

KA5x03xx-SERIES

KA5H0365R, KA5M0365R, KA5L0365R, KA5M0365RN,
KA5L0365RN, KA5H0380R, KA5M0380R, KA5L0380R
Fairchild Power Switch(FPS)

Features

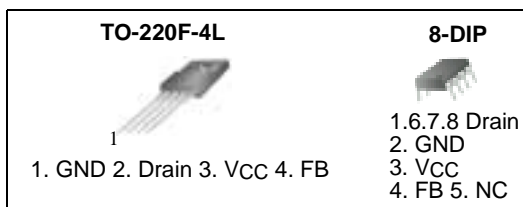
- Precision Fixed Operating Frequency (100/67/50kHz)
- Low Start-up Current(Typ. 100uA)
- Pulse by Pulse Current Limiting
- Over Current Protection
- Over Voltage Protection (Min. 25V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode

Applications

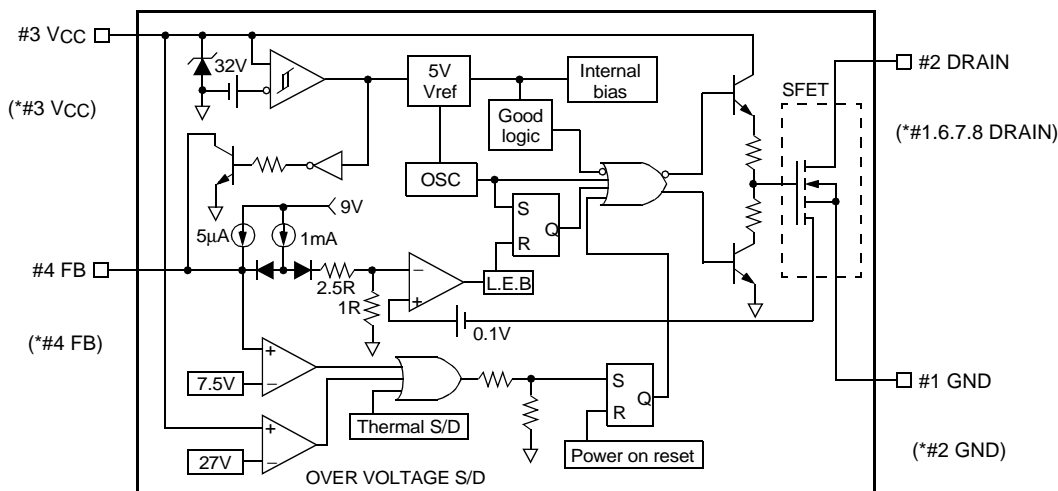
- SMPS for VCR, SVR, STB, DVD & DVCD
- SMPS for Printer, Facsimile & Scanner
- Adaptor for Camcorder

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



*Asterisk - KA5M0365RN, KA5L0365RN

Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
KA5H0365R, KA5M0365R, KA5L0365R			
Maximum Drain Voltage	V _{D,MAX}	650	V
Drain-Gate Voltage (R _{GS} =1MΩ)	V _{DGR}	650	V
Gate-Source (GND) Voltage	V _{GS}	±30	V
Drain Current Pulsed ⁽¹⁾	I _{DM}	12.0	ADC
Continuous Drain Current (T _C =25°C)	I _D	3.0	ADC
Continuous Drain Current (T _C =100°C)	I _D	2.4	ADC
Single Pulsed Avalanche Energy ⁽²⁾	E _{AS}	358	mJ
Maximum Supply Voltage	V _{CC,MAX}	30	V
Analog Input Voltage Range	V _{FB}	-0.3 to V _{SD}	V
Total Power Dissipation	P _D	75	W
	Derating	0.6	W/°C
Operating Junction Temperature.	T _J	+160	°C
Operating Ambient Temperature.	T _A	-25 to +85	°C
Storage Temperature Range.	T _{STG}	-55 to +150	°C
KA5H0380R, KA5M0380R, KA5L0380R			
Maximum Drain Voltage	V _{D,MAX}	800	V
Drain-Gate Voltage (R _{GS} =1MΩ)	V _{DGR}	800	V
Gate-Source (GND) Voltage	V _{GS}	±30	V
Drain Current Pulsed ⁽¹⁾	I _{DM}	12.0	ADC
Continuous Drain Current (T _C =25°C)	I _D	3.0	ADC
Continuous Drain Current (T _C =100°C)	I _D	2.1	ADC
Single Pulsed Avalanche Energy ⁽²⁾	E _{AS}	95	mJ
Maximum Supply Voltage	V _{CC,MAX}	30	V
Analog Input Voltage Range	V _{FB}	-0.3 to V _{SD}	V
Total Power Dissipation	P _D	75	W
	Derating	0.6	W/°C
Operating Junction Temperature.	T _J	+160	°C
Operating Ambient Temperature.	T _A	-25 to +85	°C
Storage Temperature Range.	T _{STG}	-55 to +150	°C

Note:

1. Repetitive rating: Pulse width limited by maximum junction temperature
2. L = 51mH, starting T_j = 25°C
3. L = 13μH, starting T_j = 25°C

Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
KA5M0365RN, KA5L0365RN			
Maximum Drain Voltage	V _{D,MAX}	650	V
Drain-Gate Voltage (R _{GS} =1MΩ)	V _{DGR}	650	V
Gate-Source (GND) Voltage	V _{GS}	±30	V
Drain Current Pulsed ⁽¹⁾	I _{DM}	12.0	ADC
Continuous Drain Current (Ta=25°C)	I _D	0.42	ADC
Continuous Drain Current (Ta=100°C)	I _D	0.28	ADC
Single Pulsed Avalanche Energy ⁽²⁾	E _{AS}	127	mJ
Maximum Supply Voltage	V _{CC,MAX}	30	V
Analog Input Voltage Range	V _{FB}	-0.3 to V _{SD}	V
Total Power Dissipation	P _D	1.56	W
	Derating	0.0125	W/°C
Operating Junction Temperature.	T _J	+160	°C
Operating Ambient Temperature.	T _A	-25 to +85	°C
Storage Temperature Range.	T _{STG}	-55 to +150	°C

Note:

1. Repetitive rating: Pulse width limited by maximum junction temperature
2. L = 51mH, starting T_j = 25°C
3. L = 13μH, starting T_j = 25°C

Electrical Characteristics (SenseFET Part)

(Ta = 25°C unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
KA5H0365R, KA5M0365R, KA5L0365R						
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 ^(Note)	RDS(ON)	VGS=10V, ID=0.5A	-	3.6	4.5	Ω
Forward Transconductance ^(Note)	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 (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	-	
KA5H0380R, KA5M0380R, KA5L0380R						
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 ^(Note)	RDS(ON)	VGS=10V, ID=0.5A	-	4.0	5.0	Ω
Forward Transconductance ^(Note)	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 (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 (SenseFET Part)

(Ta = 25°C unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
KA5M0365RN, KA5L0365RN						
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 ^(Note)	RDS(ON)	VGS=10V, ID=0.5A	-	3.6	4.5	Ω
Forward Transconductance ^(Note)	gfs	VDS=50V, ID=0.5A	2.0	-	-	S
Input Capacitance	Ciss	VGS=0V, VDS=25V, f=1MHz	-	314.9	-	pF
Output Capacitance	Coss		-	47	-	
Reverse Transfer Capacitance	Crss		-	9	-	
Turn On Delay Time	td(on)	VDD=0.5BVDSS, ID=1.0A (MOSFET switching time is essentially independent of operating temperature)	-	11.2	-	nS
Rise Time	tr		-	34	-	
Turn Off Delay Time	td(off)		-	28.2	-	
Fall Time	tf		-	32	-	
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)			11.93	nC
Gate-Source Charge	Qgs		-	1.95	-	
Gate-Drain (Miller) Charge	Qgd			6.85		

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
UVLO SECTION						
Start Threshold Voltage	VSTART	VFB=GND	14	15	16	V
Stop Threshold Voltage	VSTOP	VFB=GND	8.4	9	9.6	V
OSCILLATOR SECTION						
Initial Accuracy	FOSC	KA5H0365R KA5H0380R	90	100	110	kHz
Initial Accuracy	FOSC	KA5M0365R KA5M0365RN KA5M0380R	61	67	73	kHz
Initial Accuracy	FOSC	KA5L0365R KA5L0365RN KA5L0380R	45	50	55	kHz
Frequency Change With Temperature ⁽²⁾	-	-25°C≤Ta≤+85°C	-	±5	±10	%
Maximum Duty Cycle	Dmax	KA5H0365R KA5H0380R	62	67	72	%
Maximum Duty Cycle	Dmax	KA5M0365R KA5M0365RN KA5M0380R KA5L0365R KA5L0365RN KA5L0380R	72	77	82	%
FEEDBACK SECTION						
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
REFERENCE SECTION						
Output Voltage ⁽¹⁾	Vref	Ta=25°C	4.80	5.00	5.20	V
Temperature Stability ⁽¹⁾⁽²⁾	Vref/ΔT	-25°C≤Ta≤+85°C	-	0.3	0.6	mV/°C
CURRENT LIMIT(SELF-PROTECTION)SECTION						
Peak Current Limit	I _{OVER}	Max. inductor current	1.89	2.15	2.41	A
PROTECTION SECTION						
Over Voltage Protection	VOVP	VCC≥24V	25	27	29	V
Thermal Shutdown Temperature (Tj) ⁽¹⁾	TSD	-	140	160	-	°C
TOTAL STANDBY CURRENT SECTION						
Start-up Current	I _{START}	VCC=14V	-	100	170	μA
Operating Supply Current (Control Part Only)	I _{OP}	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)

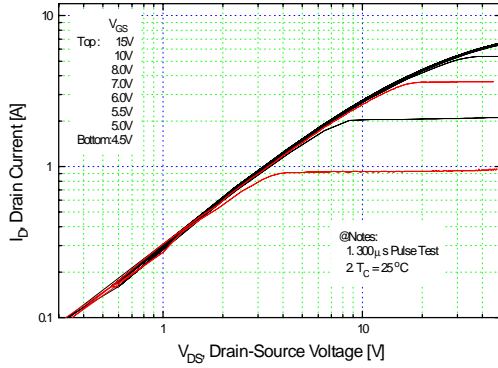


Figure 1. Output Characteristics

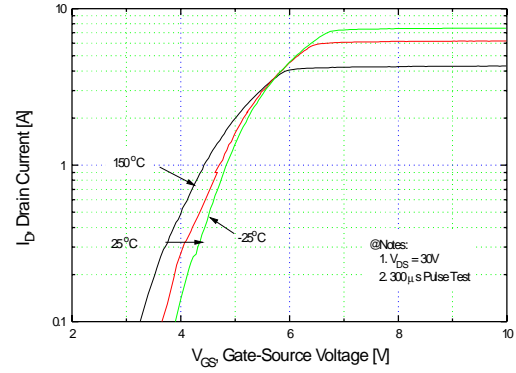


Figure 2. Transfer Characteristics

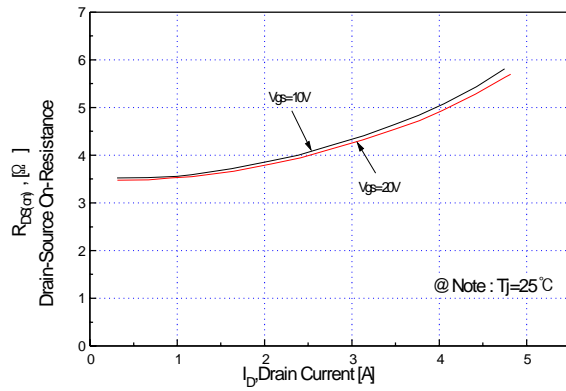


Figure 3. On-Resistance vs. Drain Current

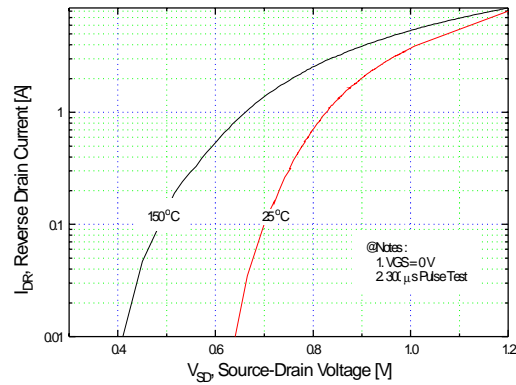


Figure 4. Source-Drain Diode Forward Voltage

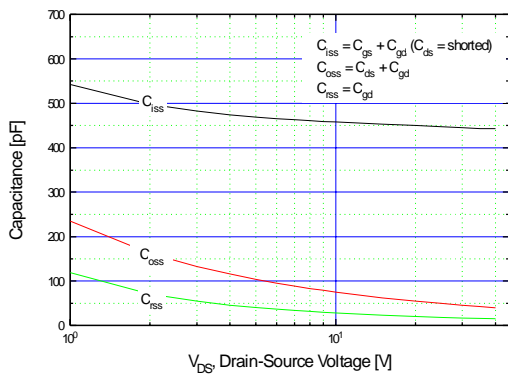


Figure 5. Capacitance vs. Drain-Source Voltage

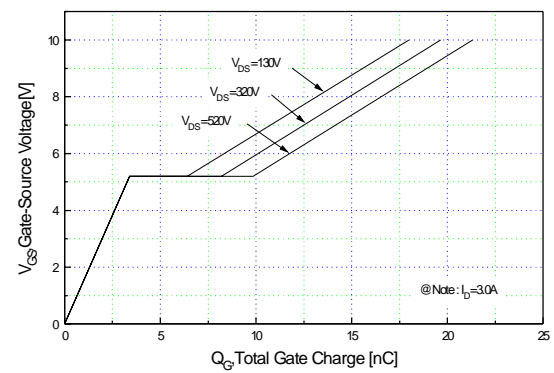


Figure 6. Gate Charge vs. Gate-Source Voltage

Typical Performance Characteristics (Continued)

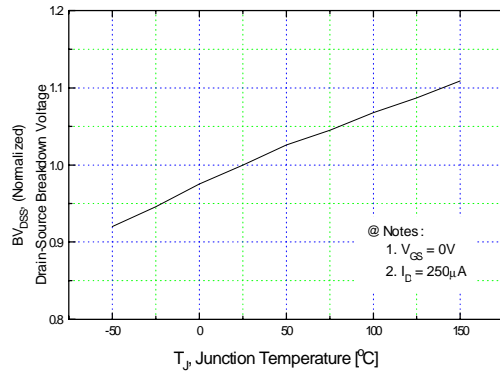


Figure 7. Breakdown Voltage vs. Temperature

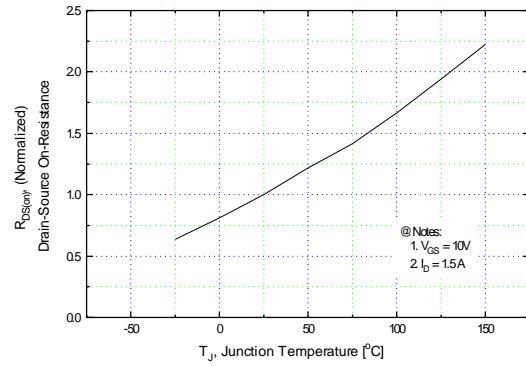


Figure 8. On-Resistance vs. Temperature

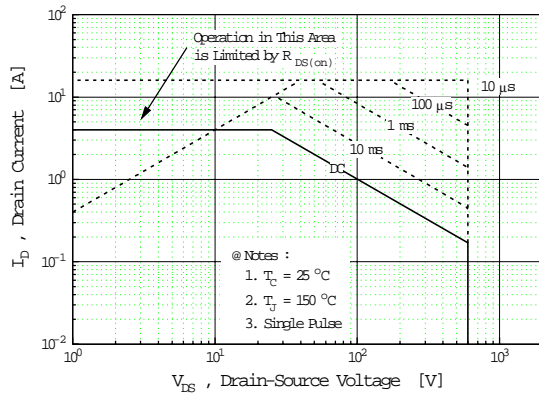


Figure 9. Max. Safe Operating Area

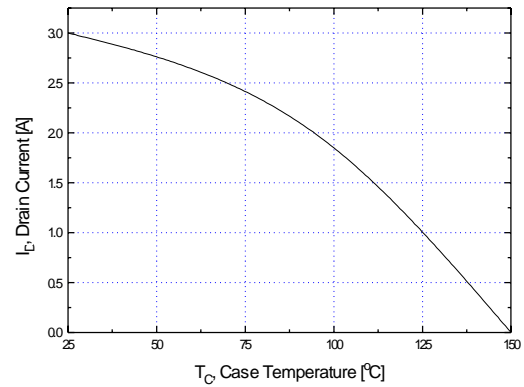


Figure 10. Max. Drain Current vs. Case Temperature

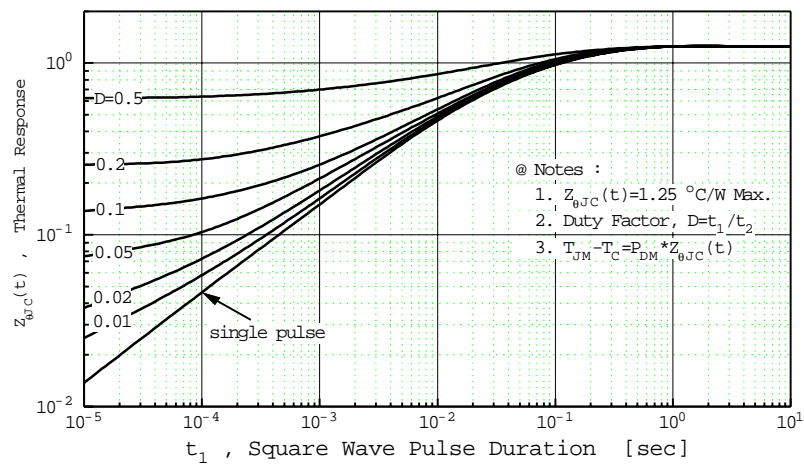


Figure 11. Thermal Response

Typical Performance Characteristics (Continued)

(KA5H0380R, KA5M0380R, KA5L0380R)

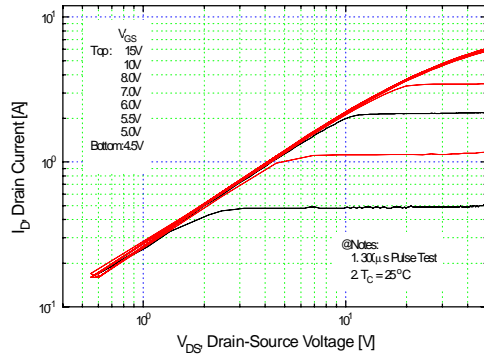


Figure 1. Output Characteristics

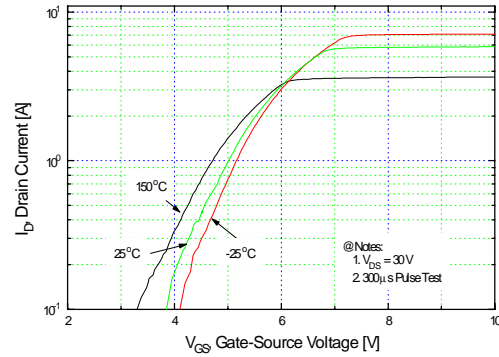


Figure 2. Transfer Characteristics

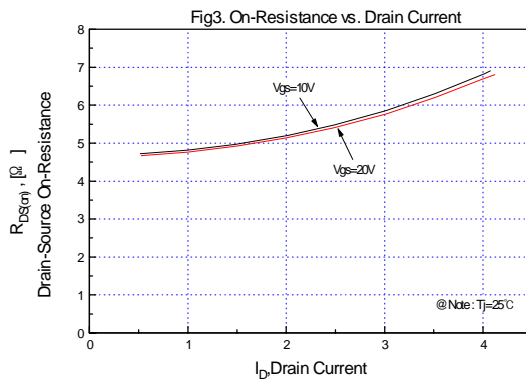


Figure 3. On-Resistance vs. Drain Current

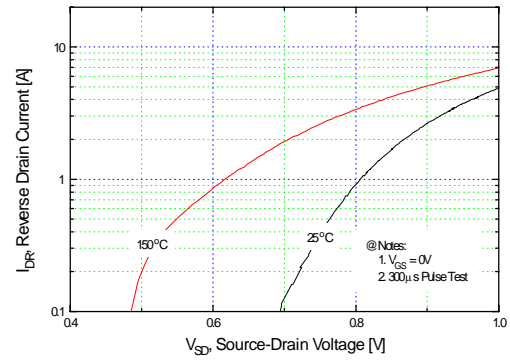


Figure 4. Source-Drain Diode Forward Voltage

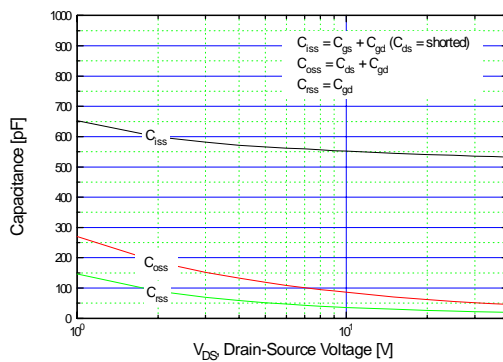


Figure 5. Capacitance vs. Drain-Source Voltage

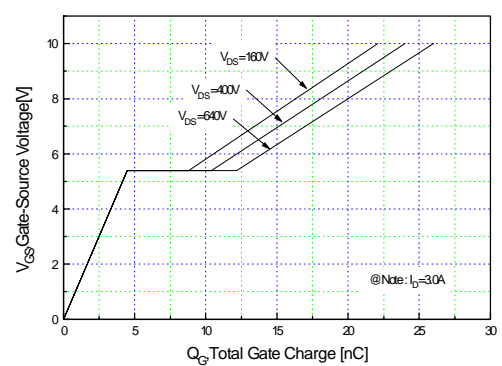


Figure 6. Gate Charge vs. Gate-Source Voltage

Typical Performance Characteristics (Continued)

(KA5H0380R, KA5M0380R, KA5L0380R)

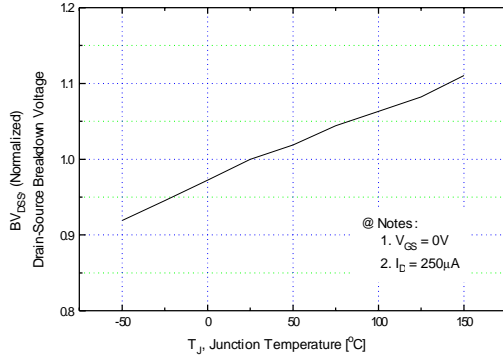


Figure 7. Breakdown Voltage vs. Temperature

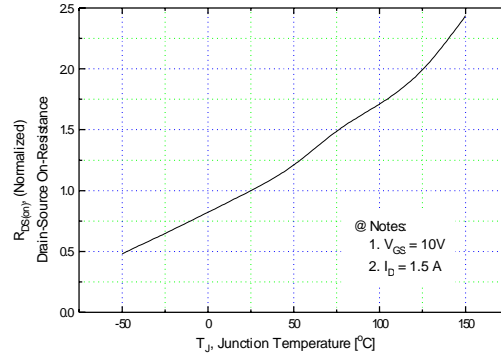


Figure 8. On-Resistance vs. Temperature

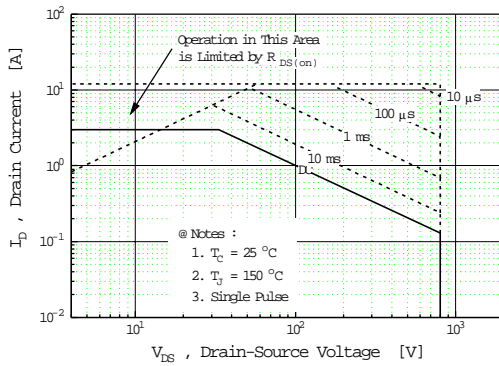


Figure 9. Max. Safe Operating Area

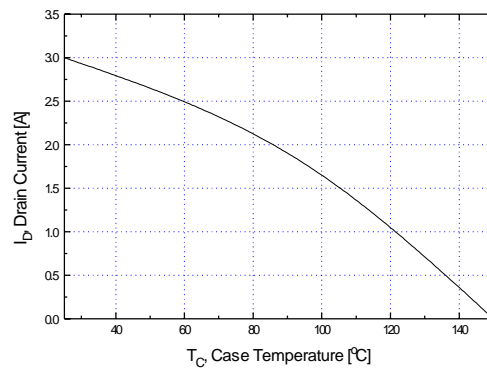


Figure 10. Max. Drain Current vs. Case Temperature

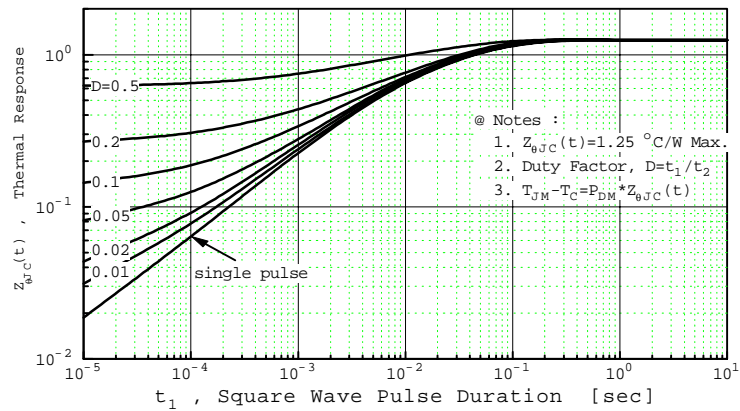


Figure 11. Thermal Response

Typical Performance Characteristics(SenseFET part) (Continued)

(KA5M0365RN, KA5L0365RN)

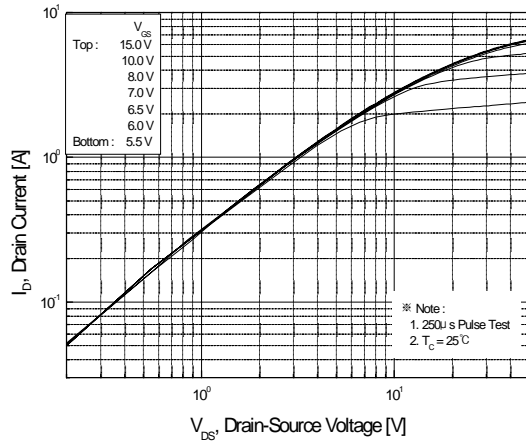


Figure 1. Output Characteristics

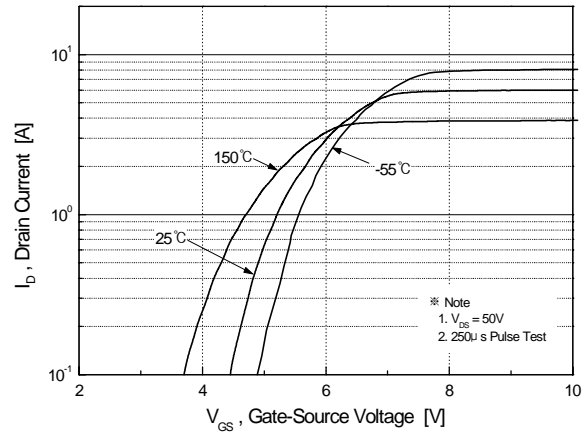


Figure 2. Transfer Characteristics

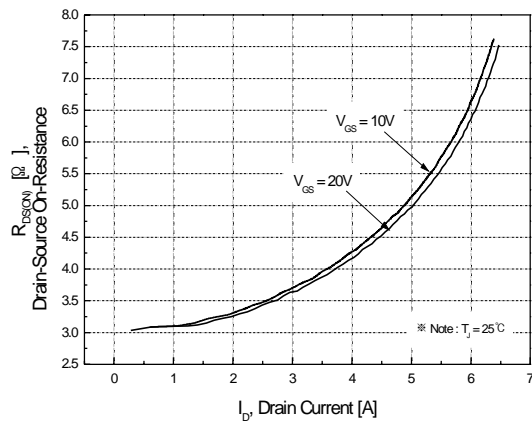


Figure 3. On-Resistance vs. Drain Current

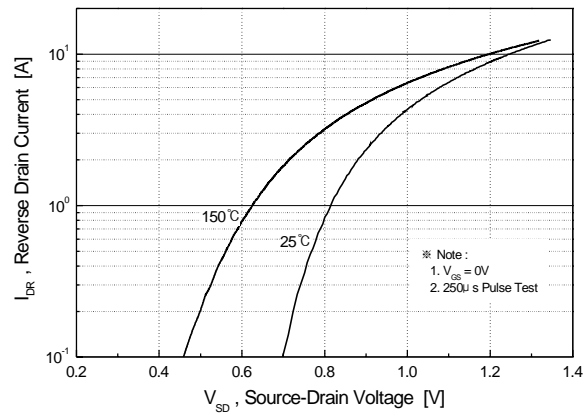


Figure 4. Source-Drain Diode Forward Voltage

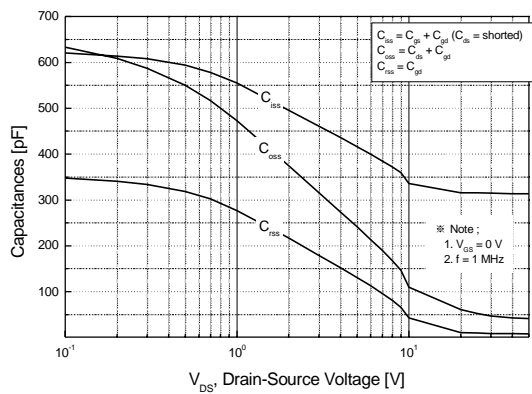


Figure 5. Capacitance vs. Drain-Source Voltage

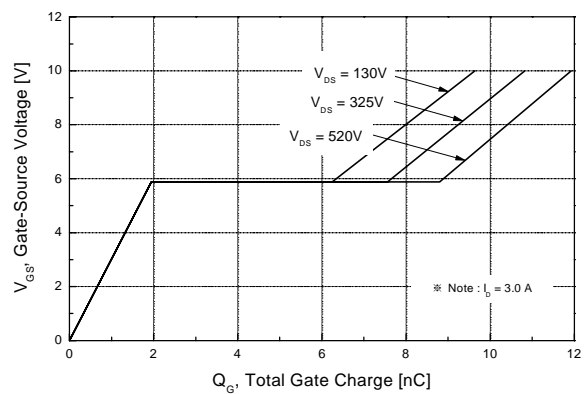


Figure 6. Gate Charge vs. Gate-Source Voltage

Typical Performance Characteristics (Continued)

(KA5M0365RN, KA5L0365RN)

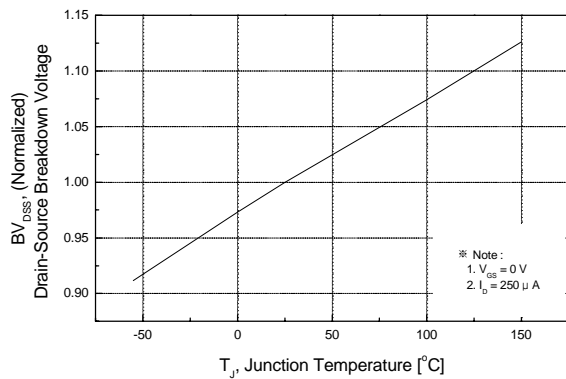


Figure 7. Breakdown Voltage vs. Temperature

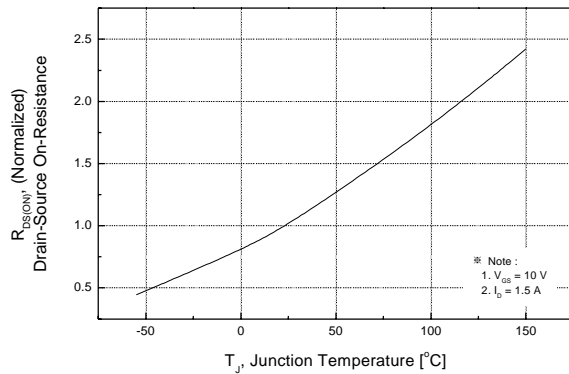


Figure 8. On-Resistance vs. Temperature

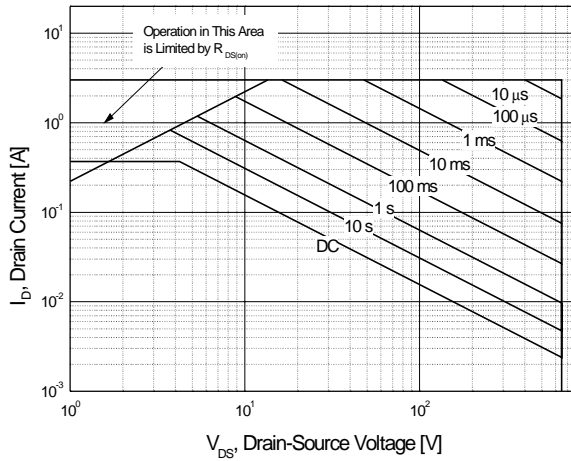


Figure 9. Max. Safe Operating Area

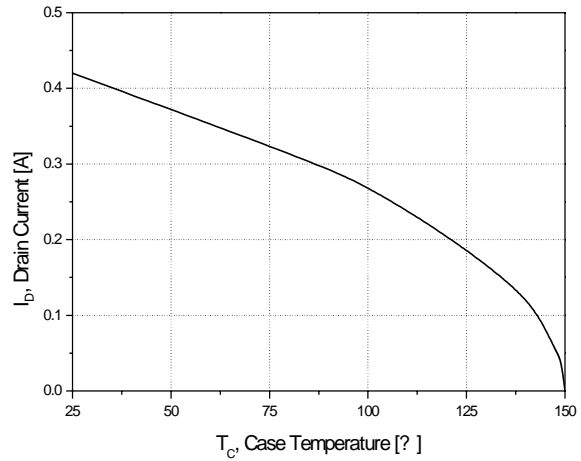


Figure 10. Max. Drain Current vs. Case Temperature

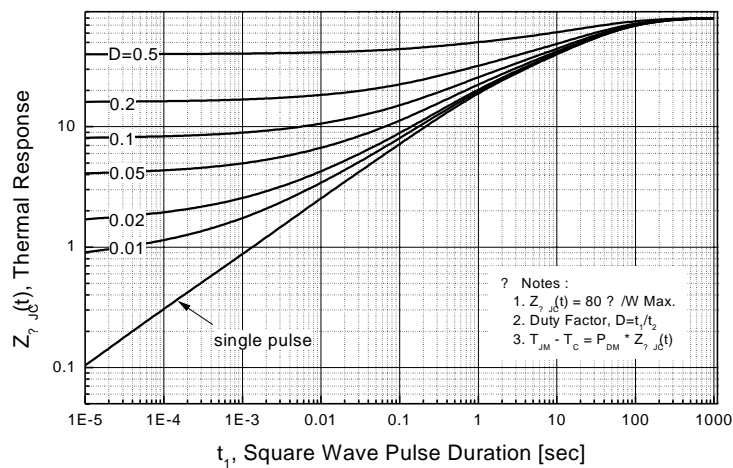


Figure 11. Thermal Response

Typical Performance Characteristics (Control Part) (Continued)

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

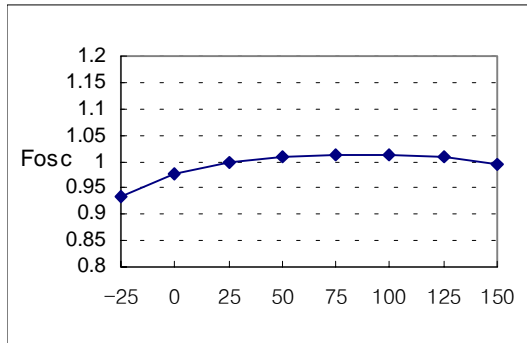


Figure 1. Operating Frequency

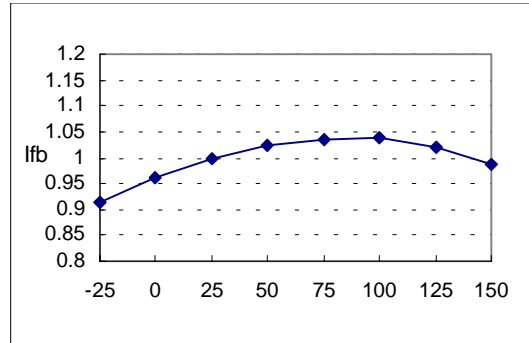


Figure 2. Feedback Source Current

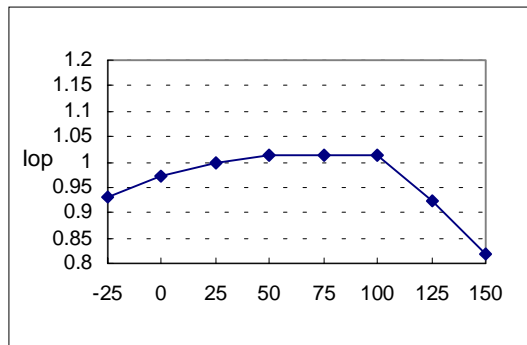


Figure 3. Operating Supply Current

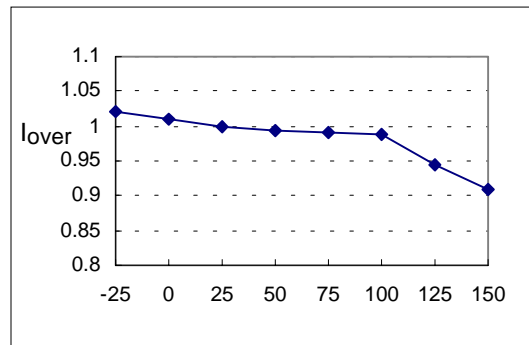


Figure 4. Peak Current Limit

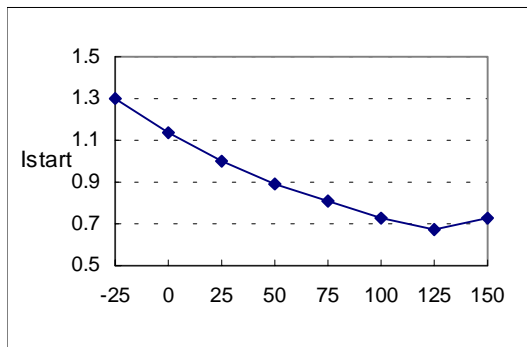


Figure 5. Start up Current

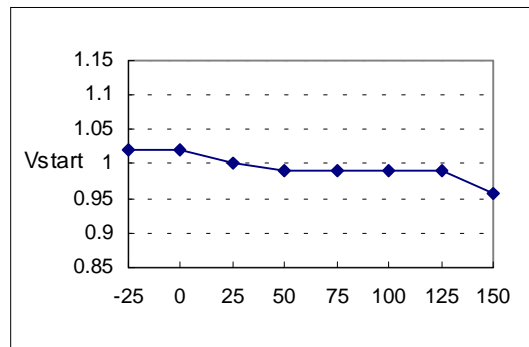


Figure 6. Start Threshold Voltage

Typical Performance Characteristics (Continued)

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

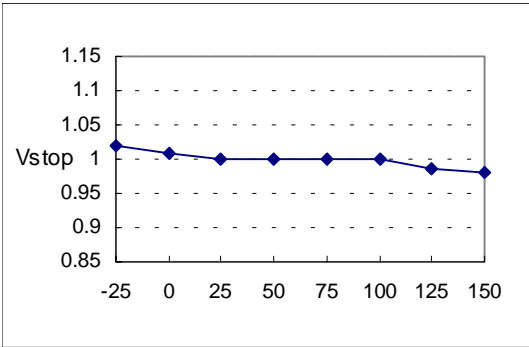


Figure 7. Stop Threshold Voltage

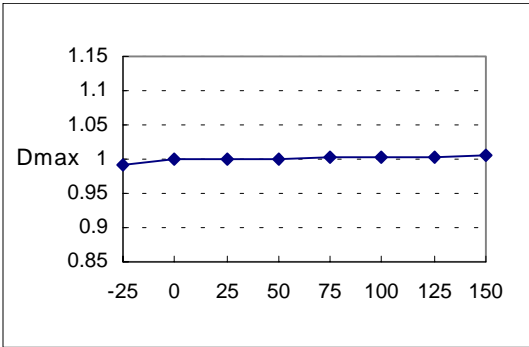


Figure 8. Maximum Duty Cycle

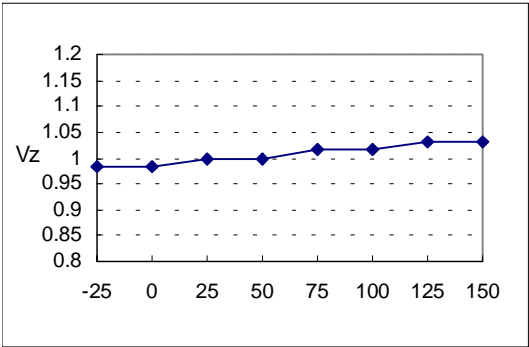


Figure 9. VCC Zener Voltage

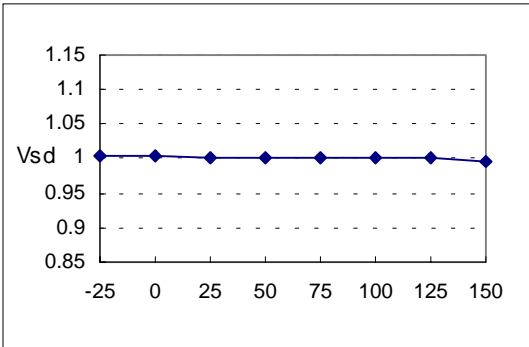


Figure 10. Shutdown Feedback Voltage

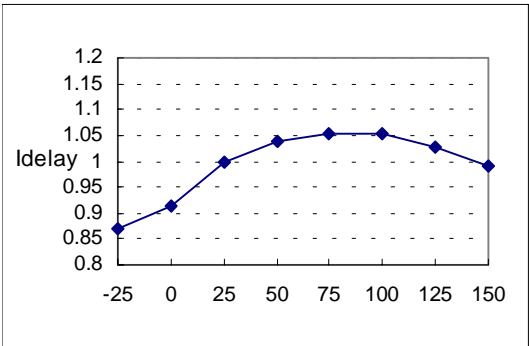


Figure 11. Shutdown Delay Current

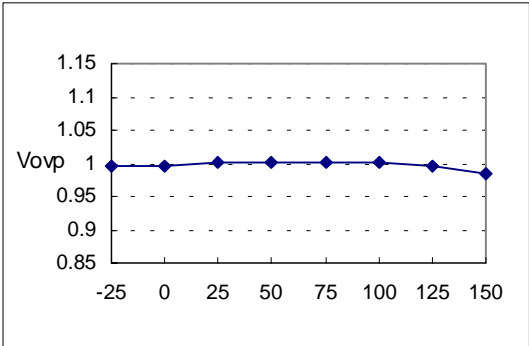


Figure 12. Over Voltage Protection

Typical Performance Characteristics (Continued)

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

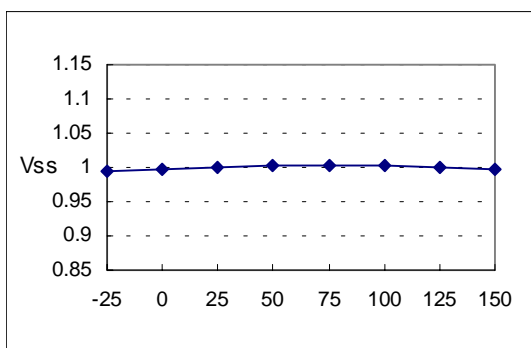


Figure13. Soft Start Voltage

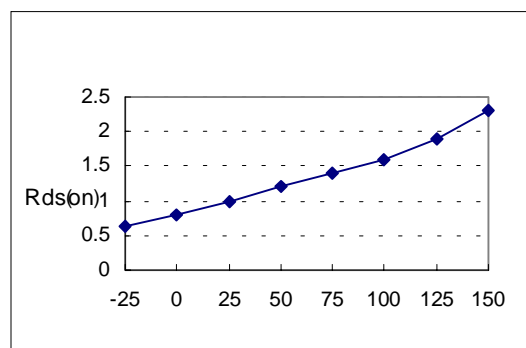
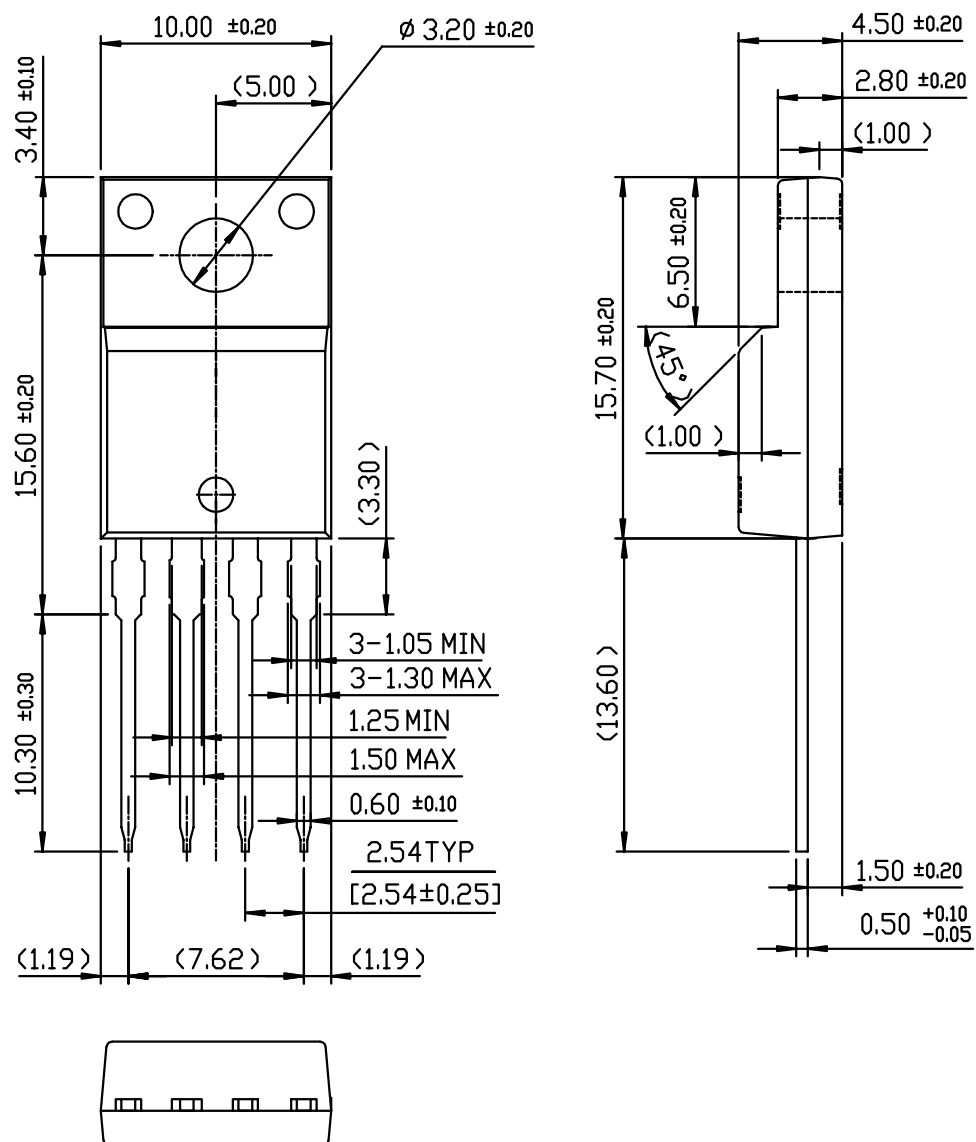


Figure 14. Static Drain-Source on Resistance

Package Dimensions

TO-220F-4L



Technical drawing of the 2000 Series 1000V Molded Case Circuit Breaker (MCCB) showing front, side, and top views with dimensions in mm.

Front View Dimensions:

- Overall Width: 10.00 ± 0.20
- Overall Height: 15.60 ± 0.20
- Top Flange Height: 3.40 ± 0.10
- Mounting Hole Diameter: $\phi 3.20 \pm 0.20$
- Mounting Hole Spacing: (5.00)
- Terminal Block Height: (3.30)
- Terminal Spacing: 2.54 TYP [2.54 ± 0.25]
- Terminal Height: 5.00 ± 0.30
- Terminal Width: 0.60 ± 0.10
- Terminal Spacing (Left): (1.19)
- Terminal Spacing (Right): (1.19)
- Terminal Spacing (Center): (7.62)
- Terminal Height (Left): $3-1.05 \text{ MIN}$
- Terminal Height (Right): $3-1.30 \text{ MAX}$
- Terminal Height (Center): 1.25 MIN
- Terminal Height (Center): 1.50 MAX

Side View Dimensions:

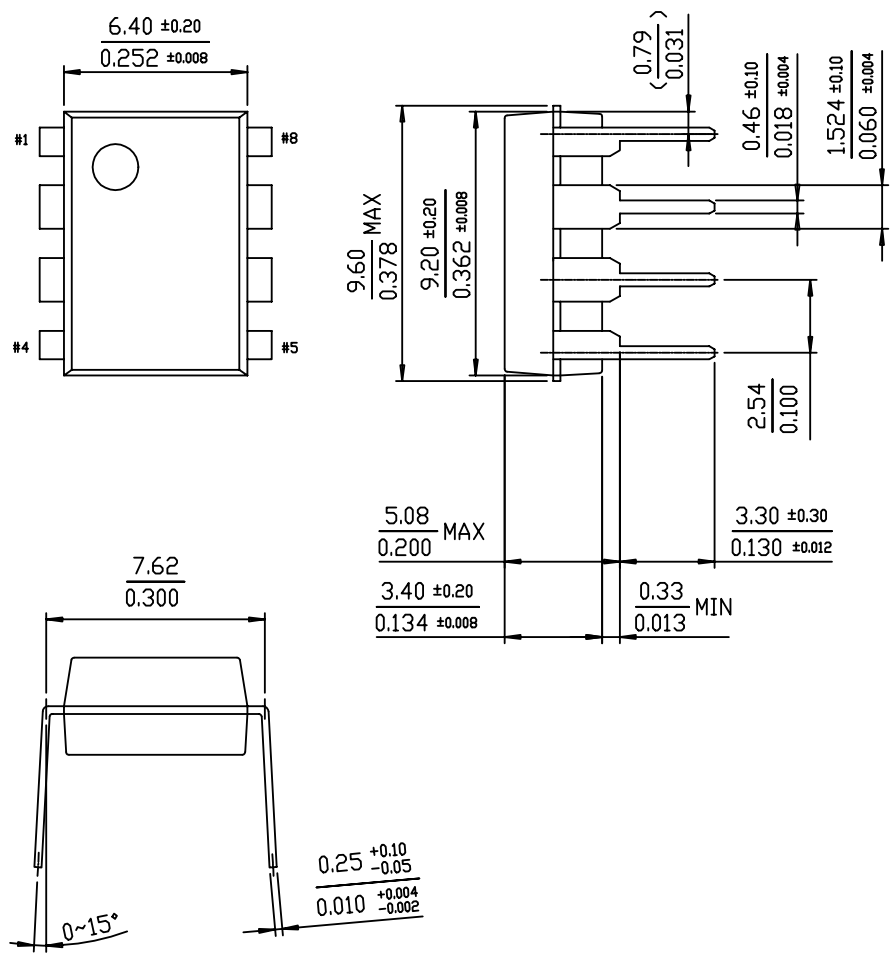
- Overall Depth: 26.00 ± 0.80
- Top Flange Depth: 4.50 ± 0.20
- Top Flange Width: 2.80 ± 0.20
- Top Flange Thickness: (1.00)
- Top Flange Height: 6.50 ± 0.20
- Top Flange Angle: 45°
- Top Flange Width (Left): (1.00)
- Top Flange Width (Right): (3.50)
- Top Flange Height (Left): 15.70 ± 0.20
- Top Flange Height (Right): 5.00 ± 0.30
- Top Flange Height (Center): 5.30 ± 0.30
- Top Flange Width (Center): 3.18 ± 0.30
- Top Flange Height (Center): 1.50 ± 0.10
- Top Flange Width (Center): $0.50^{+0.10}_{-0.05}$

Top View Dimensions:

- Overall Width: 10.00 ± 0.20
- Overall Depth: 26.00 ± 0.80
- Terminal Spacing: 2.54 TYP [2.54 ± 0.25]
- Terminal Height: 5.00 ± 0.30
- Terminal Width: 0.60 ± 0.10
- Terminal Spacing (Left): (1.19)
- Terminal Spacing (Right): (1.19)
- Terminal Spacing (Center): (7.62)
- Terminal Height (Left): $3-1.05 \text{ MIN}$
- Terminal Height (Right): $3-1.30 \text{ MAX}$
- Terminal Height (Center): 1.25 MIN
- Terminal Height (Center): 1.50 MAX

Package Dimensions (Continued)

8-DIP



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)				
KA5M0365RN	8-DIP	5M0365R	650V	67kHz	3.6Ω
KA5L0365RN	8-DIP	5L0365R	650V	50kHz	3.6Ω
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

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.