

# KA5Q-SERIES

KA5Q0765RT/KA5Q12656RT/KA5Q1265RF/

KA5Q1565RF

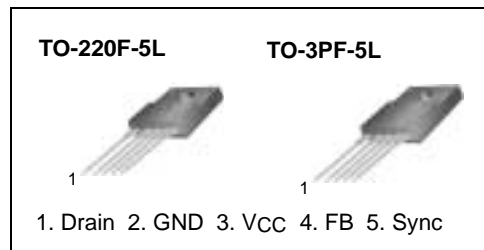
## Fairchild Power Switch(FPS)

### Features

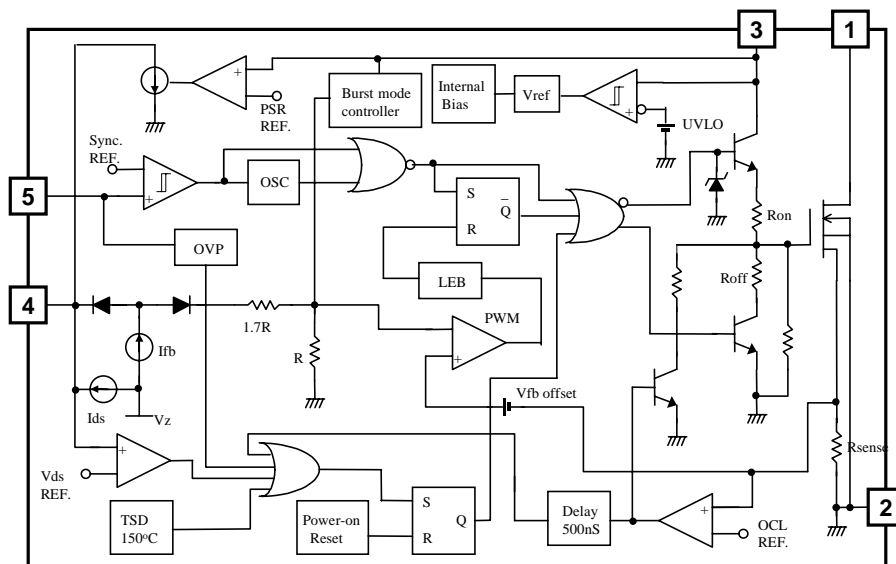
- Quasi Resonant Converter Controller
- Internal Burst mode Controller for Stand-by mode
- Pulse by pulse current limiting
- Over current Latch protection
- Over voltage protection ( $V_{sync}$ : Min. 11V)
- Internal thermal shutdown function
- Under voltage lockout
- Internal high voltage sense FET
- Auto-restart mode

### 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) consist of high voltage power SenseFET and current mode PWM controller IC. 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, temperature compensated precision current sources for loop compensation and fault protection circuit. compared to discrete MOSFET and controller or RCC switching converter solution, a Fairchild Power Switch(FPS) can reduce 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 cost-effective design in quasi resonant converter as C-TV power supply.



### Internal Block Diagram



## Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
<b>KA5Q0765RT</b>			
Drain to PKG Breakdown Voltage	BVPKG	3500	V
Maximum Drain Voltage	VD,MAX	650	V
Drain-Gate Voltage(RGS=1MΩ)	VDGR	650	V
Gate-Source(GND) Voltage	VGS	±30	V
Drain Current Pulsed <sup>(1)</sup>	IDM	28	ADC
Continuous Drain Current (Tc = 25°C)	ID	7.0	ADC
Continuous Drain Current (Tc = 100°C)	ID	5.6	ADC
Single Pulsed Avalanch Current <sup>(3)</sup> (Energy <sup>(2)</sup> )	IAS(EAS)	20(570)	A(mJ)
Maximum Supply Voltage	VCC,MAX	40	V
Input Voltage Range	VFB	-0.3 to VCC	V
	VSynC	-0.3 to 13	V
Total Power Dissipation	PD	47	W
	Derating	1.1	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>KA5Q12656RT</b>			
Drain to PKG Breakdown Voltage	BVPKG	3500	V
Maximum Drain Voltage	VD,MAX	650	V
Drain-Gate Voltage(RGS=1MΩ)	VDGR	650	V
Gate-Source(GND) Voltage	VGS	±30	V
Drain Current Pulsed <sup>(1)</sup>	IDM	48	ADC
Continuous Drain Current (Tc = 25°C)	ID	12	ADC
Continuous Drain Current (Tc = 100°C)	ID	8.4	ADC
Single Pulsed Avalanch Current(Energy <sup>(2)</sup> )	IAS(EAS)	30(950)	A(mJ)
Maximum Supply Voltage	VCC,MAX	40	V
Input Voltage Range	VFB	-0.3 to VCC	V
	VSynC	-0.3 to 13	V
Total Power Dissipation	PD	55	W
	Derating	1.1	W / °C
Operating Junction Temperature.	TJ	+160	°C
Operating Ambient Temperature.	TA	-25 to +85	°C
Storage Temperature Range.	TSTG	-55 to +150	°C

**Absolute Maximum Ratings (Continued)**

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
<b>KA5Q1265RF</b>			
Drain to PKG Breakdown Voltage	BVPKG	3500	V
Maximum Drain Voltage	V <sub>D,MAX</sub>	650	V
Drain-Gate Voltage(RGS=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>	48	ADC
Continuous Drain Current (Tc = 25°C)	I <sub>D</sub>	12	ADC
Continuous Drain Current (Tc = 100°C)	I <sub>D</sub>	8.4	ADC
Single Pulsed Avalanch Current(Energy <sup>(2)</sup> )	I <sub>AS(EAS)</sub>	33(950)	A(mJ)
Maximum Supply Voltage	V <sub>CC,MAX</sub>	40	V
Input Voltage Range	V <sub>FB</sub>	-0.3 to V <sub>CC</sub>	V
	V <sub>Sync</sub>	-0.3 to 13	V
Total Power Dissipation	P <sub>D</sub>	240	W
	Derating	1.92	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>KA5Q1565RF</b>			
Drain to PKG Breakdown Voltage	BVPKG	3500	V
Maximum Drain Voltage	V <sub>D,MAX</sub>	650	V
Drain-Gate Voltage(RGS=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>	60	ADC
Continuous Drain Current (Tc = 25°C)	I <sub>D</sub>	15	ADC
Continuous Drain Current (Tc = 100°C)	I <sub>D</sub>	12.0	ADC
Single Pulsed Avalanch Current(Energy <sup>(2)</sup> )	I <sub>AS(EAS)</sub>	36(1050)	A(mJ)
Maximum Supply Voltage	V <sub>CC,MAX</sub>	40	V
Input Voltage Range	V <sub>FB</sub>	-0.3 to V <sub>CC</sub>	V
	V <sub>Sync</sub>	-0.3 to 13	V
Total Power Dissipation	P <sub>D</sub>	280	W
	Derating	2.22	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 = 10mH, V<sub>DD</sub> =50V, R<sub>G</sub> = 27Ω, starting T<sub>j</sub> = 25°C
3. L = 13uH, starting T<sub>j</sub> = 25°C

**Electrical Characteristics (SFET part)**

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>KA5Q0765RT</b>						
Drain-source breakdown voltage	BVDSS	VGS=0V, ID=50μA	650	-	-	V
Zero gate voltage drain current	IDSS	VDS=Max., Rating, VGS=0V	-	-	200	μA
		VDS=0.8Max., Rating, VGS=0V, TC=85°C	-	-	300	μA
Static drain-source on resistance <sup>(1)</sup>	RDS(on)	VGS=10V, ID=4.0A	-	1.3	1.6	Ω
Forward transconductance <sup>(1)</sup>	gfs	VDS=15V, ID=4.0A	3.0	-	-	S
Input capacitance	Ciss	VGS=0V, VDS=25V, f = 1MHz	-	1110	-	pF
Output capacitance	Coss		-	105	-	
Reverse transfer capacitance	Crss		-	50	-	
Turn on delay time	td(on)	VDD=0.5BVDSS, ID=7.0A (MOSFET switching time are essentially independent of operating temperature)	-	25	-	nS
Rise time	tr		-	55	-	
Turn off delay time	td(off)		-	80	-	
Fall time	tf		-	50	-	
Total gate charge (gate-source+gate-drain)	Qg	VGS=10V, ID=7.0A, VDS=0.5BVDSS(MOSFET Switching time are Essentially independent of Operating temperature)	-	-	57	nC
Gate-source charge	Qgs		-	9.3	-	
Gate-drain (Miller) charge	Qgd		-	29.3	-	
<b>KA5Q12656RT/KA5Q1265RF</b>						
Drain-Source Breakdown Voltage	BVDSS	VGS=0V, ID=50μA	650	-	-	V
Zero Gate Voltage Drain Current	IDSS	VDS=Max., Rating, VGS=0V	-	-	200	μA
		VDS=0.8Max., Rating, VGS=0V, TC=85°C	-	-	300	μA
Static Drain-Source On Resistance <sup>(1)</sup>	RDS(on)	VGS=10V, ID=6A	-	0.7	0.9	Ω
Forward transconductance <sup>(1)</sup>	gfs	VDS=50V, ID=6A	-	-	-	S
Input capacitance	Ciss	VGS=0V, VDS=25V, f = 1MHz	-	1820	-	pF
Output capacitance	Coss		-	185	-	
Reverse transfer capacitance	Crss		-	32	-	
Turn on delay time	td(on)	VDD=0.5BVDSS, ID=12.0A (MOSFET switching time are essentially independent of operating temperature)	-	38	-	nS
Rise time	tr		-	120	-	
Turn off delay time	td(off)		-	200	-	
Fall time	tf		-	100	-	
Total gate charge (gate-source+gate-drain)	Qg	VGS=10V, ID=12.0A, VDS=0.5BVDSS(MOSFET Switching time are Essentially independent of Operating temperature)	-	60	-	nC
Gate-source charge	Qgs		-	10	-	
Gate-drain (Miller) charge	Qgd		-	30	-	

## Absolute Maximum Ratings (SFET PART)

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Test condition	Min.	Typ.	Max.	Unit
<b>KA5Q1565RF</b>						
Drain-source breakdown voltage	BVDSS	VGS=0V, ID=50μA	650	-	-	V
Zero gate voltage drain current	IDSS	VDS=Max., Rating, VGS=0V	-	-	200	μA
		VDS=0.8Max., Rating, VGS=0V, TC=85°C	-	-	300	mA
Static drain-source on resistance <sup>(note)</sup>	RDS(ON)	VGS=10V, ID=7.3A	-	0.5	0.65	W
Forward transconductance <sup>(note)</sup>	gfs	VDS=50V, ID=7.3A	14	-	-	S
Input capacitance	Ciss	VGS=0V, VDS=25V, f=1MHz	-	2580	-	pF
Output capacitance	Coss		-	270	-	
Reverse transfer capacitance	Crss		-	50	-	
Turn on delay time	td(on)	VDD=0.5BVDSS, ID=14.6A (MOSFET switching time are essentially independent of operating temperature)	-	50	-	nS
Rise time	tr		-	155	-	
Turn off delay time	td(off)		-	270	-	
Fall time	tf		-	125	-	
Total gate charge (gate-source+gate-drain)	Qg	VGS=10V, ID=14.6A, VDS=0.8BVDSS (MOSFET switching time are essentially independent of operating temperature)	-	-	90	nC
Gate-source charge	Qgs		-	15	-	
Gate-drain (Miller) charge	Qgd		-	45	-	

**Note:**

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

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

**Electrical Characteristics (Control part)**

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	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	9	10	V
<b>OSCILLATOR SECTION</b>						
Initial Frequency	FOSC	-	18	20	22	kHz
Voltage Stability	FSTABLE	12V ≤ VCC ≤ 23V	0	1	3	%
Temperature Stability (Note2)	ΔFOSC	-25°C ≤ Ta ≤ 85°C	0	±5	±10	%
Maximum Duty Cycle	DMAX	-	92	95	98	%
Minimum Duty Cycle	DMIN	-	-	-	0	%
<b>FEEDBACK SECTION</b>						
Feedback Source Current	IFB	VFB=GND	0.7	0.9	1.1	mA
Shutdown Feedback Voltage	VSD	VFB ≥ 6.9V	6.9	7.5	8.1	V
Shutdown Delay Current	IDELAY	VFB=5V	4	5	6	μA
<b>SYNC. SECTION</b>						
Normal Sync High Threshold Voltage	VNSH	VCC=16V, Vfb=5V	4.0	4.6	5.2	V
Normal Sync Low Threshold Voltage	VNSL	VCC=16V, Vfb=5V	2.3	2.6	2.9	V
Burst Sync High Threshold Voltage	VBSH	VCC=10.5V, Vfb=0V	3.2	3.6	4.0	V
Burst Sync Low Threshold Voltage	VBSL	VCC=10.5V, Vfb=0V	1.1	1.3	1.5	V
<b>BURST MODE SECTION</b>						
Burst Mode Low Threshold Voltage	VBURL	VFB=0V	10.4	11.0	11.6	V
Burst Mode High Threshold Voltage	VBURH	VFB=0V	11.4	12.0	12.6	V
Burst Mode Enable Feedback Voltage	VBEN	VCC=10.5V	0.7	1.0	1.3	V
Burst Mode Peak Current Limit(Note4)	IBURPK	VCC=10.5V, VFB=0V	0.65	0.85	1.1	A
<b>CURRENT LIMIT(SELF-PROTECTION)SECTION</b>						
Peak Current Limit (Note4)	IOVER	KA5Q0765RT	4.40	5.00	5.60	A
		KA5Q12656RT	5.28	6.00	6.72	
		KA5Q1265RF	7.04	8.00	8.96	
		KA5Q1565RF	10.12	11.50	12.88	
<b>PROTECTION SECTION</b>						
Over Voltage Protction	VOVP	VSYNCR ≥ 11V	11	12	13	V
Over Current Latch voltage(Note3)	VOCL	-	0.9	1.0	1.1	V
Thermal Shutdown Tempature(Note2)	TSD	-	140	160	-	°C

## Electrical Characteristics (Control part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>TOTAL DEVICE SECTION</b>						
Start Up Current	ISTART	VFB=GND, VCC=14V	-	0.1	0.2	mA
Operating Supply Current(Note1)	IOP	VFB=GND, VCC=16V	-	10	18	mA
	IOP(MIN)	VFB=GND, VCC=12V				
	IOP(MAX)	VFB=GND, VCC=28V				
<b>PRIMARY SIDE REGULATION SECTION (ONLY KA5Q0765RT/KA5Q12656RT)</b>						
Primary Regulation Threshold Voltage	VPR	I <sub>FB</sub> =700uA, V <sub>FB</sub> =4V	32.0	32.5	33.0	V
Primary Regulation Transconductance	GPR	-	2.0	2.6	-	mA/V

### Note:

1. These parameters is the Current Flowing in the Control IC.
2. These parameters, although guaranteed, are not 100% tested in production
3. These parameters, although guaranteed, are tested in EDS(wafer test) process
4. These parameters are indicated Inductor Current.

## Typical Performance Characteristics

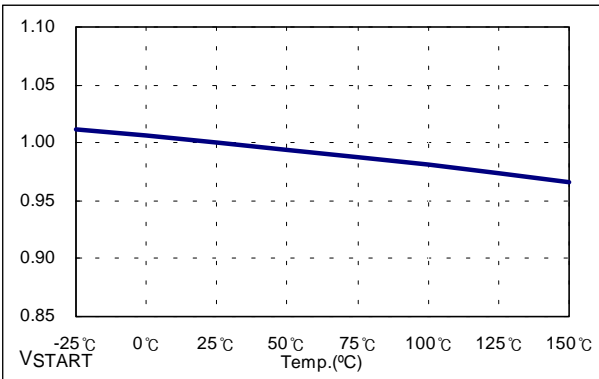


Figure 1. Start Threshold Voltage

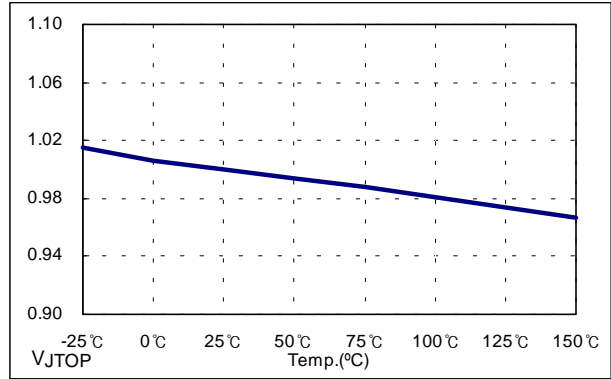


Figure 2. Stop Threshold Voltage

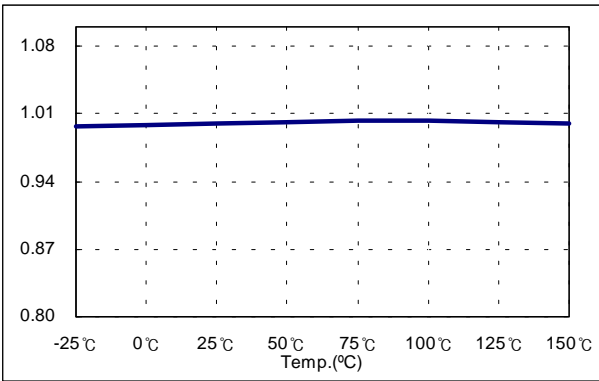


Figure 3. Start Up Current

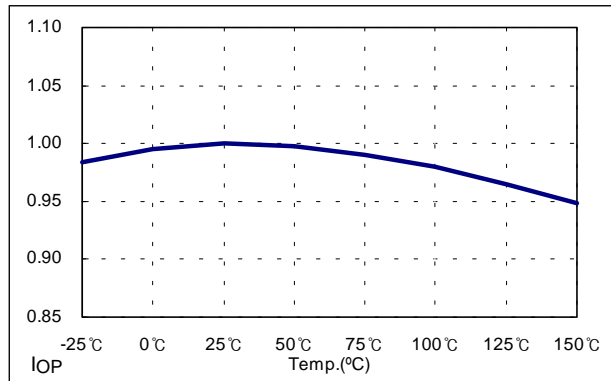


Figure 4. Operating Supply Current

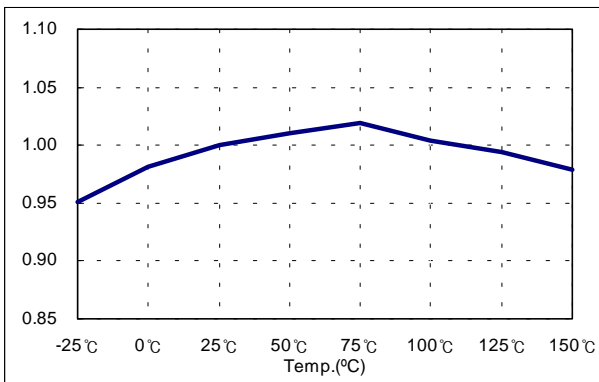


Figure 5. Initial Frequency

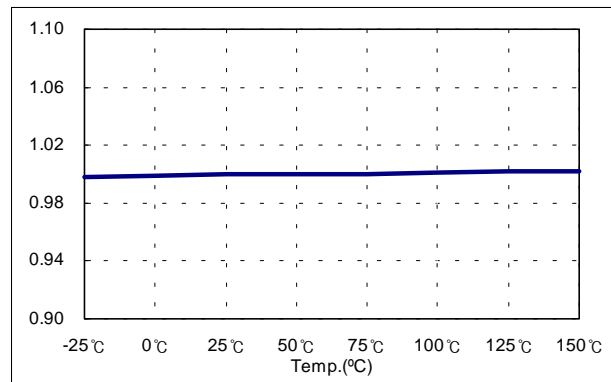


Figure 6. Maximum Duty



## Typical Performance Characteristics (Continued)

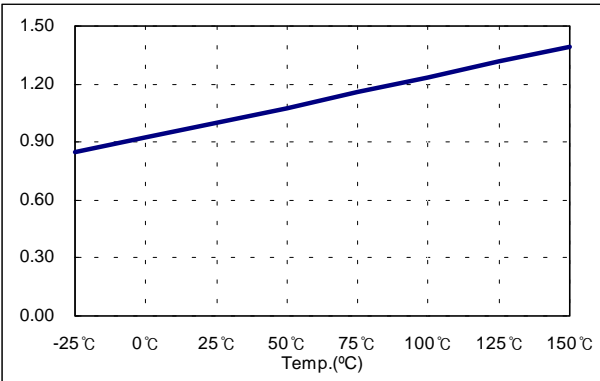


Figure 7. Feedback Offset Voltage

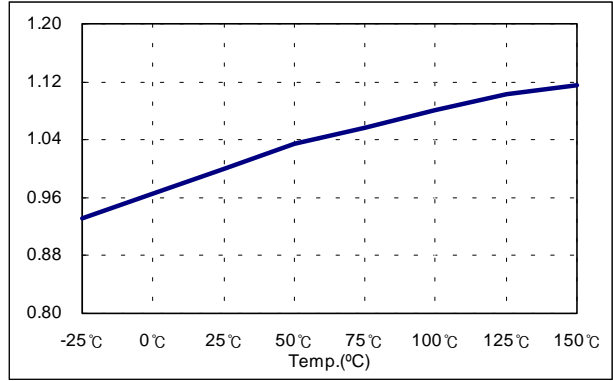


Figure 8. Feedback Source Current

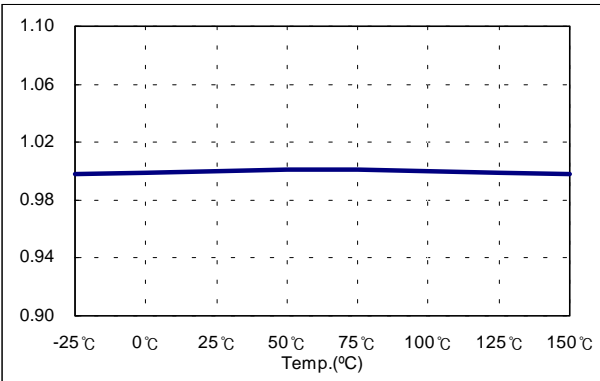


Figure 9. Over Voltage Protection

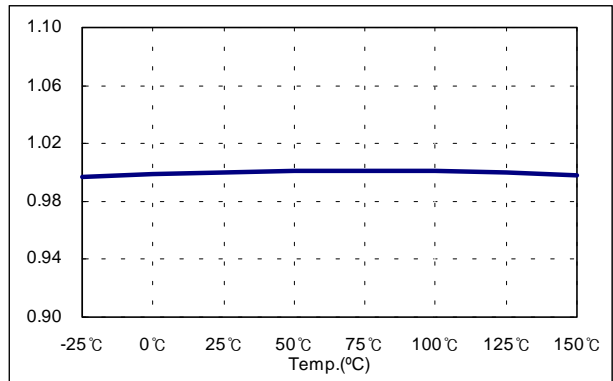


Figure 10. Shutdown Feedback Voltage

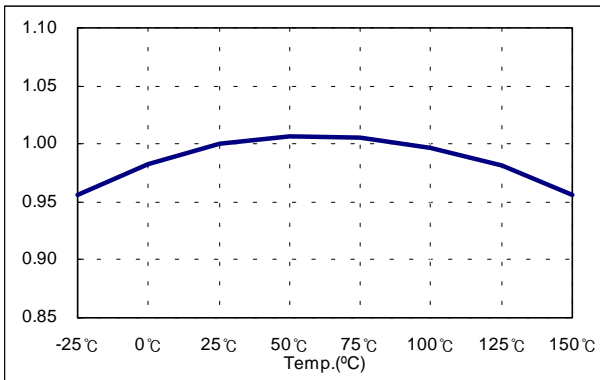


Figure 11. Shutdown Delay Current

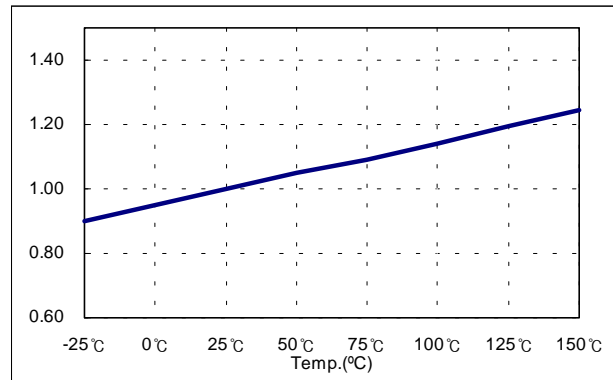


Figure 12. Burst mode Enable Feedback Voltage

## Typical Performance Characteristics (Continued)

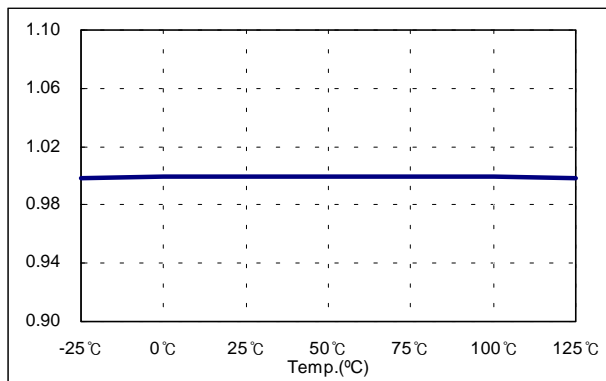


Figure 13. Burst mode Low Threshold Voltage

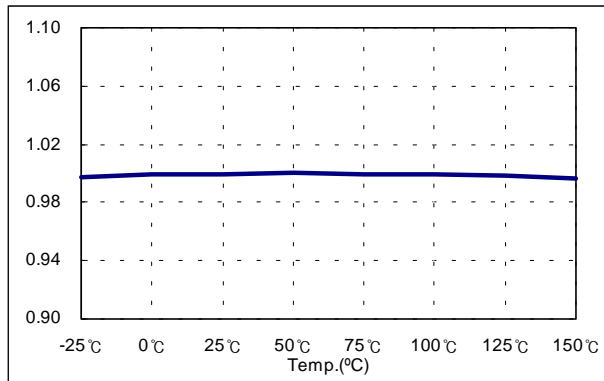


Figure 14. Burst mode High Threshold Voltage

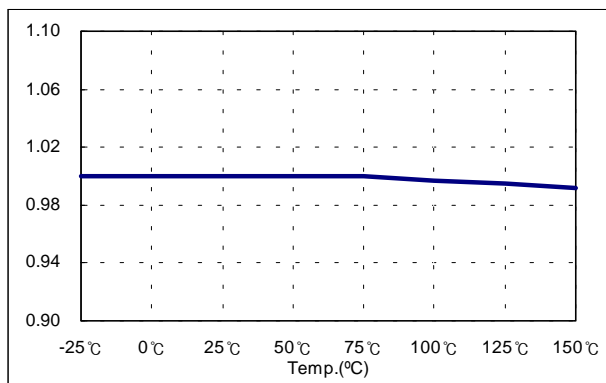


Figure 15. Burst Sync. High Threshold Voltage

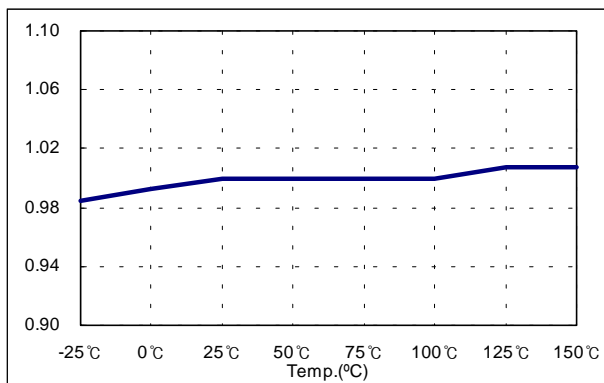


Figure 16. Burst Sync. Low Threshold Voltage

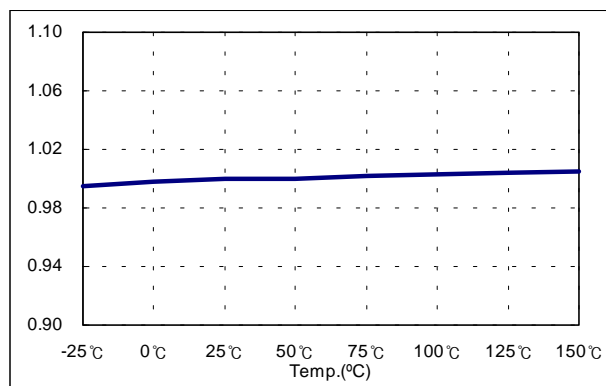


Figure 17. Primary Regulation Threshold Voltage

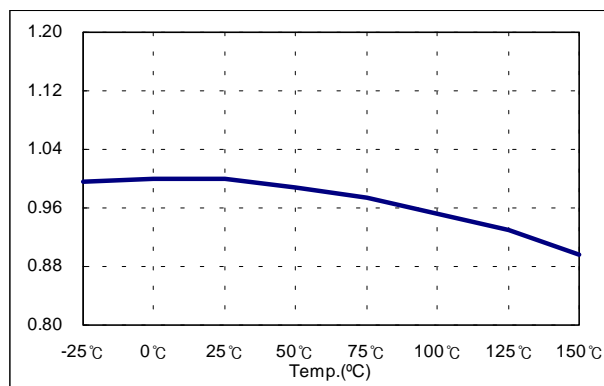


Figure 18. Primary Regulation Transconductance

## Typical Performance Characteristics (Continued)

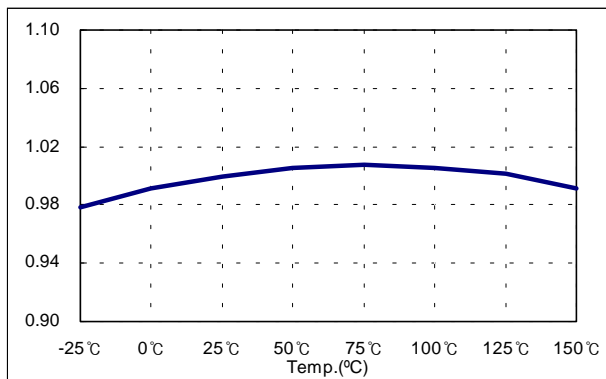


Figure 19. Peak Current Limit

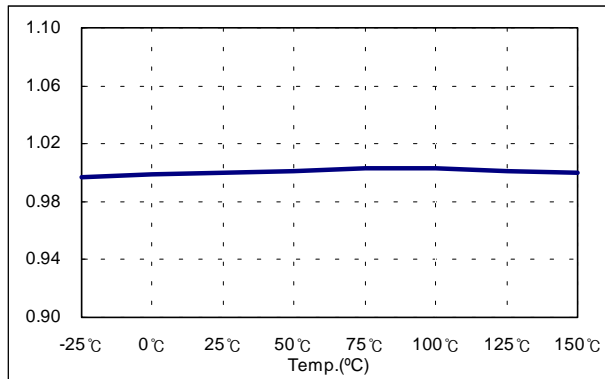


Figure 20. Burst mode Peak Current Limit

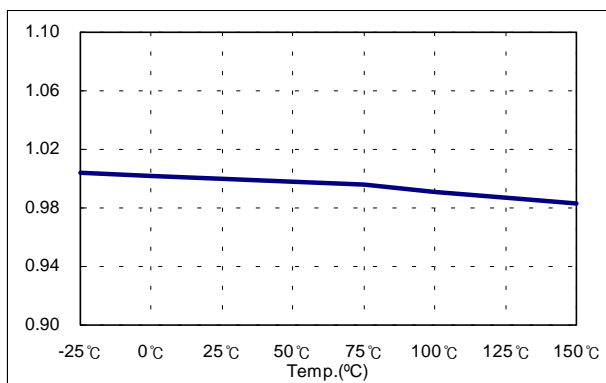


Figure 21. Normal Sync. High Threshold Voltage

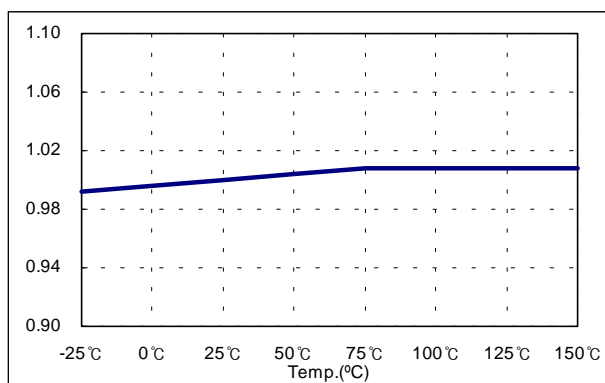
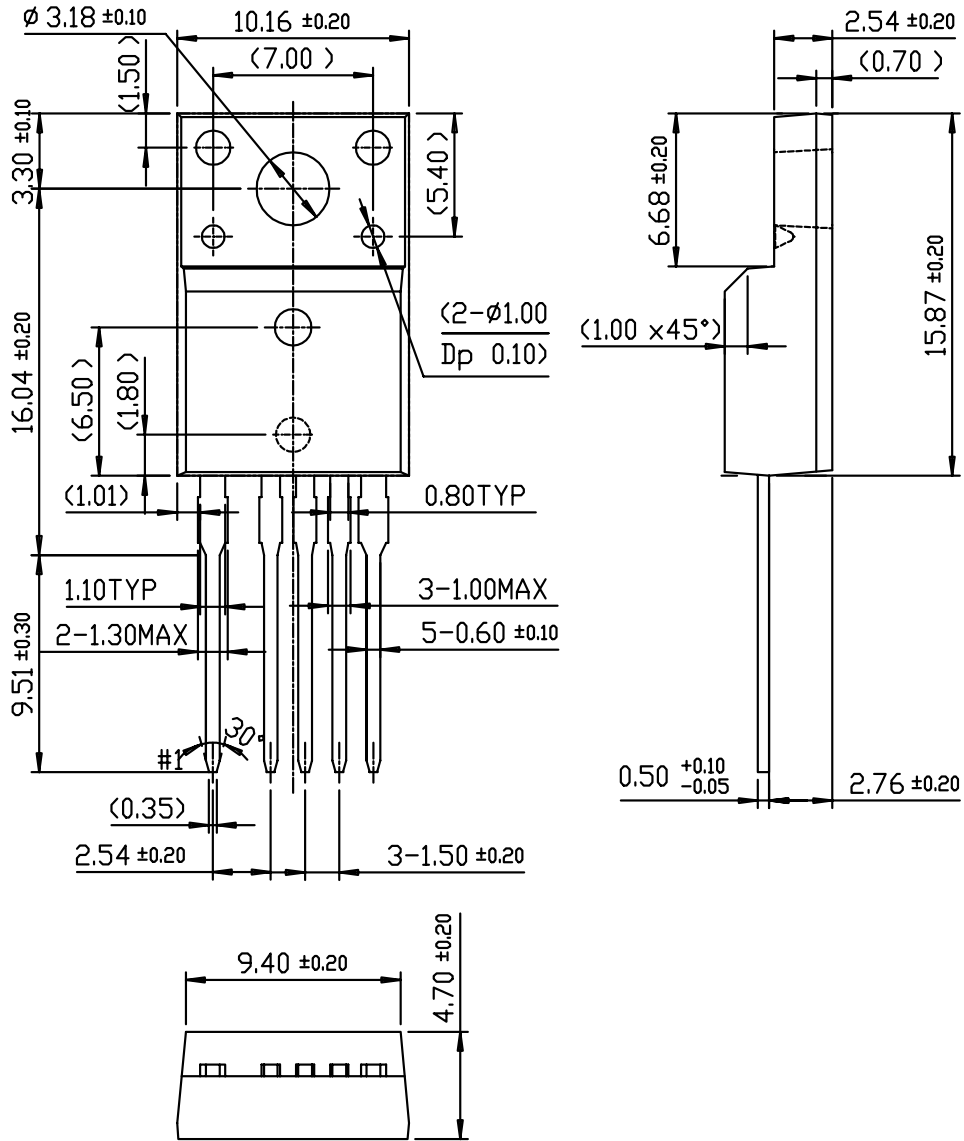


Figure 22. Normal Sync. Low Threshold Voltage

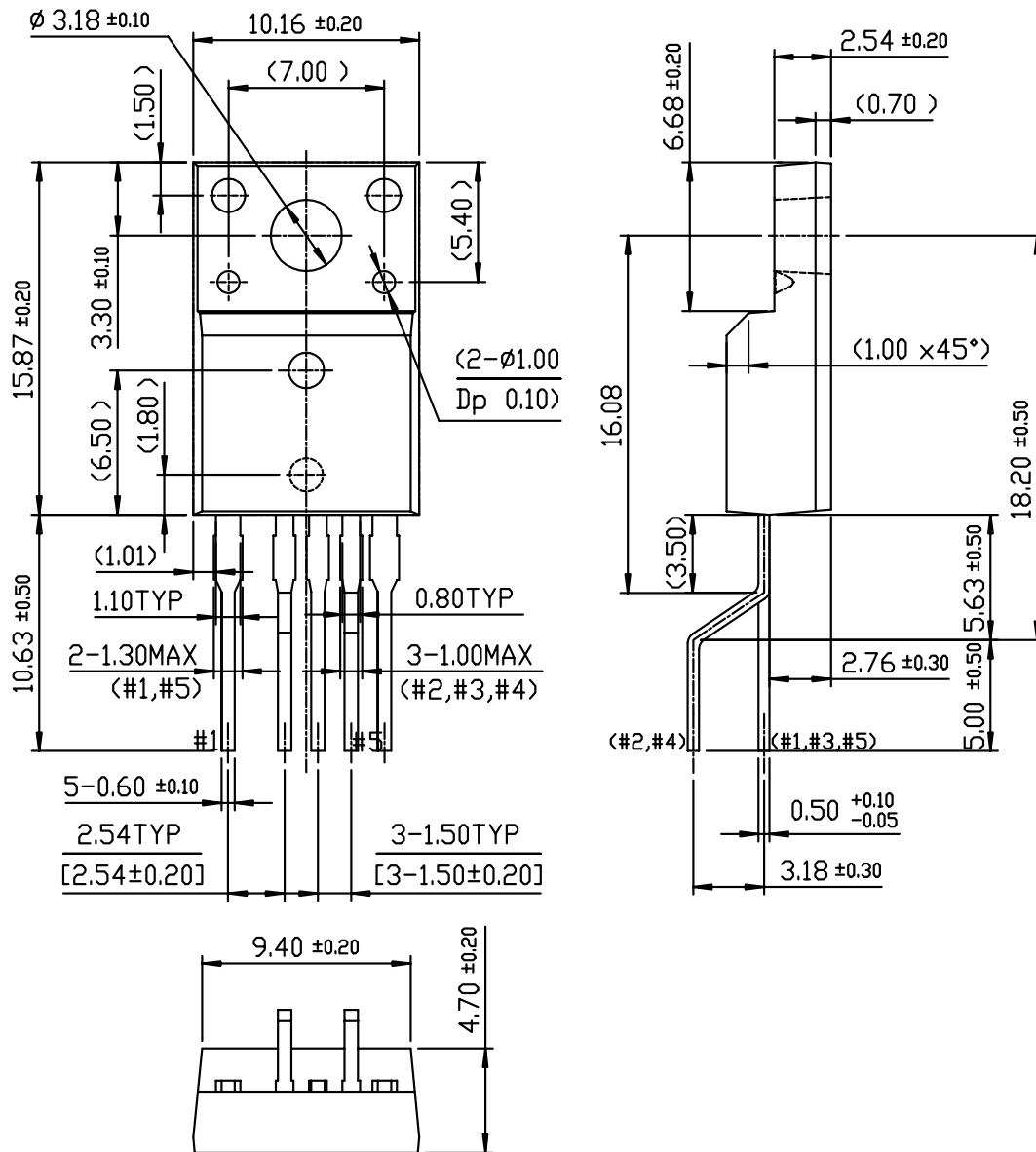
# Package Dimensions

## TO-220F-5L



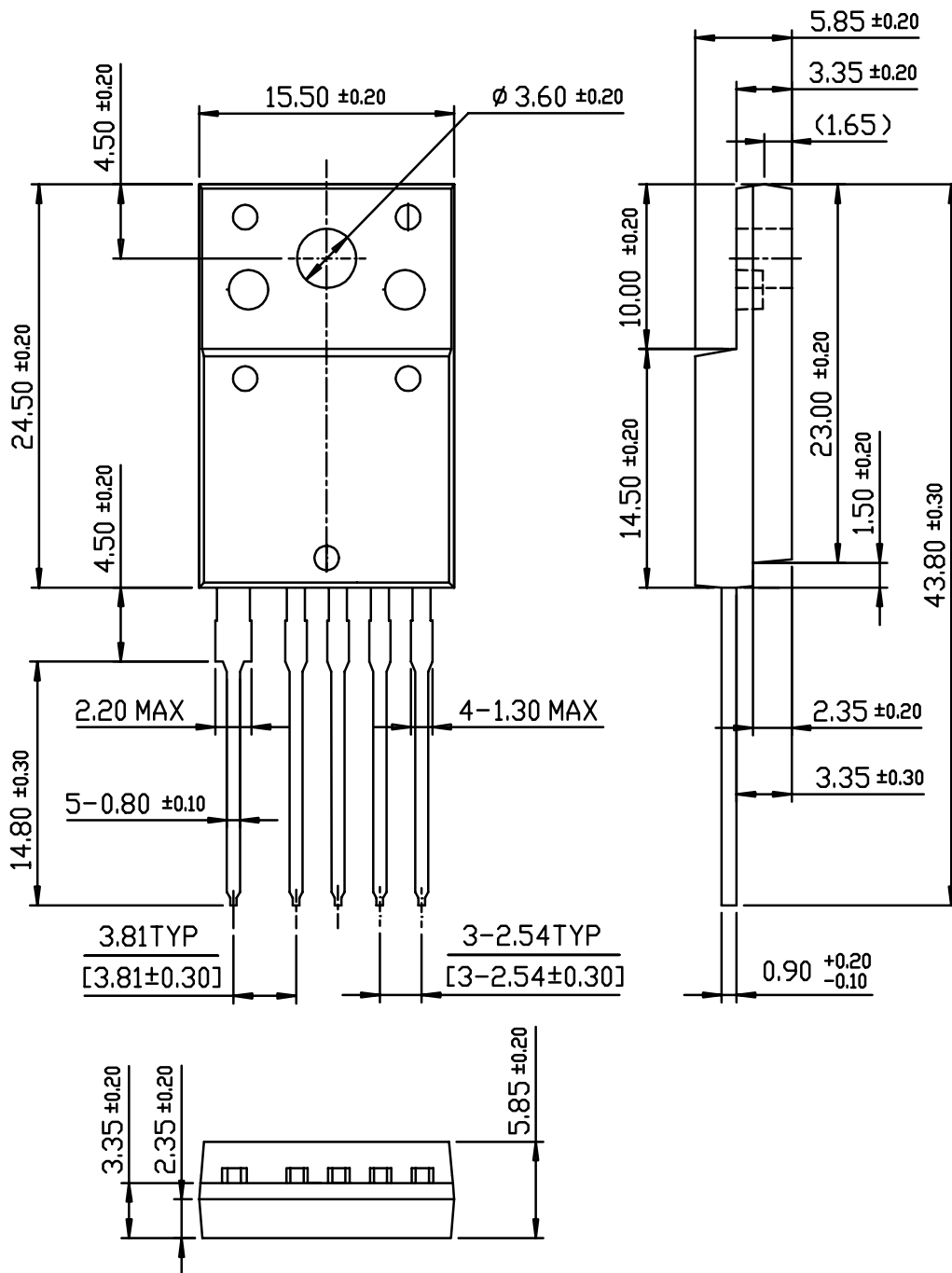
Package Dimensions (Continued)

TO-220F-5L(Forming)



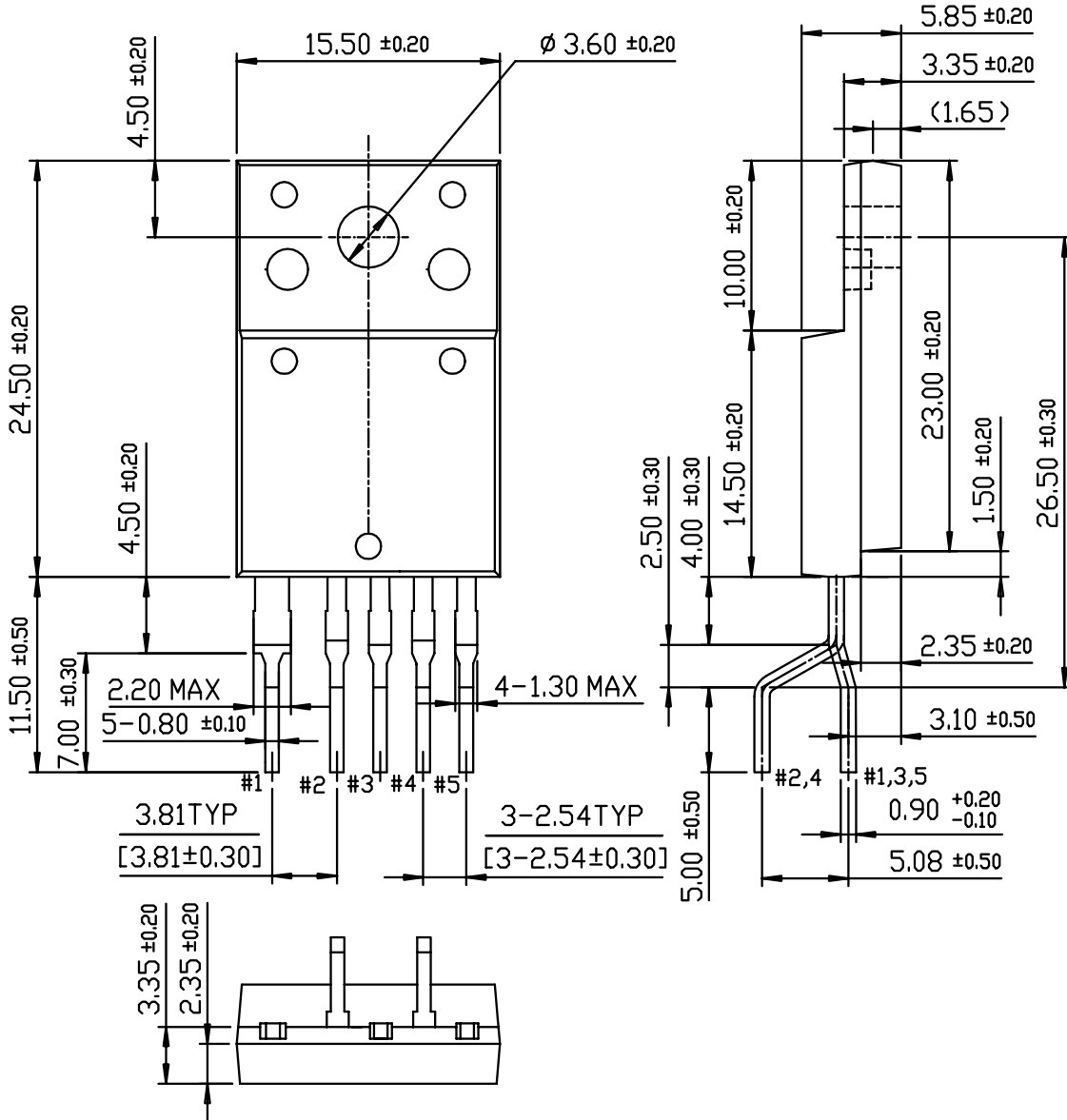
Package Dimensions (Continued)

TO-3PF-5L



Package Dimensions (Continued)

TO-3PF-5L(Forming)



## Ordering Information

Product Number	Package	Rating	I <sub>OVER</sub>
KA5Q0765RT-TU	TO-220F-5L	650V, 7A	5A
KA5Q0765RT-YDTU	TO-220F-5L (Forming)		
KA5Q12656RT-TU	TO-220F-5L	650V, 12A	6A
KA5Q12656RT-YDTU	TO-220F-5L (Forming)		
KA5Q1265RF-TU	TO-3PF-5L	650V, 12A	8A
KA5Q1265RF-YDTU	TO-3PF-5L (Forming)		
KA5Q1565RF-TU	TO-3PF-5L	650V, 15A	11.5A
KA5Q1565RF-YDTU	TO-3PF-5L (Forming)		

TU : Non Forming Type

YDTU : Forming Type

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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.