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ON Semiconductor®

# KA5x02xx-SERIES

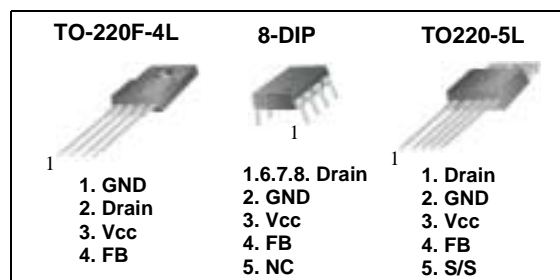
KA5H0265RC, KA5M0265R, KA5L0265R,  
KA5H02659RN/KA5M02659RN, KA5H0280R,  
KA5M0280R  
Power Switch

## Features

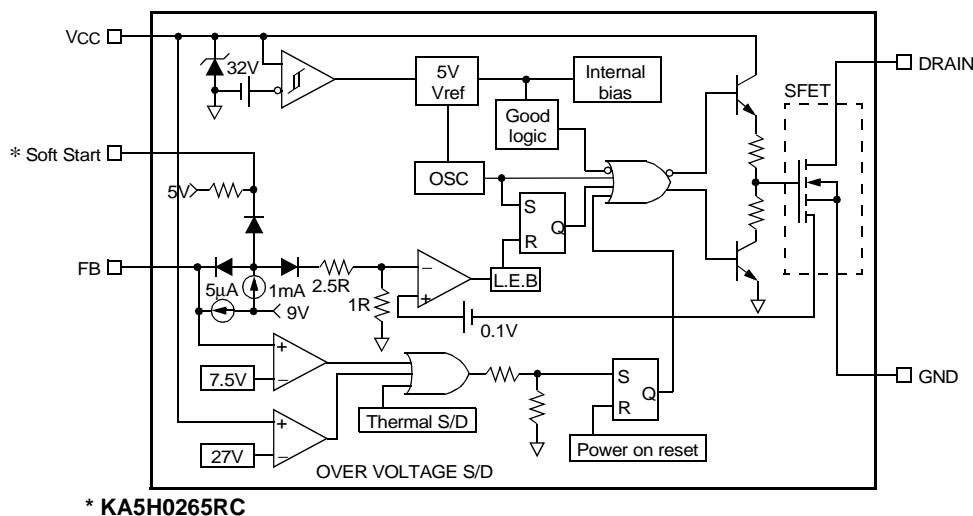
- Precision Fixed Operating Frequency (100/67/50kHz)
- Low Start-up Current (Typ. 100uA)
- Pulse by Pulse Current Limiting
- Over Load Protection
- Over Voltage Protection (Min. 25V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode

## 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 (RGS=1MΩ)	VDGR	650	V
Gate-Source (GND) Voltage	VGS	±30	V
Drain Current Pulsed <sup>(1)</sup>	IDM	8.0	ADC
Continuous Drain Current (TC=25°C)	ID	2.0	ADC
Continuous Drain Current (TC=100°C)	ID	1.3	ADC
Single Pulsed Avalanche Energy <sup>(2)</sup>	EAS	68	mJ
Maximum Supply Voltage	VCC,MAX	30	V
Analog Input Voltage Range	VFB	-0.3 to VSD	V
Total Power Dissipation	PD	42	W
	Darting	0.33	W/°C
Operating Junction Temperature.	TJ	+160	°C
Operating Ambient Temperature.	TA	-25 to +85	°C
Storage Temperature Range.	TSTG	-55 to +150	°C
<b>KA5x0280R</b>			
Drain-Gate Voltage (RGS=1MΩ)	VDGR	800	V
Gate-Source (GND) Voltage	VGS	±30	V
Drain Current Pulsed <sup>(1)</sup>	IDM	8.0	ADC
Continuous Drain Current (TC=25°C)	ID	2.0	ADC
Continuous Drain Current (TC=100°C)	ID	1.3	ADC
Single Pulsed Avalanche Energy <sup>(2)</sup>	EAS	90	mJ
Maximum Supply Voltage	VCC,MAX	30	V
Analog Input Voltage Range	VFB	-0.3 to VSD	V
Total Power Dissipation	PD	35	W
	Darting	0.28	W/°C
Operating Junction Temperature.	TJ	+160	°C
Operating Ambient Temperature.	TA	-25 to +85	°C
Storage Temperature Range.	TSTG	-55 to +150	°C

**Note:**

1. Repetitive rating: Pulse width limited by maximum junction temperature

2. L = 51mH, starting TJ = 25°C

## Electrical Characteristics (SFET Part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
KA5x0265xRx						
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	-	5.0	6.0	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	-	550	-	pF
Output Capacitance	Coss		-	38	-	
Reverse Transfer Capacitance	Crss		-	17	-	
Turn on Delay Time	td(on)	VDD=0.5B VDSS, ID=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	VGS=10V, ID=1.0A, VDS=0.5B VDSS (MOSFET switching time is essentially independent of operating temperature)	-	-	35	nC
Gate-Source Charge	Qgs		-	3	-	
Gate-Drain (Miller) Charge	Qgd		-	12	-	
KA5x0280R						
Drain-Source Breakdown Voltage	BVDSS	VGS=0V, ID=50μA	800	-	-	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	-	5.6	7.0	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	-	250	-	pF
Output Capacitance	Coss		-	52	-	
Reverse Transfer Capacitance	Crss		-	25	-	
Turn on Delay Time	td(on)	VDD=0.5B VDSS, ID=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	VGS=10V, ID=1.0A, VDS=0.5B VDSS (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
UVLO SECTION						
Start Threshold Voltage	VSTART	VFB=GND	14	15	16	V
Stop Threshold Voltage	VSTOP	VFB=GND	8.2	8.8	9.4	V
OSCILLATOR SECTION						
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>	ΔF/ΔT	-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	%
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
SOFT START SECTION						
Soft Start Voltage	VSS	KA5H0265RC	4.7	5.0	5.3	V
Soft Start Current	ISS		0.8	1.0	1.2	mA
REFERENCE SECTION						
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
CURRENT LIMIT(SELF-PROTECTION)SECTION						
Peak Current Limit	IOVER	KA5x02659RN	0.79	0.9	1.01	A
Peak Current Limit	IOVER	KA5x0265Rx KA5x0280R	1.05	1.2	1.34	A
PROTECTION SECTION						
Over Voltage Protection	VOVP	VCC ≥ 24V	25	27	29	V
Thermal Shutdown Temperature <sup>(1)</sup>	TSD	-	140	160	-	°C
TOTAL DEVICE SECTION						
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  $T_a=25^{\circ}\text{C}$ )

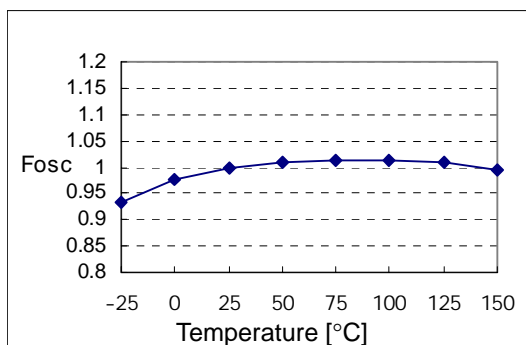


Figure 1. Operating Frequency

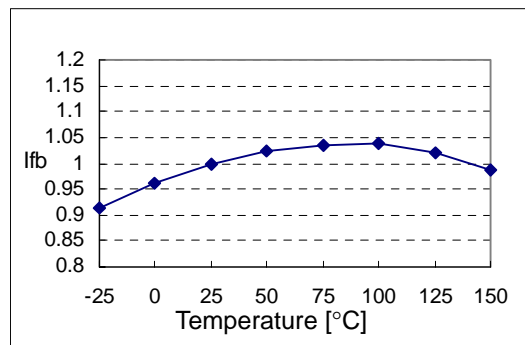


Figure 2. Feedback Source Current

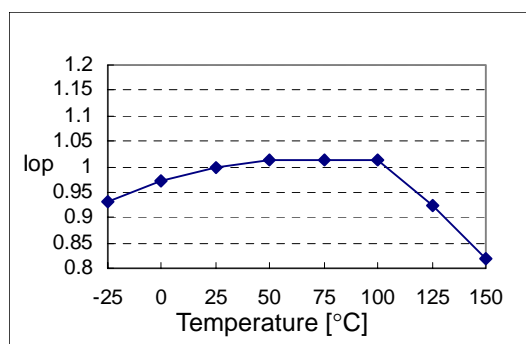


Figure 3. Operating Supply Current

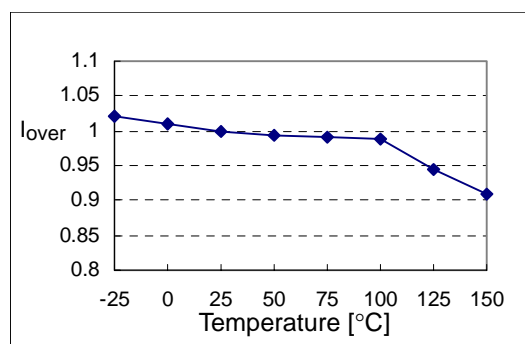


Figure 4. Peak Current Limit

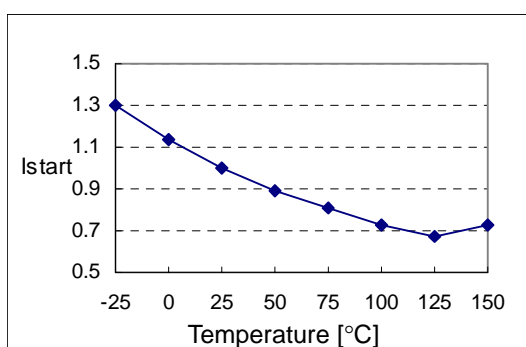


Figure 5. Start up Current

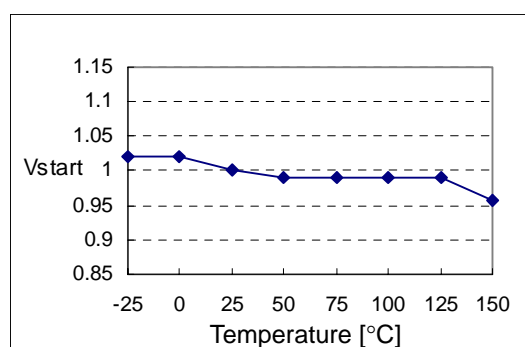


Figure 6. Start Threshold Voltage

## Typical Performance Characteristics (Continued)

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

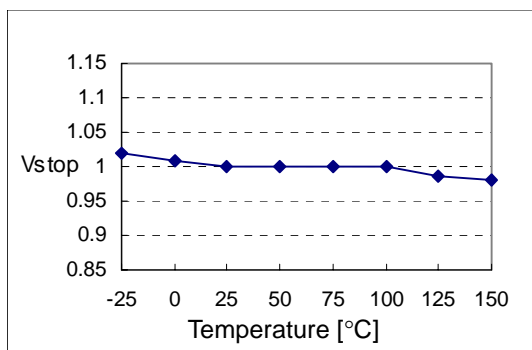


Figure 7. Stop Threshold Voltage

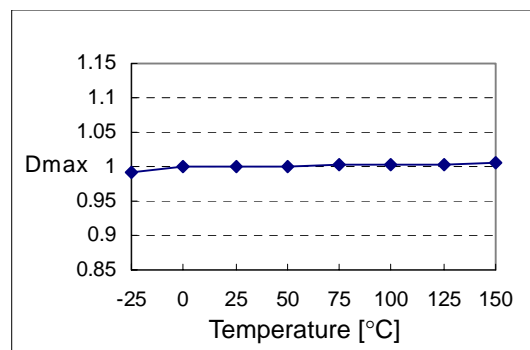


Figure 8. Maximum Duty Cycle

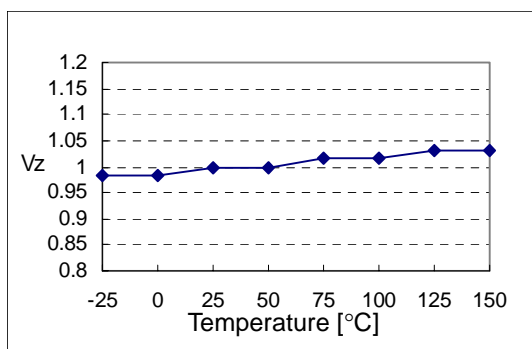


Figure 9. VCC Zener Voltage

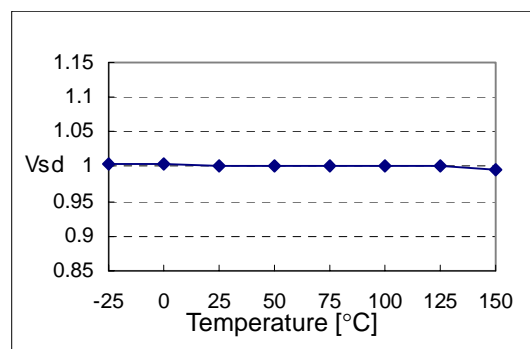


Figure 10. Shutdown Feedback Voltage

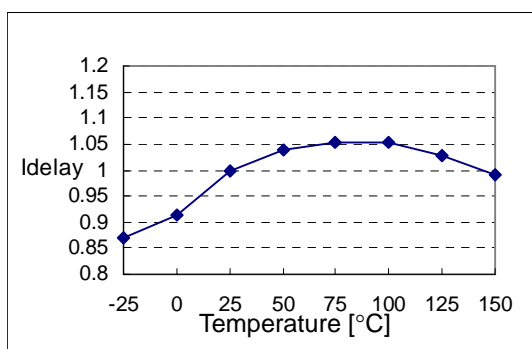


Figure 11. Shutdown Delay Current

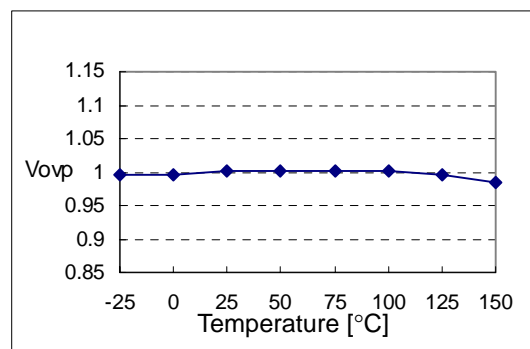


Figure 12. Over Voltage Protection

## Typical Performance Characteristics (Continued)

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

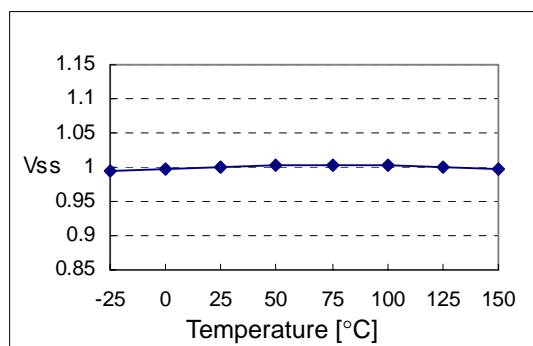


Figure13. Soft Start Voltage

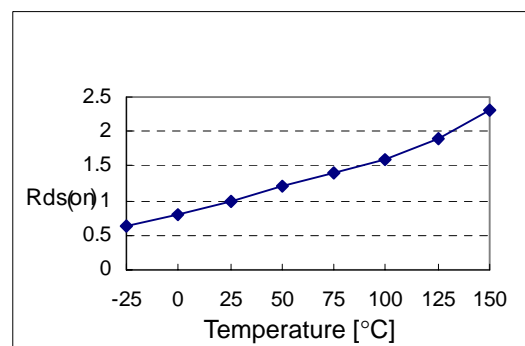
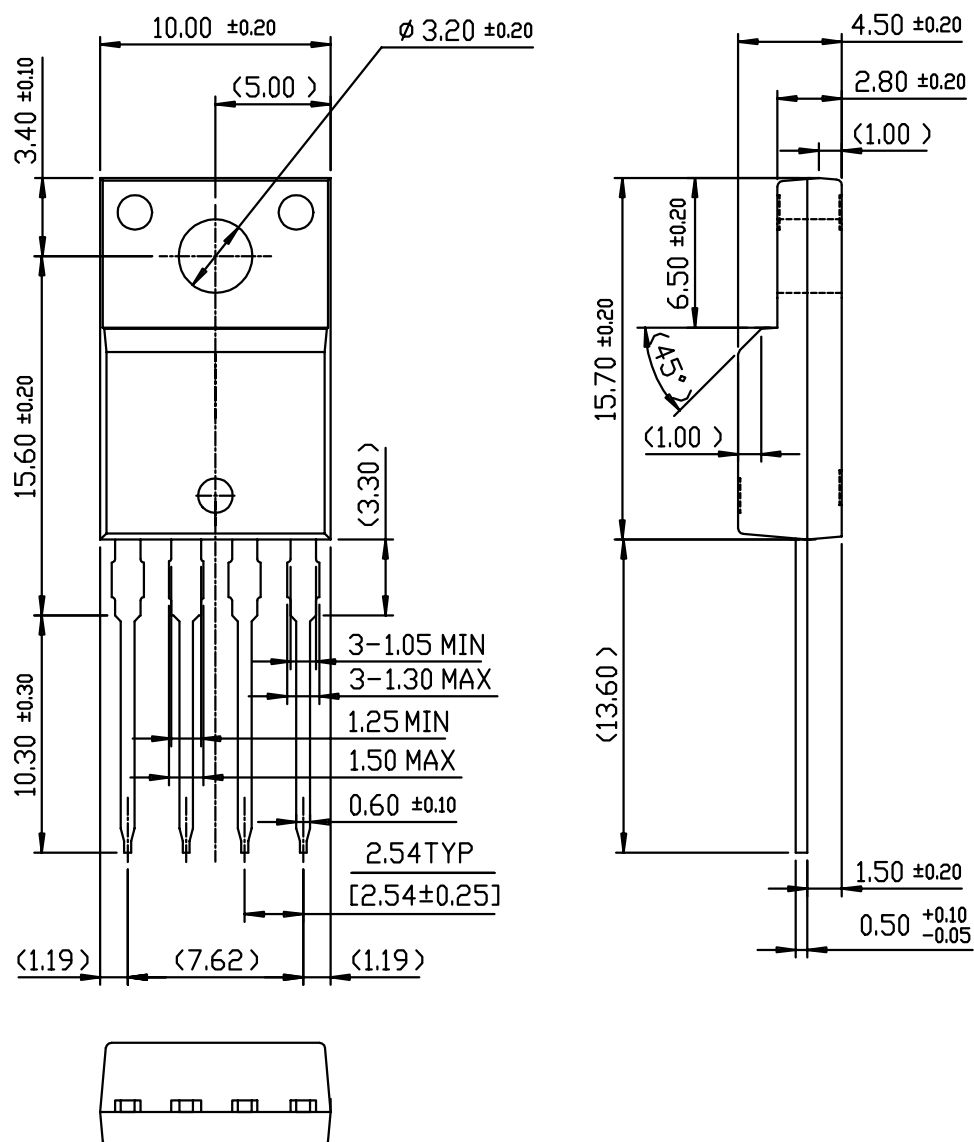


Figure 14. Static Drain-Source on Resistance



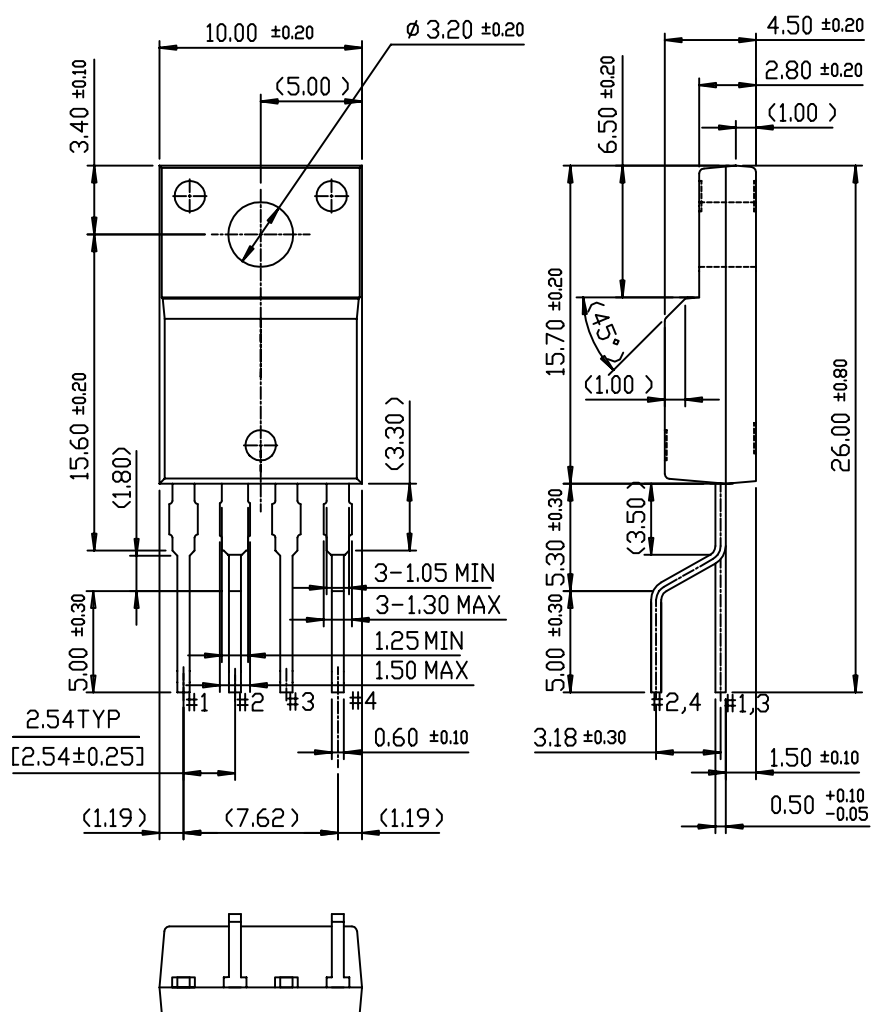
## Package Dimensions

## TO-220F-4L



# Package Dimensions (Continued)

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



The technical drawing illustrates a connector assembly with the following dimensions:

- Top View:**
  - Overall width:  $\frac{6.40 \pm 0.20}{0.252 \pm 0.008}$
  - Pin positions labeled #1, #8, #4, and #5.
- Side View:**
  - Total height:  $\frac{9.60}{0.378} \text{ MAX}$
  - Height from base to pin centerline:  $\frac{9.20 \pm 0.20}{0.362 \pm 0.008}$
  - Pin diameter:  $\frac{0.79}{0.031}$
  - Pin length:  $\frac{0.46 \pm 0.10}{0.018 \pm 0.004}$
  - Pin thickness at base:  $\frac{1.524 \pm 0.10}{0.060 \pm 0.004}$
- Front Elevation:**
  - Overall width:  $\frac{7.62}{0.300}$
  - Pin pitch:  $\frac{5.08}{0.200} \text{ MAX}$
  - Pin length:  $\frac{3.40 \pm 0.20}{0.134 \pm 0.008}$
  - Pin diameter:  $\frac{0.33}{0.013} \text{ MIN}$
  - Pin thickness at base:  $\frac{3.30 \pm 0.30}{0.130 \pm 0.012}$
  - Base thickness:  $\frac{2.54}{0.100}$
  - Bottom flange width:  $\frac{0.25^{+0.10}_{-0.05}}{0.010^{+0.004}_{-0.002}}$
  - Flange angle:  $0\sim 15^\circ$

Technical drawing of a connector showing front, side, and top views with dimensions in millimeters.

**Front View Dimensions:**

- Overall width:  $9.88 \pm 0.20$
- Internal width:  $(8.70)$
- Top flange width:  $1.30 \pm 0.10$
- Top flange height:  $(1.70)$
- Central hole diameter:  $\varnothing 3.60 \pm 0.10$
- Distance from top flange to center of main body:  $2.80 \pm 0.10$
- Main body height:  $15.90 \pm 0.20$
- Distance from top of main body to bottom of pin array:  $(3.70)$
- Pin array height:  $(4.60)$
- Pin array width:  $(3.00)$
- Overall height:  $18.70 \pm 0.20$
- Pin array pitch:  $1.10$  TYP
- Pin array width:  $2-1.30$  MAX (#1, #5)
- Pin array height:  $13.08 \pm 0.20$
- Pin array angle:  $(40^\circ)$
- Pin array width:  $(0.93)$
- Pin array height:  $0.80$  TYP
- Pin array width:  $3-1.00$  MAX (#2, #3, #4)
- Pin array height:  $5-0.60 \pm 0.10$
- Pin array width:  $(0.35)$
- Pin array height:  $2.54$  TYP
- Pin array width:  $[2.54 \pm 0.20]$
- Pin array height:  $3-1.50$  TYP
- Pin array width:  $[3-1.50 \pm 0.20]$

**Side View Dimensions:**

- Overall width:  $4.50 \pm 0.20$
- Internal width:  $1.30^{+0.10}_{-0.05}$
- Pin array width:  $0.50^{+0.10}_{-0.05}$
- Pin array height:  $2.40 \pm 0.20$

**Top View Dimensions:**

- Overall width:  $10.00 \pm 0.20$

[illegible]

## 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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