Turn On Delay Time                                  | td(on)  | VDD=0.5BVDSS, ID=1.0A<br>(MOSFET switching time is essentially independent of operating temperature)       | -    | 40   | -    | nS   |
| Rise Time   | tr      |  | -    | 95   | -    |      |
| Turn Off Delay Time                                 | td(off) |  | -    | 150  | -    |      |
| Fall Time   | tf      |  | -    | 60   | -    |      |
| Total Gate Charge (Gate-Source+Gate-Drain)          | Qg      | VGS=10V, ID=1.0A, VDS=0.5BVDSS (MOSFET switching time is essentially independent of operating temperature) | -    | -    | 34   | nC   |
| Gate-Source Charge                                  | Qgs     |  | -    | 7.2  | -    |      |
| Gate-Drain (Miller) Charge                          | Qgd     |  | -    | 12.1 | -    |      |

### Note:

1. Pulse test: Pulse width ≤ 300μs, duty ≤ 2%

$$2. S = \frac{1}{R}$$

**Electrical Characteristics (Control Part)** (Continued)

(Ta = 25°C unless otherwise specified)

| Characteristic                                   | Symbol             | Test condition                                   | Min. | Typ. | Max. | Unit  |
|--|--------------------|--|------|------|------|-------|
| <b>UVLO SECTION</b>                              |                    |  |      |      |      |       |
| Start Threshold Voltage                          | VSTART             | VFB=GND  | 14   | 15   | 16   | V     |
| Stop Threshold Voltage                           | VSTOP              | VFB=GND  | 8.4  | 9    | 9.6  | V     |
| <b>OSCILLATOR SECTION</b>                        |                    |  |      |      |      |       |
| Initial Accuracy                                 | FOSC               | KA5H0365R<br>KA5H0380R                           | 90   | 100  | 110  | kHz   |
| Initial Accuracy                                 | FOSC               | KA5M0365R<br>KA5M0380R                           | 61   | 67   | 73   | kHz   |
| Initial Accuracy                                 | FOSC               | KA5L0365R<br>KA5L0380R                           | 45   | 50   | 55   | kHz   |
| Frequency Change With Temperature <sup>(2)</sup> | -                  | -25°C≤Ta≤+85°C                                   | -    | ±5   | ±10  | %     |
| Maximum Duty Cycle                               | Dmax               | KA5H0365R<br>KA5H0380R                           | 62   | 67   | 72   | %     |
| Maximum Duty Cycle                               | Dmax               | KA5M0365R<br>KA5M0380R<br>KA5L0365R<br>KA5L0380R | 72   | 77   | 82   | %     |
| <b>FEEDBACK SECTION</b>                          |                    |  |      |      |      |       |
| Feedback Source Current                          | IFB                | Ta=25°C, 0V≤Vfb≤3V                               | 0.7  | 0.9  | 1.1  | mA    |
| Shutdown Feedback Voltage                        | VSD                | Vfb≥6.5V   | 6.9  | 7.5  | 8.1  | V     |
| Shutdown Delay Current                           | Idelay             | Ta=25°C, 5V≤Vfb≤VSD                              | 4    | 5    | 6    | μA    |
| <b>REFERENCE SECTION</b>                         |                    |  |      |      |      |       |
| Output Voltage <sup>(1)</sup>                    | Vref               | Ta=25°C  | 4.80 | 5.00 | 5.20 | V     |
| Temperature Stability <sup>(1)(2)</sup>          | Vref/ΔT            | -25°C≤Ta≤+85°C                                   | -    | 0.3  | 0.6  | mV/°C |
| <b>CURRENT LIMIT(SELF-PROTECTION)SECTION</b>     |                    |  |      |      |      |       |
| Peak Current Limit                               | I <sub>OVER</sub>  | Max. inductor current                            | 1.89 | 2.15 | 2.41 | A     |
| <b>PROTECTION SECTION</b>                        |                    |  |      |      |      |       |
| Over Voltage Protection                          | VOVP               | VCC≥24V  | 25   | 27   | 29   | V     |
| Thermal Shutdown Temperature (Tj) <sup>(1)</sup> | TSD                | -  | 140  | 160  | -    | °C    |
| <b>TOTAL STANDBY CURRENT SECTION</b>             |                    |  |      |      |      |       |
| Start-up Current                                 | I <sub>START</sub> | VCC=14V  | -    | 100  | 170  | μA    |
| Operating Supply Current (Control Part Only)     | I <sub>OP</sub>    | VCC≤28   | -    | 7    | 12   | mA    |

**Note:**

1. These parameters, although guaranteed, are not 100% tested in production
2. These parameters, although guaranteed, are tested in EDS(water test) process

# Typical Performance Characteristics(SenseFET part)

(KA5H0365R, KA5M0365R, KA5L0365R)

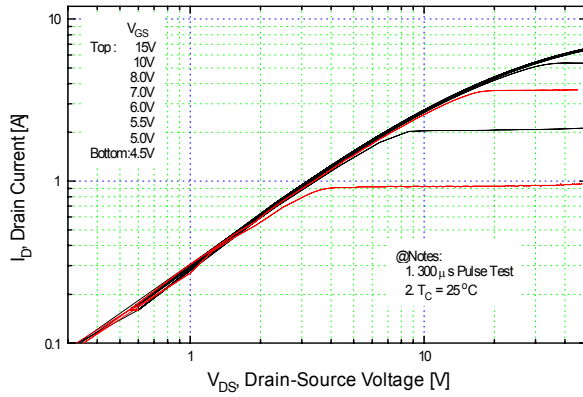


Figure 1. Output Characteristics

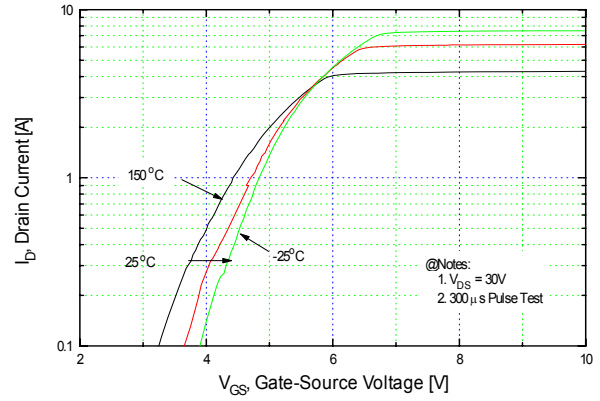


Figure 2. Transfer Characteristics

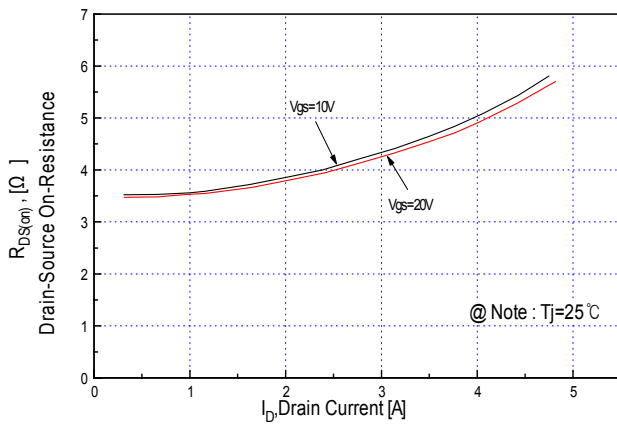


Figure 3. On-Resistance vs. Drain Current

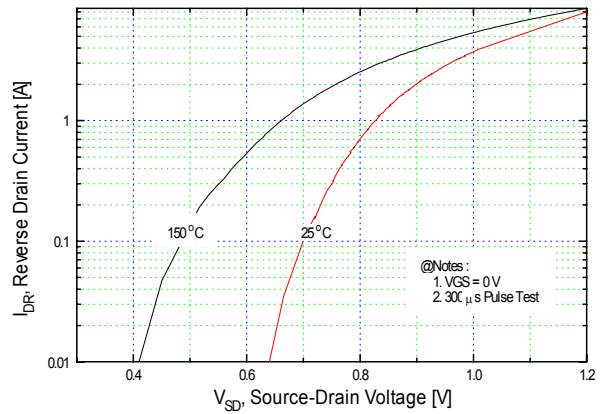


Figure 4. Source-Drain Diode Forward Voltage

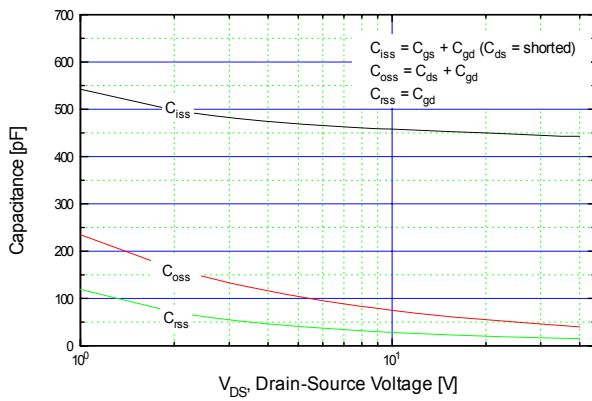


Figure 5. Capacitance vs. Drain-Source Voltage

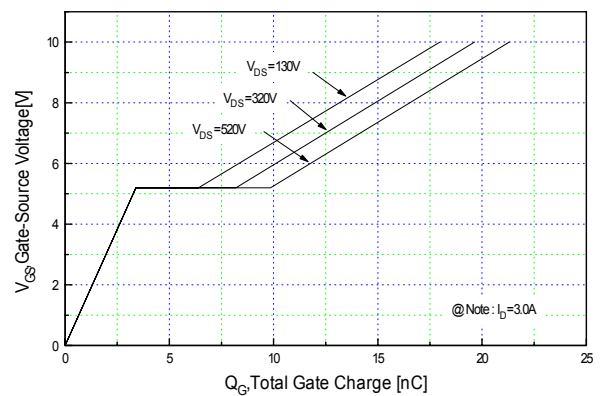


Figure 6. Gate Charge vs. Gate-Source Voltage

Typical Performance Characteristics (Continued)

(KA5H0365R, KA5M0365R, KA5L0365R)

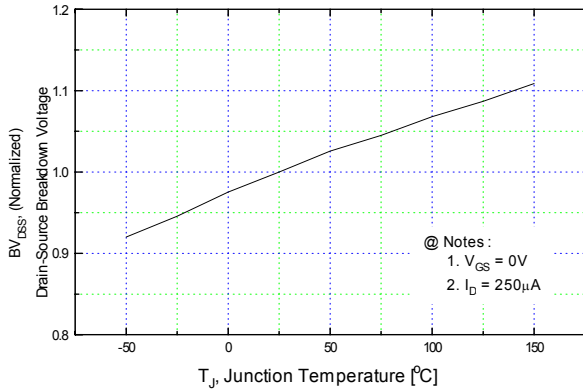


Figure 7. Breakdown Voltage vs. Temperature

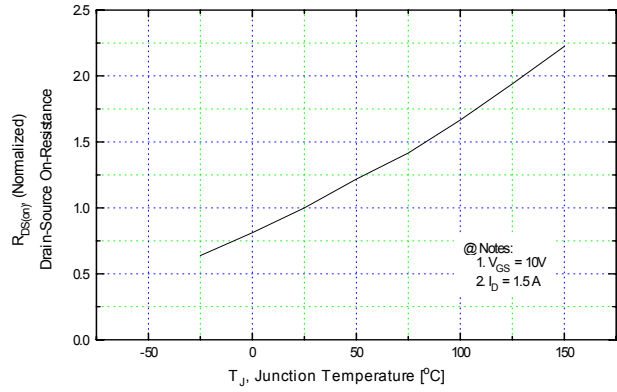


Figure 8. On-Resistance vs. Temperature

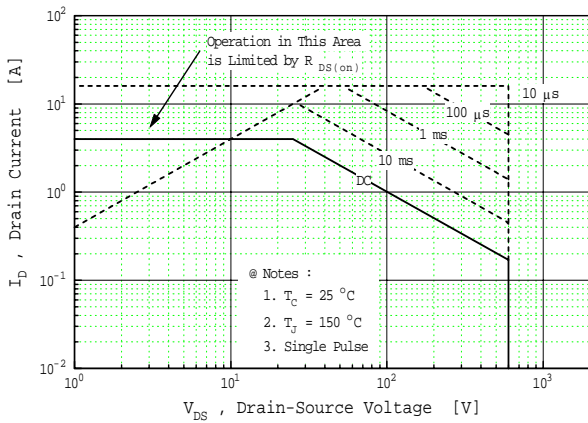


Figure 9. Max. Safe Operating Area

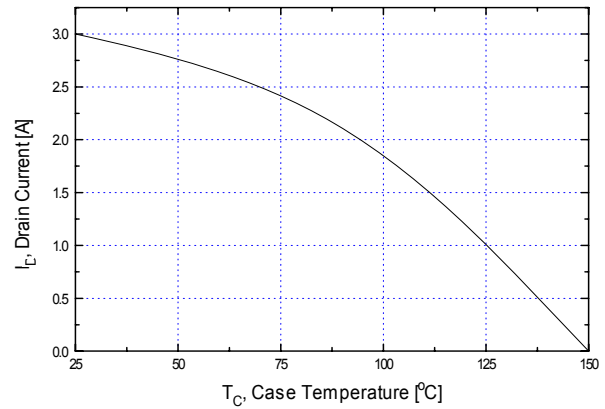


Figure 10. Max. Drain Current vs. Case Temperature

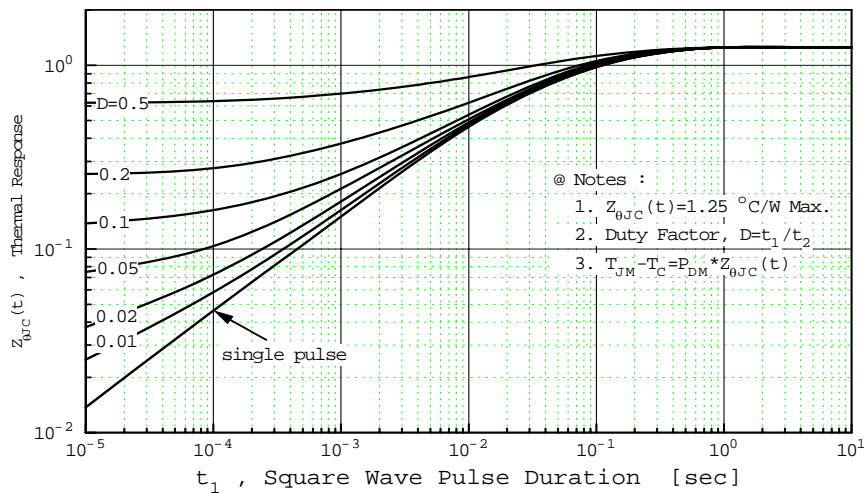


Figure 11. Thermal Response

# Typical Performance Characteristics (Continued)

(KA5H0380R, KA5M0380R, KA5L0380R)

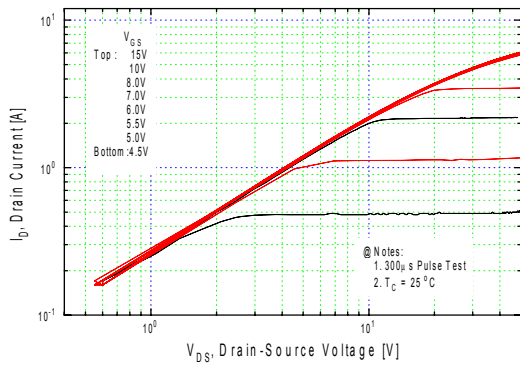


Figure 1. Output Characteristics

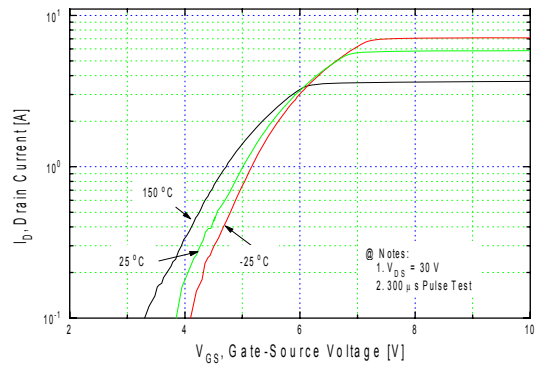


Figure 2. Transfer Characteristics

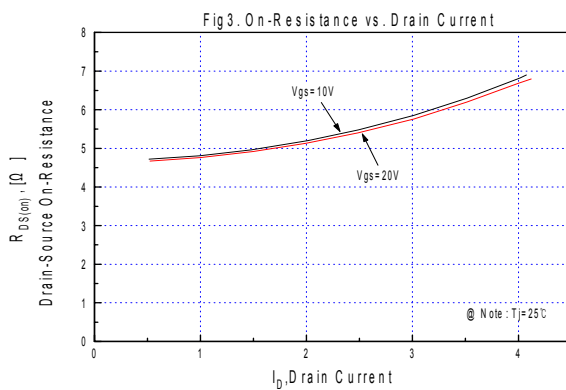


Figure 3. On-Resistance vs. Drain Current

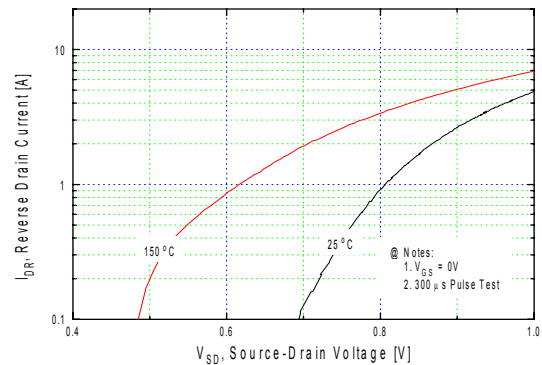


Figure 4. Source-Drain Diode Forward Voltage

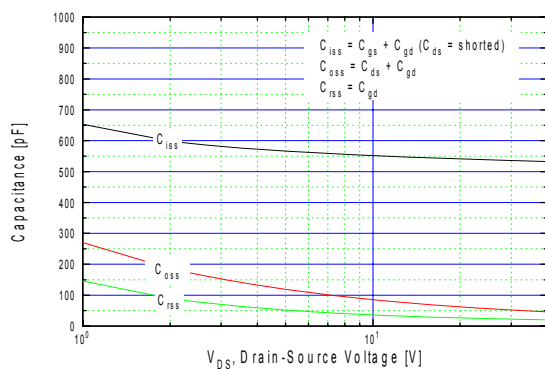


Figure 5. Capacitance vs. Drain-Source Voltage

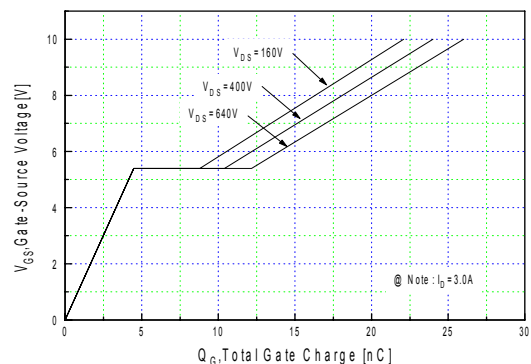


Figure 6. Gate Charge vs. Gate-Source Voltage



Typical Performance Characteristics (Continued)

(KA5H0380R, KA5M0380R, KA5L0380R)

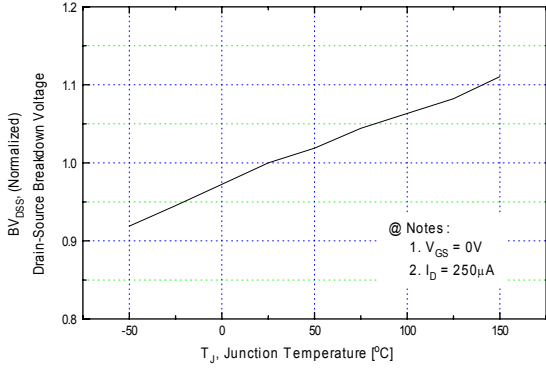


Figure 7. Breakdown Voltage vs. Temperature

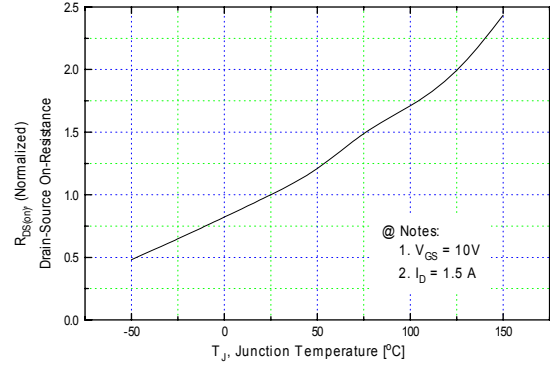


Figure 8. On-Resistance vs. Temperature

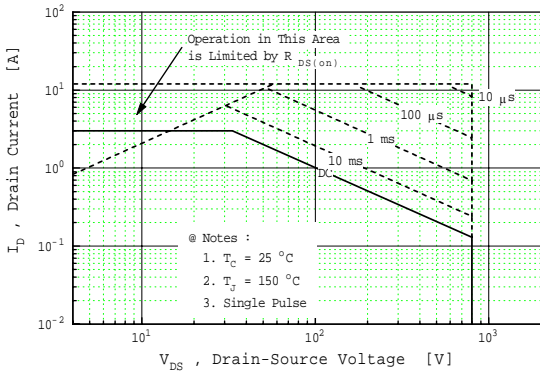


Figure 9. Max. Safe Operating Area

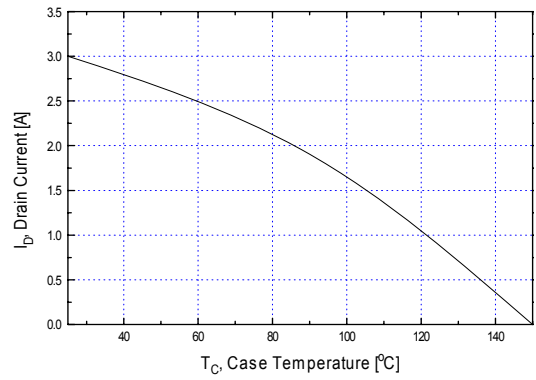


Figure 10. Max. Drain Current vs. Case Temperature

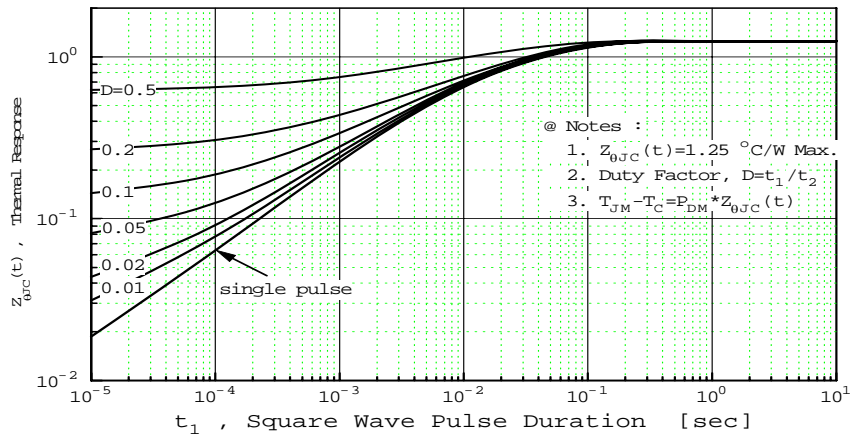


Figure 11. Thermal Response

## Typical Performance Characteristics (Control Part) (Continued)

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

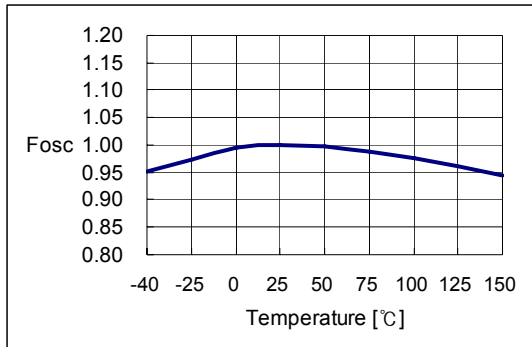


Figure 1. Operating Frequency

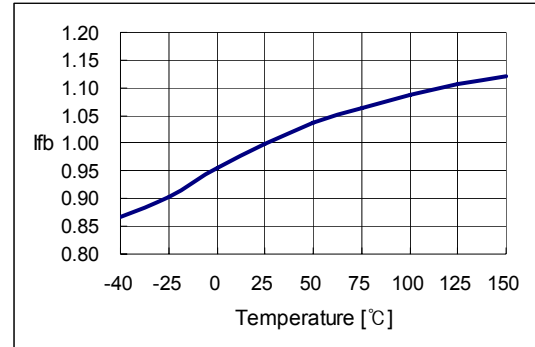


Figure 2. Feedback Source Current

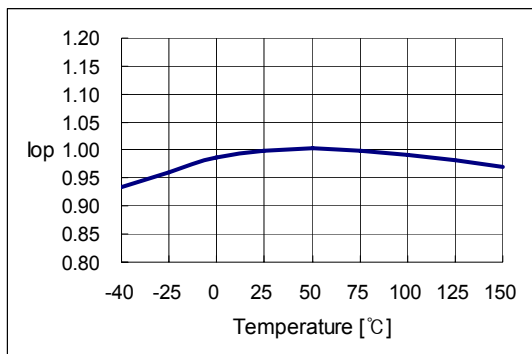


Figure 3. Operating Supply Current

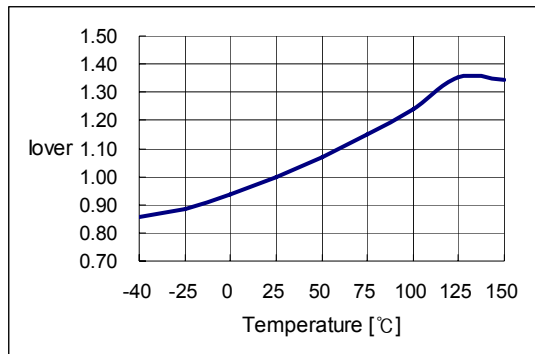


Figure 4. Peak Current Limit

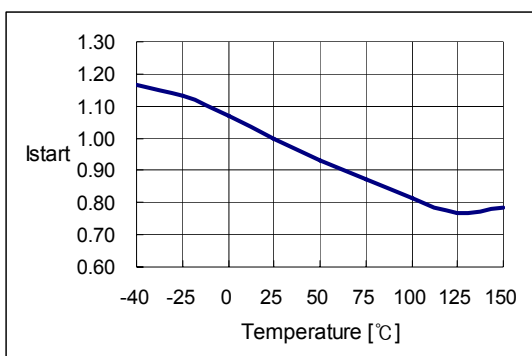


Figure 5. Start up Current

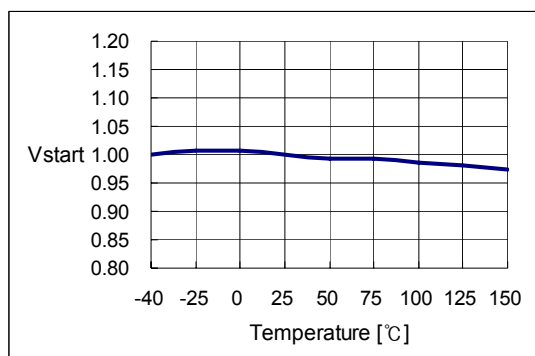
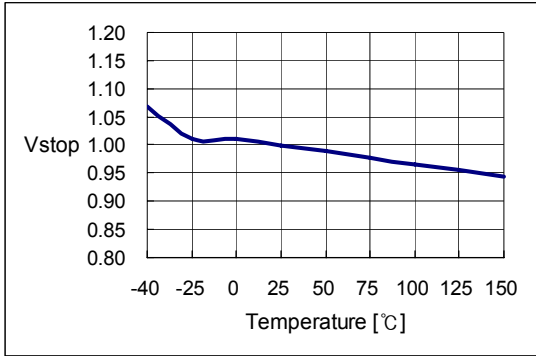


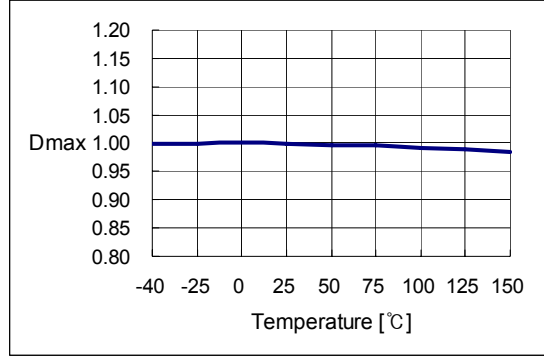
Figure 6. Start Threshold Voltage

**Typical Performance Characteristics** (Continued)

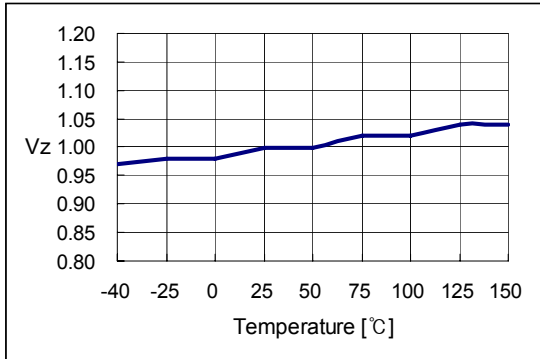
(These characteristic graphs are normalized at  $T_a = 25^\circ\text{C}$ )



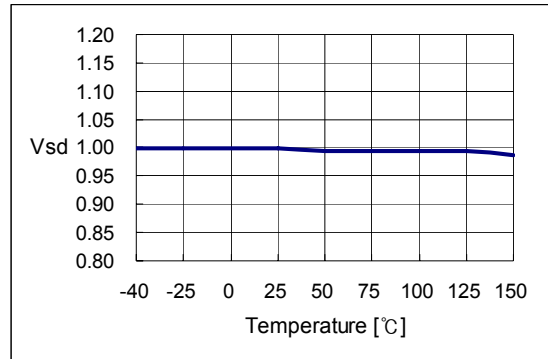
**Figure 7. Stop Threshold Voltage**



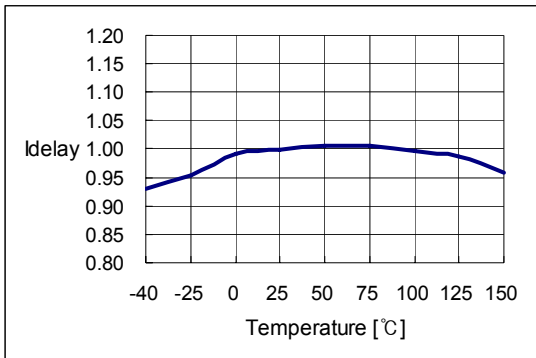
**Figure 8. Maximum Duty Cycle**



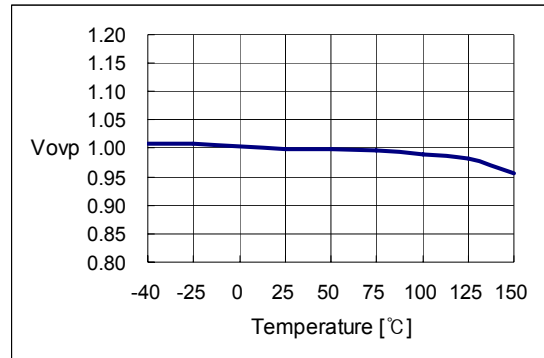
**Figure 9. VCC Zener Voltage**



**Figure 10. Shutdown Feedback Voltage**



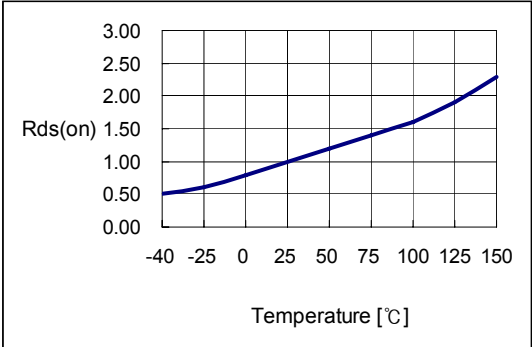
**Figure 11. Shutdown Delay Current**



**Figure 12. Over Voltage Protection**

**Typical Performance Characteristics** (Continued)

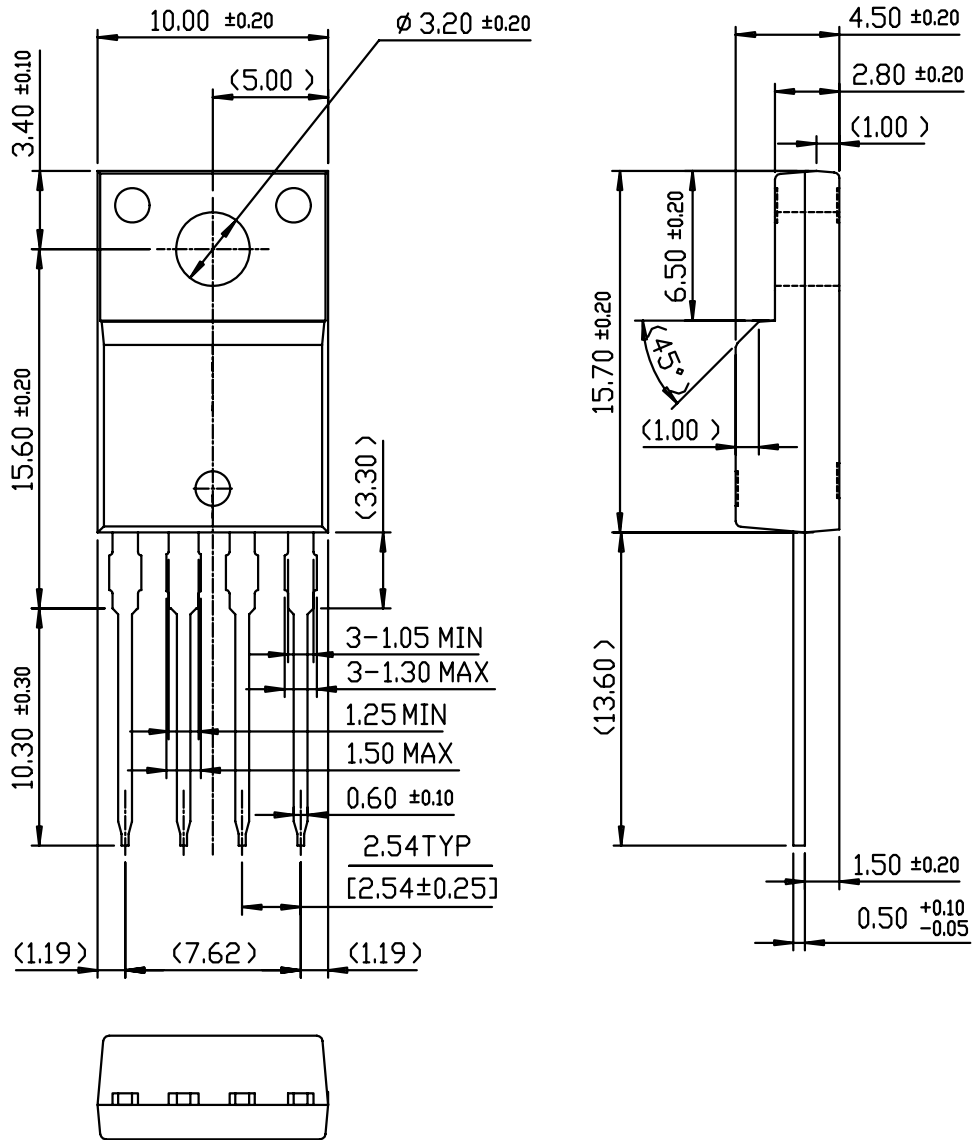
(These characteristic graphs are normalized at Ta = 25°C)



**Figure13. Static Drain-Source on Resistance**

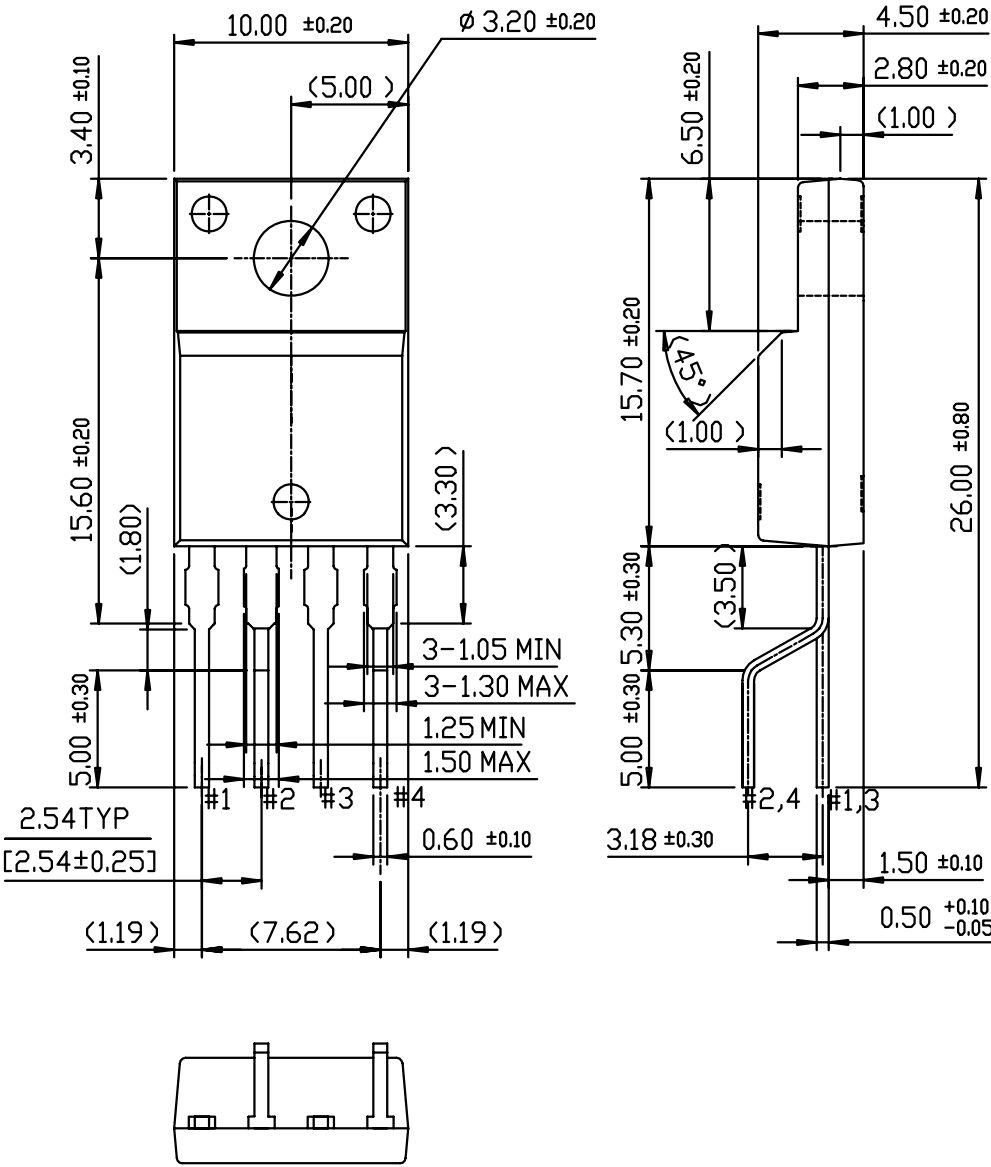
# Package Dimensions

## TO-220F-4L



Package Dimensions (Continued)

TO-220F-4L(Forming)



## Ordering Information

| Product Number | Package             | Marking Code | BVDSS | FOSC   | RDS(on) |
|----------------|---------------------|--------------|-------|--------|---------|
| KA5H0365RTU    | TO-220F-4L          | 5H0365R      | 650V  | 100kHz | 3.6Ω    |
| KA5H0365RYDTU  | TO-220F-4L(Forming) |              |       |        |         |
| KA5M0365RTU    | TO-220F-4L          | 5M0365R      | 650V  | 67kHz  | 3.6Ω    |
| KA5M0365RYDTU  | TO-220F-4L(Forming) |              |       |        |         |
| KA5L0365RTU    | TO-220F-4L          | 5L0365R      | 650V  | 50kHz  | 3.6Ω    |
| KA5L0365RYDTU  | TO-220F-4L(Forming) |              |       |        |         |
| Product Number | Package             | Marking Code | BVDSS | FOSC   | RDS(on) |
| KA5H0380RTU    | TO-220F-4L          | 5H0380R      | 800V  | 100kHz | 4.6Ω    |
| KA5H0380RYDTU  | TO-220F-4L(Forming) |              |       |        |         |
| KA5M0380RTU    | TO-220F-4L          | 5M0380R      | 800V  | 67kHz  | 4.6Ω    |
| KA5M0380RYDTU  | TO-220F-4L(Forming) |              |       |        |         |
| KA5L0380RTU    | TO-220F-4L          | 5L0380R      | 800V  | 50kHz  | 4.6Ω    |
| KA5L0380RYDTU  | TO-220F-4L(Forming) |              |       |        |         |





TU :Non Forming Type

YDTU : Forming type



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| BitSiC®   | Green FPS™                                     | Programmable Active Droop™   | TinyBuck™   |
| Build it Now™   | Green FPS™ e-Series™                           | QFET®  | TinyCalc™   |
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| CROSSVOL™   | IntelliMAX™                                    | RapidConfigure™  | TinyPower™  |
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