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# KA5x02xx-SERIES

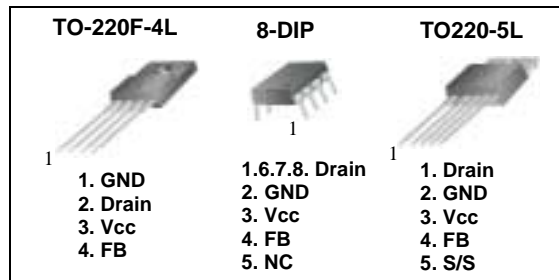
KA5H0265RC, KA5M0265R, KA5L0265R,  
 KA5H02659RN/KA5M02659RN, KA5H0280R,  
 KA5M0280R  
 Power Switch

## Features

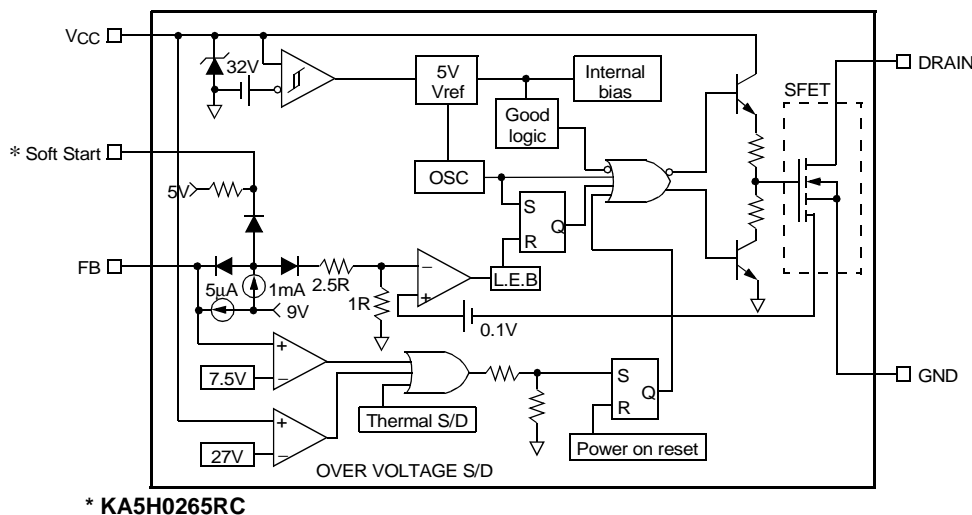
- Precision Fixed Operating Frequency (100/67/50kHz)
- Low Start-up Current (Typ. 100uA)
- Pulse by Pulse Current Limiting
- Over Load Protection
- Over Voltage Protection (Min. 25V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode

## Description

The Power Switch product family is specially designed for an off-line SMPS with minimal external components. The Power Switch consist of high voltage power SenseFET and current mode PWM IC. Included PWM controller features integrated fixed oscillator, under voltage lock out, leading edge blanking, optimized gate turn-on/turn-off driver, thermal shut down protection, over voltage protection, and temperature compensated precision current sources for loop compensation and fault protection circuitry-compared to discrete MOSFET and controller or RCC switching converter solution. The Power Switch 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.



## Internal Block Diagram



## Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
<b>KA5x0265xRx</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>	8.0	ADC
Continuous Drain Current (T <sub>C</sub> =25°C)	I <sub>D</sub>	2.0	ADC
Continuous Drain Current (T <sub>C</sub> =100°C)	I <sub>D</sub>	1.3	ADC
Single Pulsed Avalanche Energy <sup>(2)</sup>	E <sub>AS</sub>	68	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	P <sub>D</sub>	42	W
	Darting	0.33	W/°C
Operating Junction Temperature.	T <sub>J</sub>	+160	°C
Operating Ambient Temperature.	T <sub>A</sub>	-25 to +85	°C
Storage Temperature Range.	T <sub>STG</sub>	-55 to +150	°C
<b>KA5x0280R</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>	8.0	ADC
Continuous Drain Current (T <sub>C</sub> =25°C)	I <sub>D</sub>	2.0	ADC
Continuous Drain Current (T <sub>C</sub> =100°C)	I <sub>D</sub>	1.3	ADC
Single Pulsed Avalanche Energy <sup>(2)</sup>	E <sub>AS</sub>	90	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	P <sub>D</sub>	35	W
	Darting	0.28	W/°C
Operating Junction Temperature.	T <sub>J</sub>	+160	°C
Operating Ambient Temperature.	T <sub>A</sub>	-25 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

## Electrical Characteristics (SFET Part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>KA5x0265xRx</b>						
Drain-Source Breakdown Voltage	BVDSS	V <sub>GS</sub> =0V, I <sub>D</sub> =50μA	650	-	-	V
Zero Gate Voltage Drain Current	IDSS	V <sub>D</sub> S=Max. Rating, V <sub>GS</sub> =0V	-	-	50	μA
		V <sub>D</sub> S=0.8Max. Rating, V <sub>GS</sub> =0V, T <sub>C</sub> =125°C	-	-	200	μA
Static Drain-Source on Resistance <sup>(Note)</sup>	RDS(ON)	V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A	-	5.0	6.0	Ω
Forward Transconductance <sup>(Note)</sup>	gfs	V <sub>D</sub> S=50V, I <sub>D</sub> =0.5A	1.5	2.5	-	S
Input Capacitance	Ciss	V <sub>GS</sub> =0V, V <sub>D</sub> S=25V, f=1MHz	-	550	-	pF
Output Capacitance	Coss		-	38	-	
Reverse Transfer Capacitance	Crss		-	17	-	
Turn on Delay Time	td(on)	V <sub>DD</sub> =0.5B V <sub>D</sub> SS, I <sub>D</sub> =1.0A (MOSFET switching time is essentially independent of operating temperature)	-	20	-	nS
Rise Time	tr		-	15	-	
Turn Off Delay Time	td(off)		-	55	-	
Fall Time	tf		-	25	-	
Total Gate Charge (Gate-Source+Gate-Drain)	Qg	V <sub>GS</sub> =10V, I <sub>D</sub> =1.0A, V <sub>D</sub> S=0.5B V <sub>D</sub> SS (MOSFET switching time is essentially independent of operating temperature)	-	-	35	nC
Gate-Source Charge	Qgs		-	3	-	
Gate-Drain (Miller) Charge	Qgd		-	12	-	
<b>KA5x0280R</b>						
Drain-Source Breakdown Voltage	BVDSS	V <sub>GS</sub> =0V, I <sub>D</sub> =50μA	800	-	-	V
Zero Gate Voltage Drain Current	IDSS	V <sub>D</sub> S=Max. Rating, V <sub>GS</sub> =0V	-	-	50	μA
		V <sub>D</sub> S=0.8Max. Rating, V <sub>GS</sub> =0V, T <sub>C</sub> =125°C	-	-	200	μA
Static Drain-Source on Resistance <sup>(Note)</sup>	RDS(ON)	V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A	-	5.6	7.0	Ω
Forward Transconductance <sup>(Note)</sup>	gfs	V <sub>D</sub> S=50V, I <sub>D</sub> =0.5A	1.5	2.5	-	S
Input Capacitance	Ciss	V <sub>GS</sub> =0V, V <sub>D</sub> S=25V, f=1MHz	-	250	-	pF
Output Capacitance	Coss		-	52	-	
Reverse Transfer Capacitance	Crss		-	25	-	
Turn on Delay Time	td(on)	V <sub>DD</sub> =0.5B V <sub>D</sub> SS, I <sub>D</sub> =1.0A (MOSFET switching time is essentially independent of operating temperature)	-	21	-	nS
Rise Time	tr		-	28	-	
Turn Off Delay Time	td(off)		-	77	-	
Fall Time	tf		-	24	-	
Total Gate Charge (Gate-Source+Gate-Drain)	Qg	V <sub>GS</sub> =10V, I <sub>D</sub> =1.0A, V <sub>D</sub> S=0.5B V <sub>D</sub> SS (MOSFET switching time is essentially independent of operating temperature)	-	-	60	nC
Gate-Source Charge	Qgs		-	15	-	
Gate-Drain (Miller) Charge	Qgd		-	20	-	

### Note:

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

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

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

(Ta=25°C unless otherwise specified)

Parameter	Symbol	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	8.2	8.8	9.4	V
<b>OSCILLATOR SECTION</b>						
Initial Accuracy	FOSC	KA5H0265xRx KA5H0280R	90	100	110	kHz
Initial Accuracy	FOSC	KA5M0265xRx KA5M0280R	61	67	73	kHz
Initial Accuracy	FOSC	KA5L0265R	45	50	55	kHz
Frequency Change With Temperature <sup>(2)</sup>	$\Delta F/\Delta T$	-25°C ≤ Ta ≤ +85°C	-	±5	±10	%
Maximum Duty Cycle	Dmax	KA5H0265xRx KA5H0280R	62	67	72	%
Maximum Duty Cycle	Dmax	KA5M0265xRx KA5M0280R KA5L0265R	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>SOFT START SECTION</b>						
Soft Start Voltage	VSS	KA5H0265RC	4.7	5.0	5.3	V
Soft Start Current	ISS		0.8	1.0	1.2	mA
<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>	KA5x02659RN	0.79	0.9	1.01	A
Peak Current Limit	I <sub>OVER</sub>	KA5x0265Rx KA5x0280R	1.05	1.2	1.34	A
<b>PROTECTION SECTION</b>						
Over Voltage Protection	VOVP	VCC ≥ 24V	25	27	29	V
Thermal Shutdown Temperature <sup>(1)</sup>	TSD	-	140	160	-	°C
<b>TOTAL DEVICE SECTION</b>						
Start-up Current	ISTART	VCC=14V	-	100	170	μA
Operating Supply Current (Control Part Only)	IOPR	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 (wafer test) process

## Typical Performance Characteristics

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

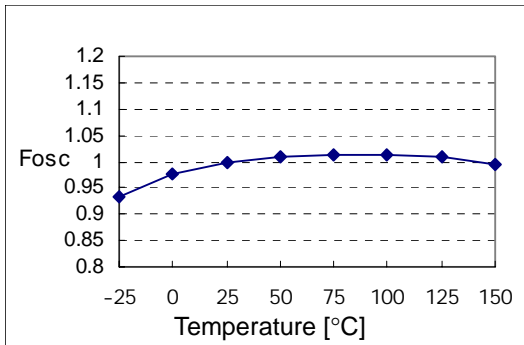


Figure 1. Operating Frequency

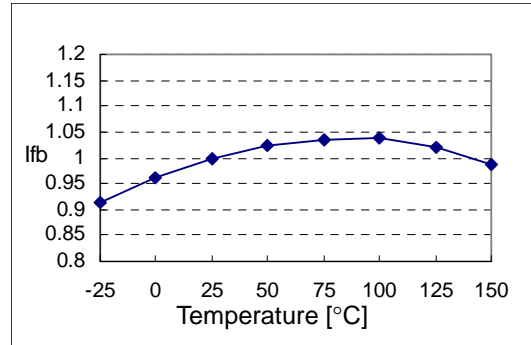


Figure 2. Feedback Source Current

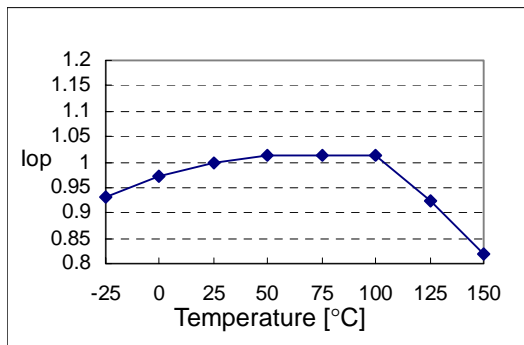


Figure 3. Operating Supply Current

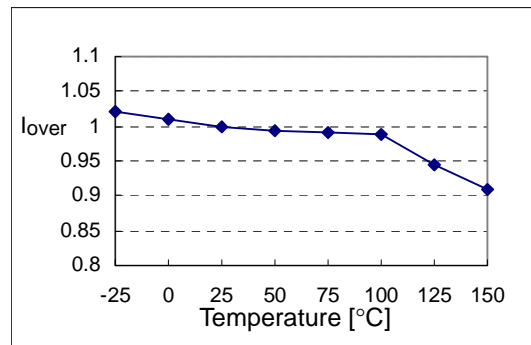


Figure 4. Peak Current Limit

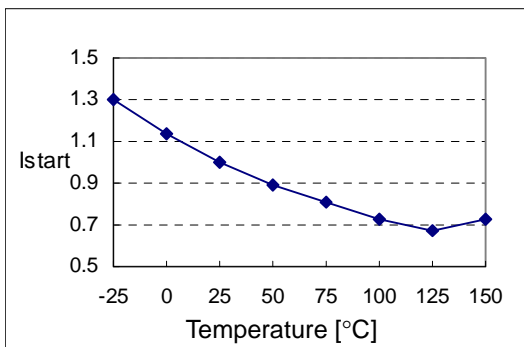


Figure 5. Start up Current

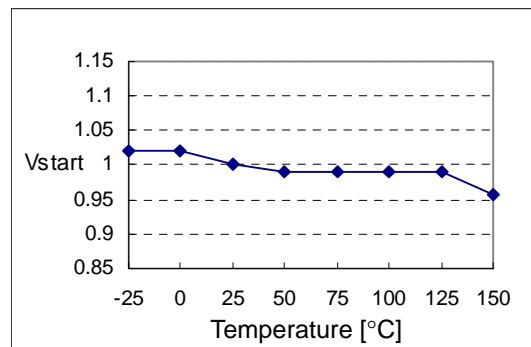


Figure 6. Start Threshold Voltage

## Typical Performance Characteristics (Continued)

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

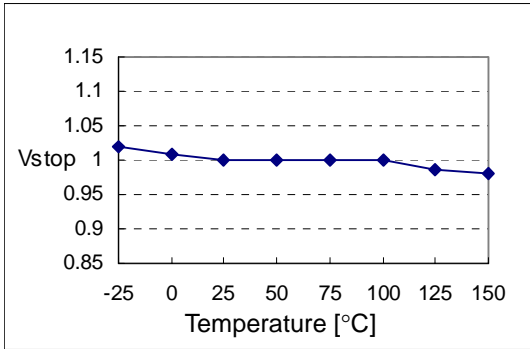


Figure 7. Stop Threshold Voltage

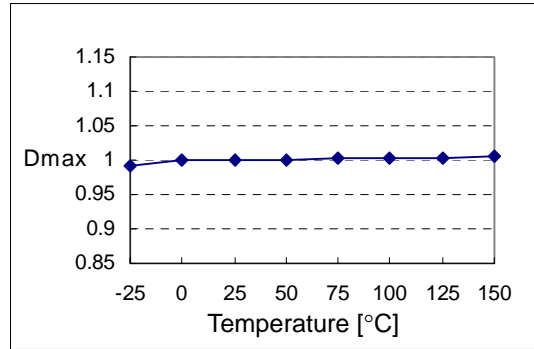


Figure 8. Maximum Duty Cycle

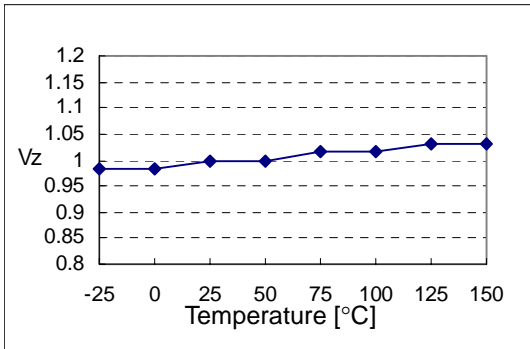


Figure 9. VCC Zener Voltage

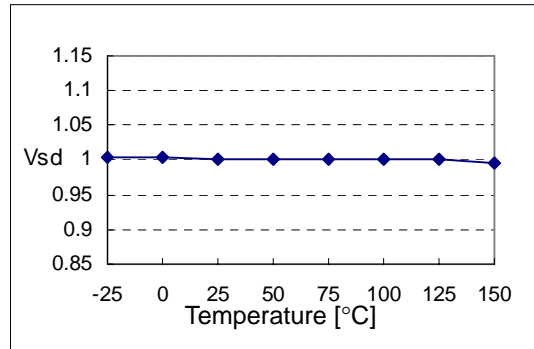


Figure 10. Shutdown Feedback Voltage

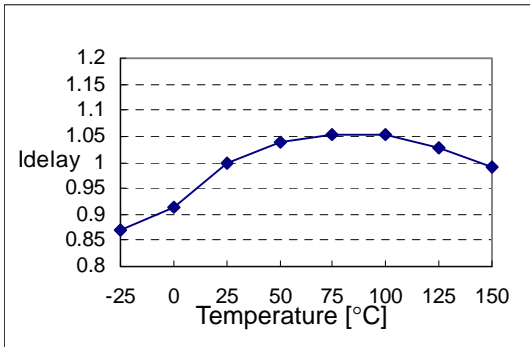


Figure 11. Shutdown Delay Current

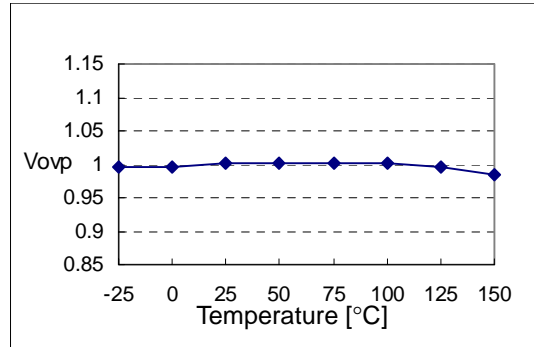


Figure 12. Over Voltage Protection

## Typical Performance Characteristics (Continued)

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

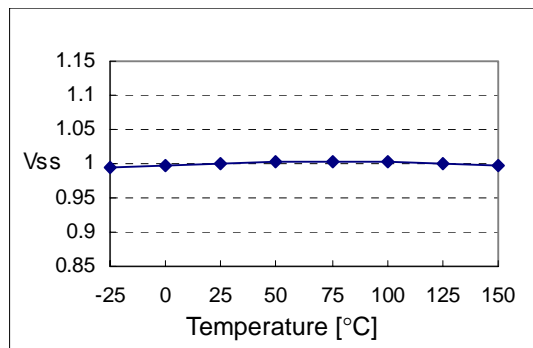


Figure 13. Soft Start Voltage

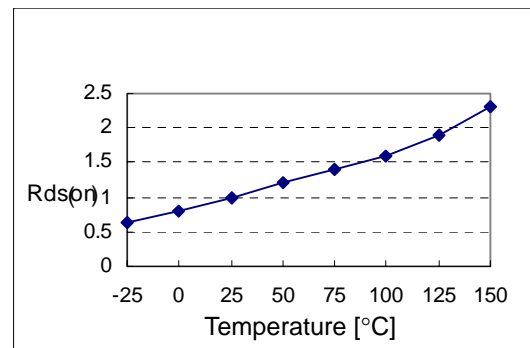
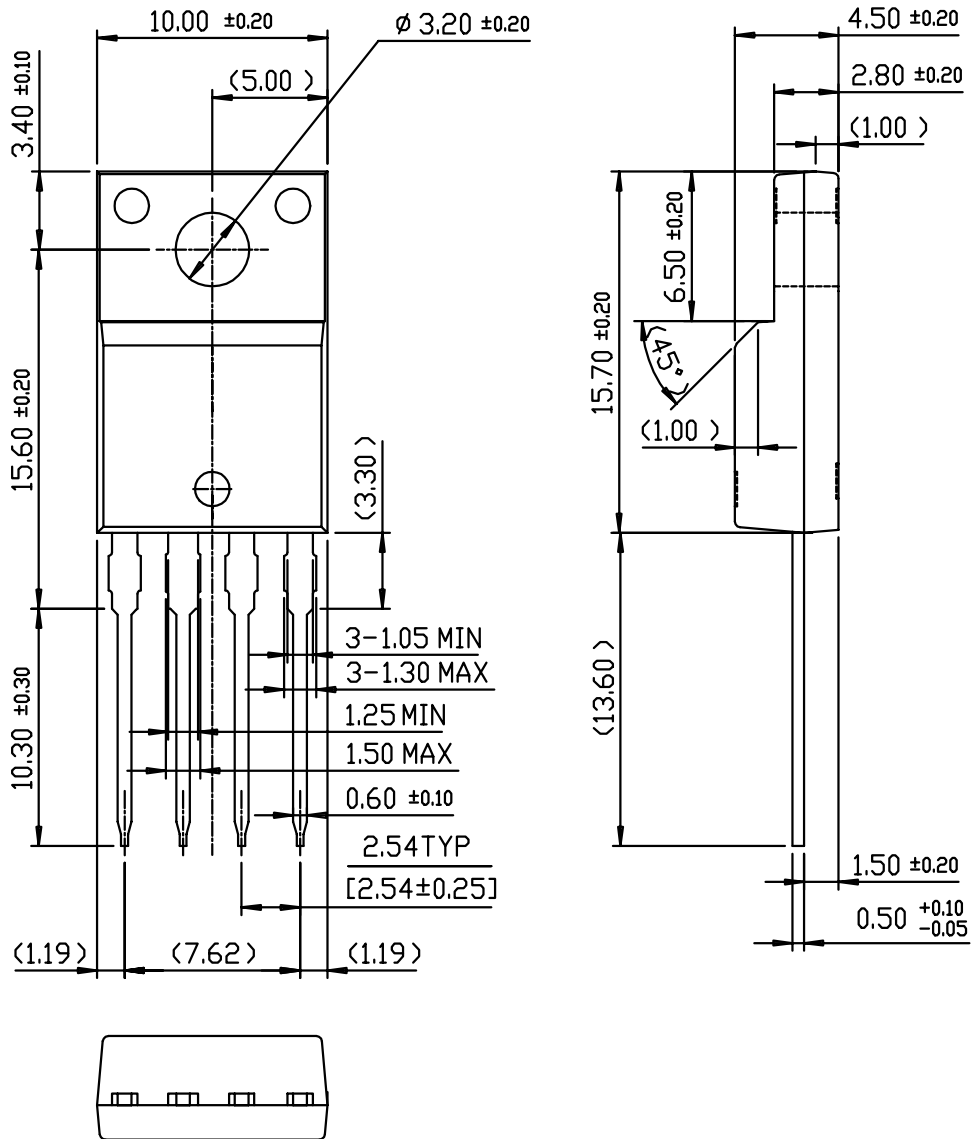


Figure 14. Static Drain-Source on Resistance



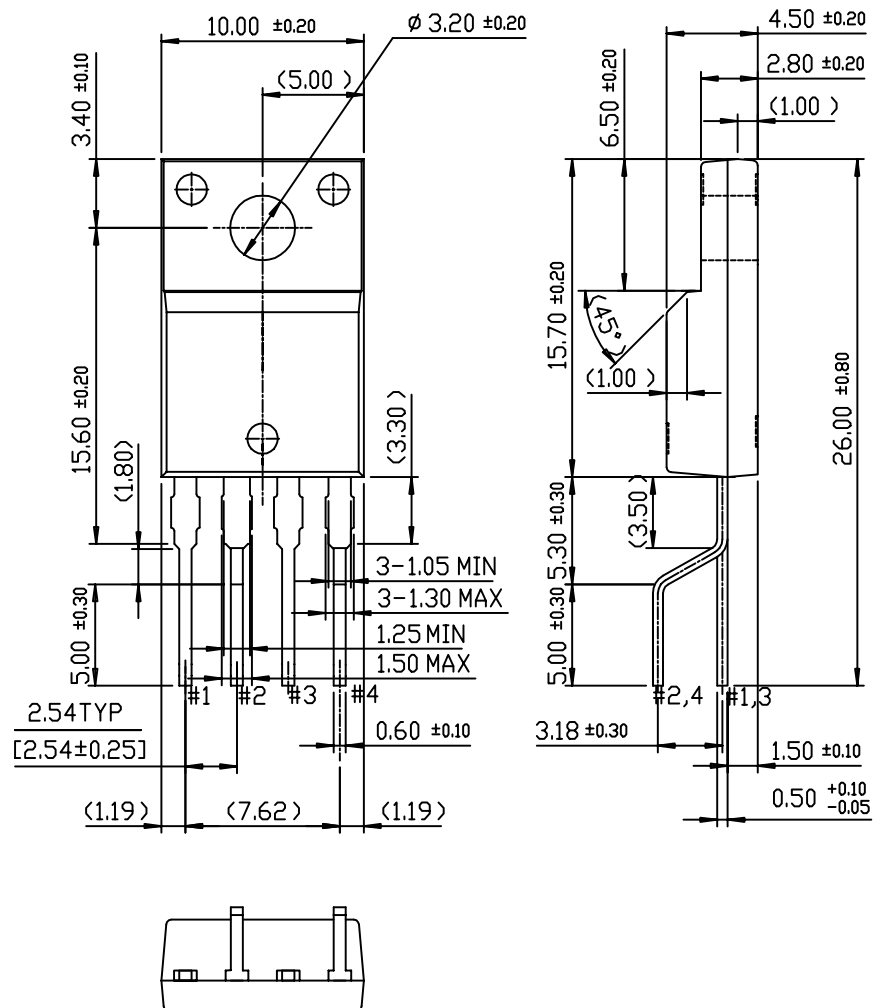
Package Dimensions

TO-220F-4L



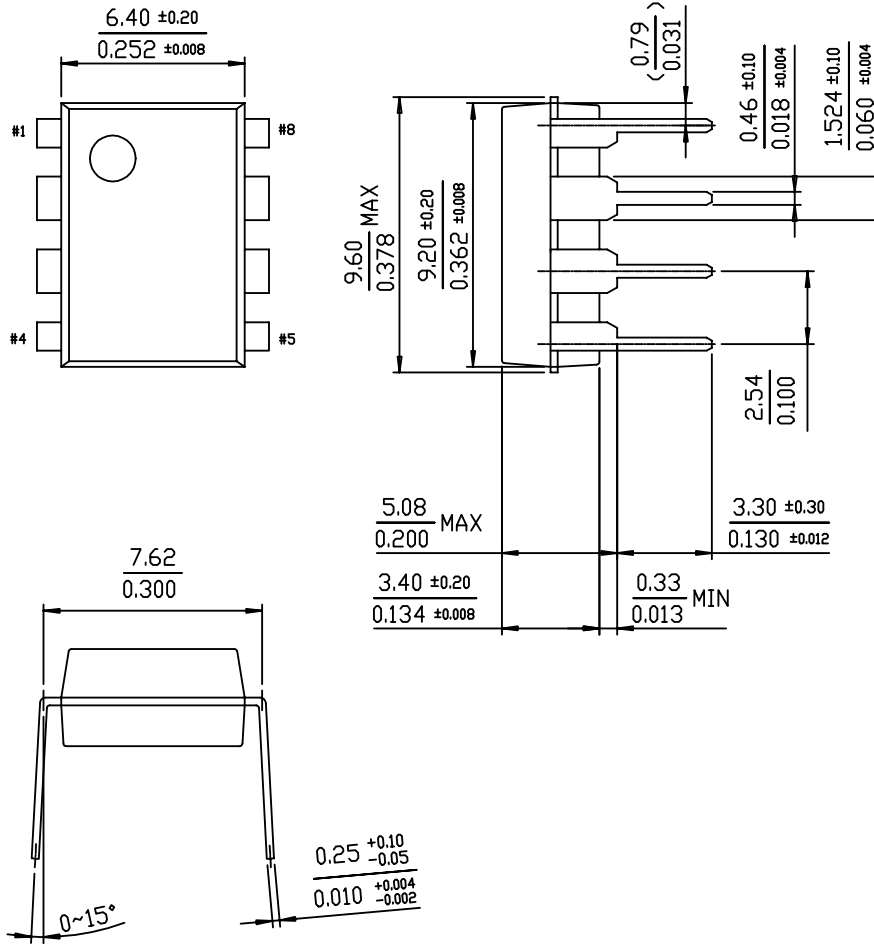
## Package Dimensions (Continued)

## TO-220F-4L(Forming)



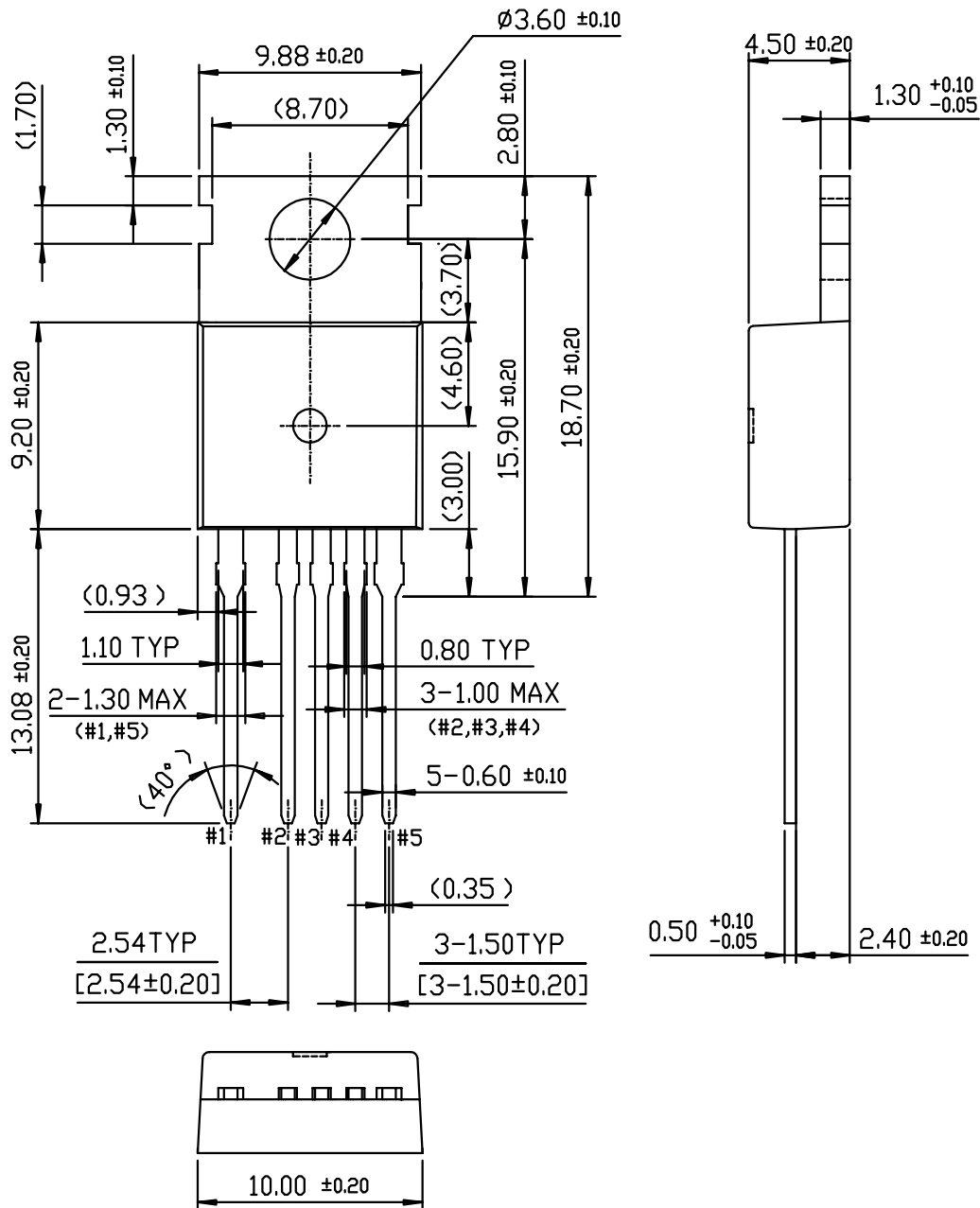
Package Dimensions (Continued)

8-DIP



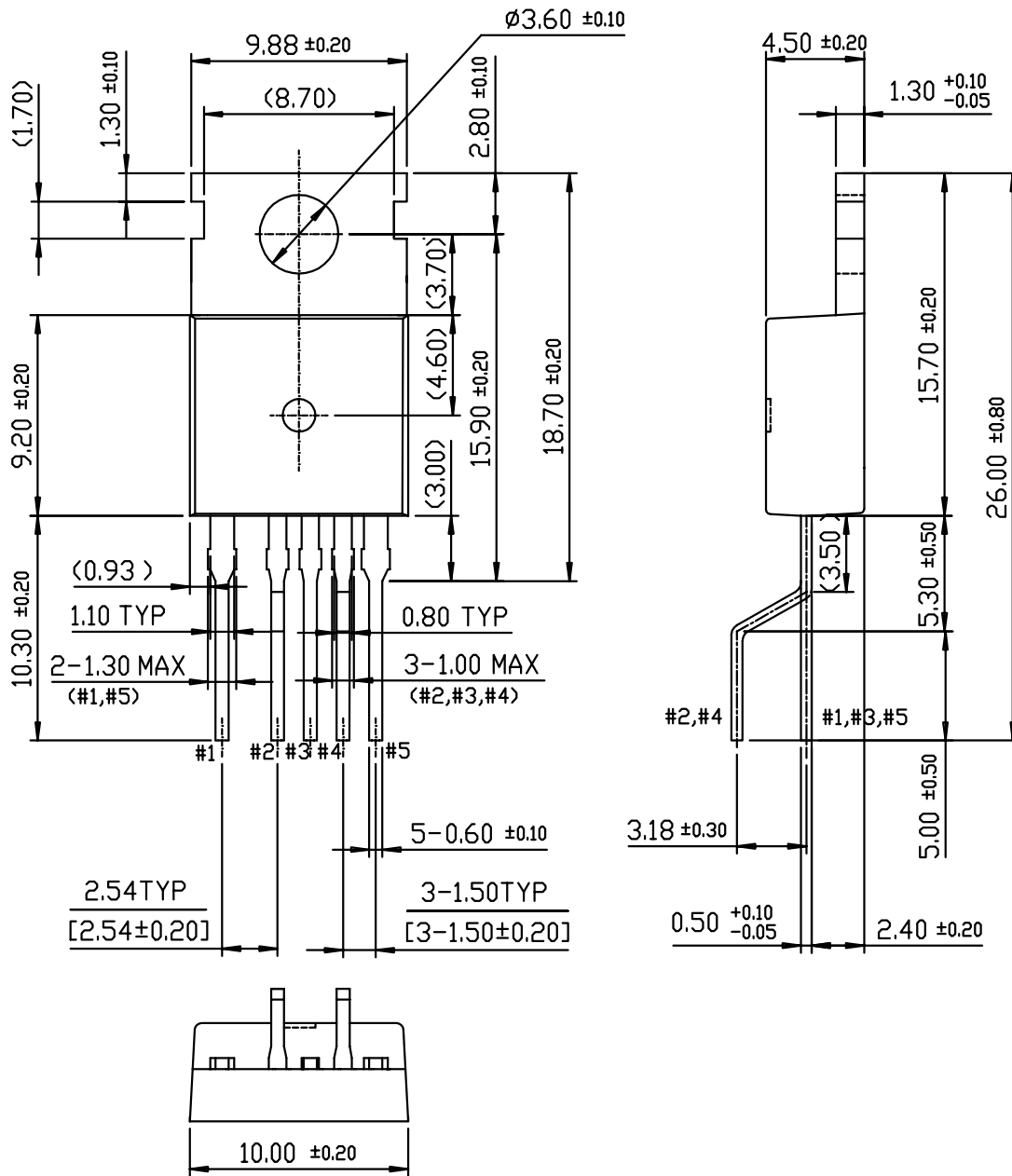
Package Dimensions (Continued)

TO-220-5L



Package Dimensions (Continued)

TO-220-5L(Forming)



## Ordering Information

Product Number	Package	Marking Code	BVDSS	FOSC	RDS(on)
KA5H0265RCTU	TO-220-5L	5H0265RC	650V	100kHz	5Ω
KA5H0265RCYDTU	TO-220-5L(Forming)				
KA5M0265RTU	TO-220F-4L	5M0265R	650V	67kHz	5Ω
KA5M0265RYDTU	TO-220F-4L(Forming)				
KA5L0265RTU	TO-220F-4L	5L0265R	650V	50kHz	5Ω
KA5L0265RYDTU	TO-220F-4L(Forming)				
Product Number	Package	Marking Code	BVDSS	FOSC	RDS(on)
KA5H0280RTU	TO-220F-4L	5H0280R	800V	100kHz	5.6Ω
KA5H0280RYDTU	TO-220F-4L(Forming)				
KA5M0280RTU	TO-220F-4L	5M0280R	800V	67kHz	5.6Ω
KA5M0280RYDTU	TO-220F-4L(Forming)				
Product Number	Package	Marking Code	BVDSS	FOSC	RDS(on)
KA5H02659RN	8-DIP	5H02659R	650V	100kHz	5Ω
KA5M02659RN	8-DIP	5M02659R	650V	67kHz	5Ω

TU : Non Forming Type

YDTU : Forming Type

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