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 (Vsync: Min. 11V)
- Internal Thermal Shutdown Function
- Under Voltage Lockout
- Internal High Voltage Sense FET
- Auto-Restart Mode

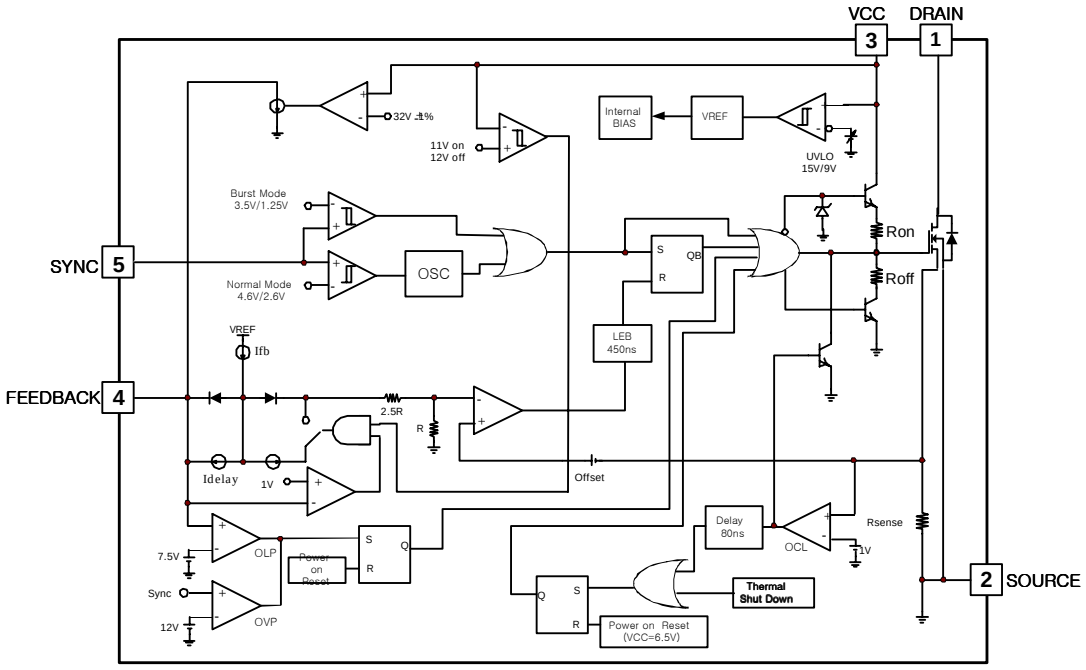
Description

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 R_{CC} 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.

TO-220F-5L **TO-3PF-5L**

1. Drain 2. GND 3. V_{CC} 4. FB 5. Sync

Internal Block Diagram



Rev.1.0.4

Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
KA5Q0765RT			
Drain-source Voltage	V_{DSS}	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}	15	ADC
Continuous Drain Current (Tc = 25°C)	I_D	3.8	ADC
Continuous Drain Current (Tc = 100°C)	I_D	2.4	ADC
Single Pulsed Avalanch Current[3](Energy [2])	I_{AS}(E_{AS})	20(570)	A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	40	V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}	V
	V_{Sync}	-0.3 to 13	V
Total Power Dissipation	P_D	47	W
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
Thermal Resistance	Rthjc	2.7	°C/W
ESD Capability, HBM Model (All pins)		2.0	kV
ESD Capability, Machine Model (All pins)		300	V

KA5Q12656RT			
Drain-source Voltage	V_{DSS}	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}	21	ADC
Continuous Drain Current (Tc = 25°C)	I_D	5.3	ADC
Continuous Drain Current (Tc = 100°C)	I_D	3.4	ADC
Single Pulsed Avalanch Current(Energy [2])	I_{AS}(E_{AS})	30(950)	A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	40	V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}	V
	V_{Sync}	-0.3 to13	V
Total Power Dissipation	P_D	55	W
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
Thermal Resistance	Rthjc	2.7	°C/W
ESD Capability, HBM Model (All pins)		2.0	kV
ESD Capability, Machine Model (All pins)		300	V

Absolute Maximum Ratings (Continued)

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
KA5Q1265RF			
Drain-source Voltage	V_{DSS}	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}	36	ADC
Continuous Drain Current (Tc = 25°C)	I_D	8.3	ADC
Continuous Drain Current (Tc = 100°C)	I_D	5.3	ADC
Single Pulsed Avalanch Current(Energy (2))	I_{AS}(E_{AS})	33(950)	A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	40	V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}	V
	V_{Sync}	-0.3 to 13	V
Total Power Dissipation	P_D	95	W
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
Thermal Resistance	Rthjc	2.7	°C/W
ESD Capability, HBM Model (All pins)		2.0	kV
ESD Capability, Machine Model (All pins)		300	V

KA5Q1565RF			
Drain-source Voltage	V_{DSS}	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}	60	ADC
Continuous Drain Current (Tc = 25°C)	I_D	10.3	ADC
Continuous Drain Current (Tc = 100°C)	I_D	6.6	ADC
Single Pulsed Avalanch Current(Energy (2))	I_{AS}(E_{AS})	36(1050)	A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	40	V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}	V
	V_{Sync}	-0.3 to 13	V
Total Power Dissipation	P_D	98	W
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
Thermal Resistance	Rthjc	2.7	°C/W
ESD Capability, HBM Model (All pins)		2.0	kV
ESD Capability, Machine Model (All pins)		300	V

Note:

1. Repetitive rating : Pulse width limited by maximum junction temperature
2. L = 10mH, V_{DD} =50V, R_G = 27Ω, starting Tj = 25°C
3. L = 13uH, starting Tj = 25°C

Electrical Characteristics (SFET part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
KA5Q0765RT						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=50μA	650	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=Max., Rating, V_{GS}=0V	-	-	200	μA
		V_{DS}=0.8Max., Rating, V_{GS}=0V, T_C=85°C	-	-	300	μA
Static Drain-Source on Resistance(1)	R_{DS}(on)	V_{GS}=10V, I_D=4.0A	-	1.3	1.6	Ω
Input Capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f = 1MHz	-	1110	-	pF
Output Capacitance	Coss		-	105	-	
Reverse Transfer Capacitance	Crss		-	50	-	
Turn on Delay Time	td(on)	V_{DD}=0.5BV_{DSS}, I_D=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	V_{GS}=10V, I_D=7.0A, V_{DS}=0.5BV_{DSS}(MOSFET Switching time are Essentially independent of Operating temperature)	-	57	74	nC
Gate-Source Charge	Qgs		-	9.3	-	
Gate-Drain (Miller) Charge	Qgd		-	29.3	-	
KA5Q12656RT/KA5Q1265RF						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=50μA	650	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=Max., Rating, V_{GS}=0V	-	-	200	μA
		V_{DS}=0.8Max., Rating, V_{GS}=0V, T_C=85°C	-	-	300	μA
Static Drain-Source on Resistance (1)	$R_{DS(on)}$	V_{GS}=10V, I_D=6A	-	0.7	0.9	Ω
Input Capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f = 1MHz	-	1820	-	pF
Output Capacitance	Coss		-	185	-	
Reverse Transfer Capacitance	Crss		-	32	-	
Turn on Delay Time	td(on)	V_{DD}=0.5BV_{DSS}, I_D=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	V_{GS}=10V, I_D=12.0A, V_{DS}=0.5BV_{DSS}(MOSFET Switching time are Essentially independent of Operating temperature)	-	60	78	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
KA5Q1565RF						
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=50μA	650	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=Max., Rating, V_{GS}=0V	-	-	200	μA
		V_{DS}=0.8Max., Rating, V_{GS}=0V, T_C=85°C	-	-	300	μA
Static Drain-Source on Resistance (Note)	$R_{DS(ON)}$	V_{GS}=10V, I_D=7.3A	-	0.5	0.65	W
Input Capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	2580	-	pF
Output Capacitance	Coss		-	270	-	
Reverse Transfer Capacitance	Crss		-	50	-	
Turn on Delay Time	td(on)	V_{DD}=0.5BV_{DSS}, I_D=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	V_{GS}=10V, I_D=14.6A, V_{DS}=0.8BV_{DSS} (MOSFET switching time are essentially independent of operating temperature)	-	90	117	nC
Gate-Source Charge	Qgs		-	15	-	
Gate-Drain (Miller) Charge	Qgd		-	45	-	

Note:

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

Electrical Characteristics (Control Part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
UVLO SECTION						
Start Threshold Voltage	V_{START}	V_{FB}=GND	14	15	16	V
Stop Threshold Voltage	V_{STOP}	V_{FB}=GND	8	9	10	V
OSCILLATOR SECTION						
Initial Frequency	F_{OSC}	-	18	20	22	kHz
Voltage Stability	F_{STABLE}	12V ≤ V_{CC} ≤ 23V	0	1	3	%
Temperature Stability (Note2)	ΔF_{OSC}	-25°C ≤ Ta≤ 85°C	0	±5	±10	%
Maximum Duty Cycle	D_{MAX}	-	92	95	98	%
Minimum Duty Cycle	D_{MIN}	-	-	-	0	%
FEEDBACK SECTION						
Feedback Source Current	I_{FB}	V_{FB}=GND	0.7	0.9	1.1	mA
Shutdown Feedback Voltage	V_{SD}	V_{FB} ≥ 6.9V	6.9	7.5	8.1	V
Shutdown Delay Current	I_{DELAY}	V_{FB}=5V	4	5	6	μA
SYNC. SECTION						
Normal Sync High Threshold Voltage	V_{NSH}	V_{CC}=16V, Vfb=5V	4.0	4.6	5.2	V
Normal Sync Low Threshold Voltage	V_{NSL}	V_{CC}=16V, Vfb=5V	2.3	2.6	2.9	V
Burst Sync High Threshold Voltage	V_{BSH}	V_{CC}=10.5V, Vfb=0V	3.2	3.6	4.0	V
Burst Sync Low Threshold Voltage	V_{BSL}	V_{CC}=10.5V, Vfb=0V	1.1	1.3	1.5	V
BURST MODE SECTION						
Burst Mode Low Threshold Voltage	V_{BURL}	V_{FB}=0V	10.4	11.0	11.6	V
Burst Mode High Threshold Voltage	V_{BURH}	V_{FB}=0V	11.4	12.0	12.6	V
Burst Mode Enable Feedback Voltage	V_{BEN}	V_{CC}=10.5V	0.7	1.0	1.3	V
Burst Mode Peak Current Limit(Note4)	I_{BURPK}	V_{CC}=10.5V , V_{FB}=0V	0.65	0.85	1.1	A
CURRENT LIMIT(SELF-PROTECTION)SECTION						
Peak Current Limit (Note4)	I_{OVER}	**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	
PROTECTION SECTION						
Over Voltage Protection	V_{OVP}	V_{SYNC} ≥ 11V	11	12	13	V
Over Current Latch voltage(Note3)	V_{OCL}	-	0.9	1.0	1.1	V
Thermal Shutdown Tempature(Note2)	TSD	-	140	160	-	°C

Electrical Characteristics (Control Part) (Continued)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
TOTAL DEVICE SECTION						
Start Up Current	I_{START}	V_{FB}=GND, V_{CC}=14V	-	0.1	0.2	mA
Operating Supply Current(Note1)	I_{OP}	V_{FB}=GND, V_{CC}=16V	-	10	18	mA
	$I_{OP(MIN)}$	V_{FB}=GND, V_{CC}=12V				
	$I_{OP(MAX)}$	V_{FB}=GND, V_{CC}=28V				
PRIMARY SIDE REGULATION SECTION (ONLY KA5Q0765RT/KA5Q12656RT)						
Primary Regulation Threshold Voltage	V_{PR}	I_{FB}=700uA, V_{FB}=4V	32.0	32.5	33.0	V
Primary Regulation Transconductance	G_{PR}	-	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

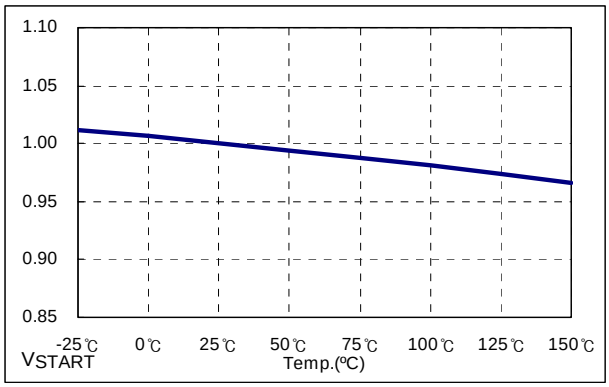


Figure 1. Start Threshold Voltage

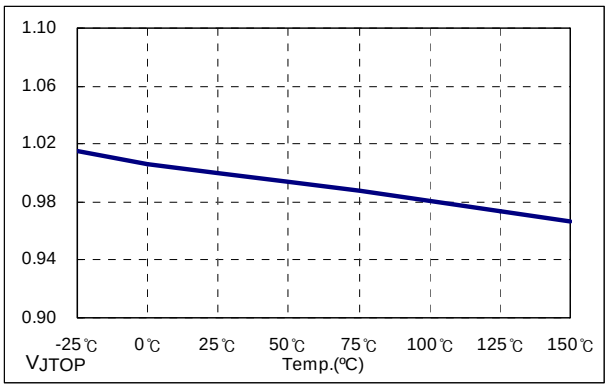


Figure 2. Stop Threshold Voltage

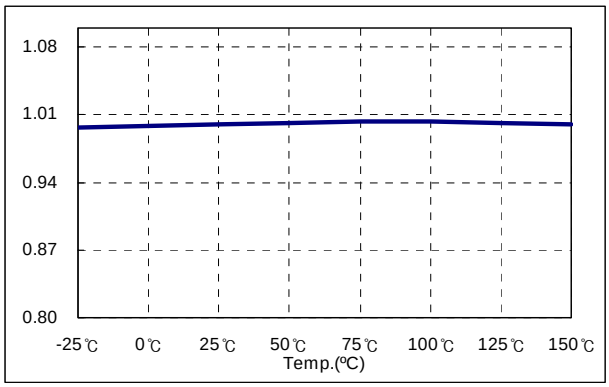


Figure 3. Start Up Current

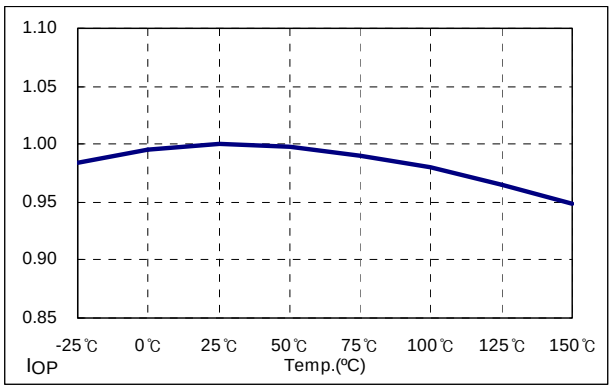


Figure 4. Operting Supply Current

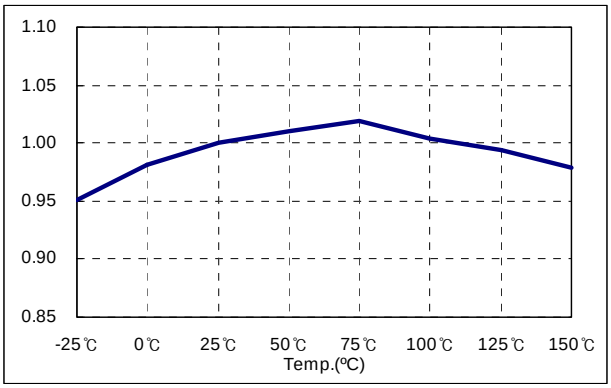


Figure 5. Initial Freqency

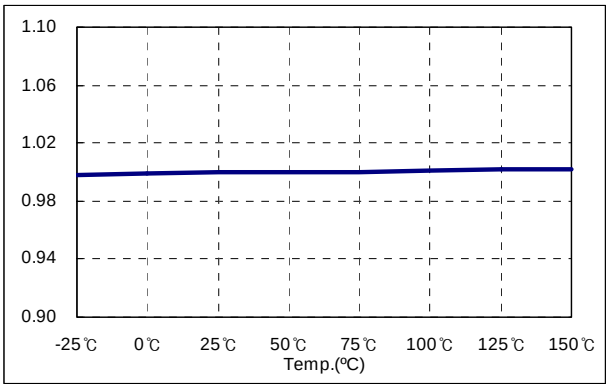


Figure 6. Maximum Duty

Typical Performance Characteristics (Continued)

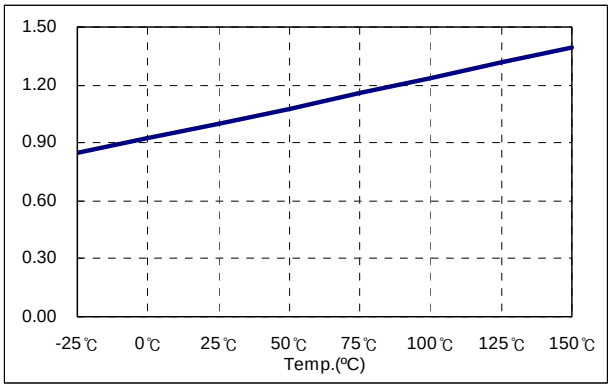


Figure 7. Feedback Offset Voltage

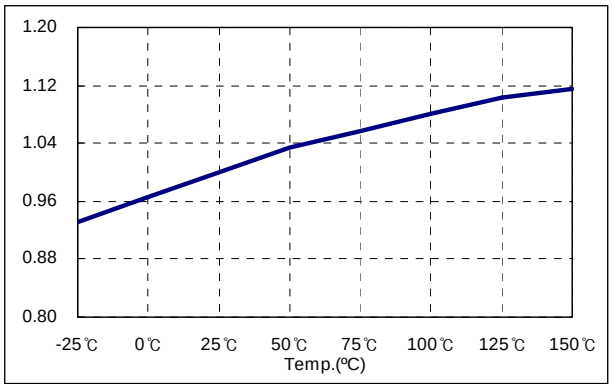


Figure 8. Feedback Source Current

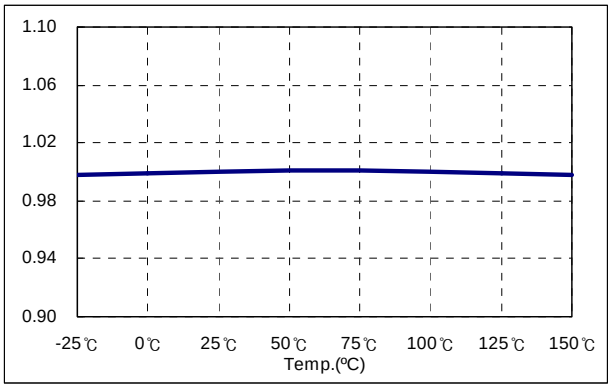


Figure 9. Over Voltage Protection

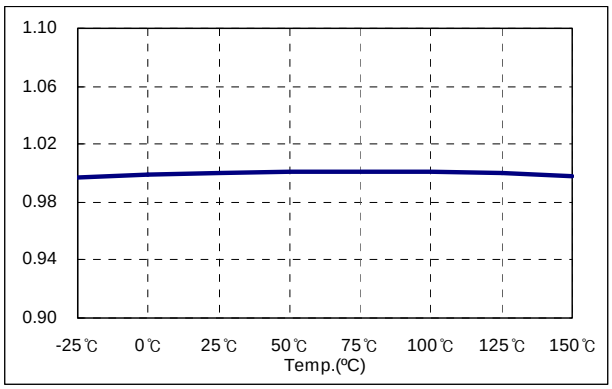


Figure 10. Shutdown Feedback Voltage

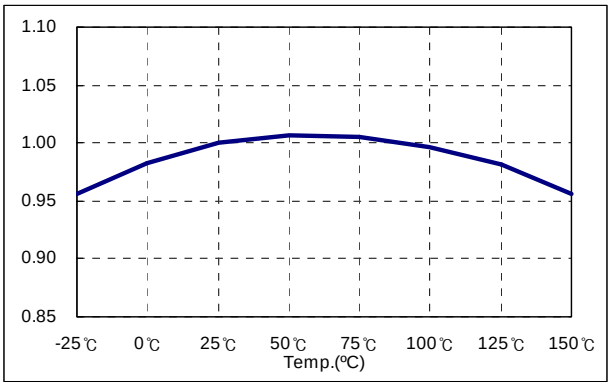


Figure 11. Shutdown Delay Current

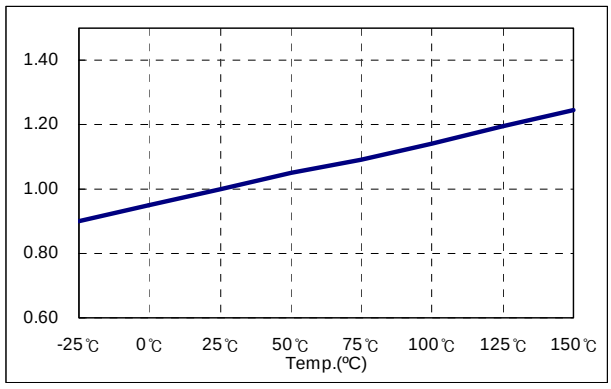


Figure 12. Burst mode Enable Feedback Voltage

Typical Performance Characteristics (Continued)

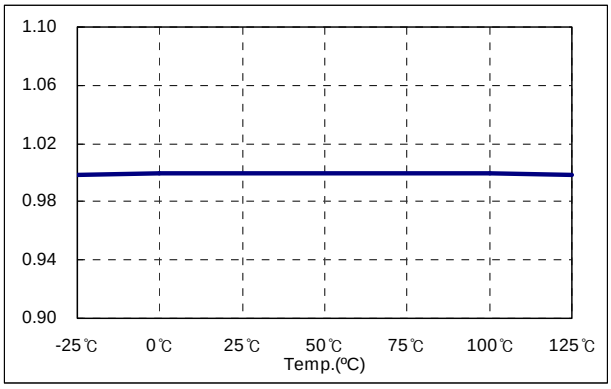


Figure 13. Burst mode Low Threshold Voltage

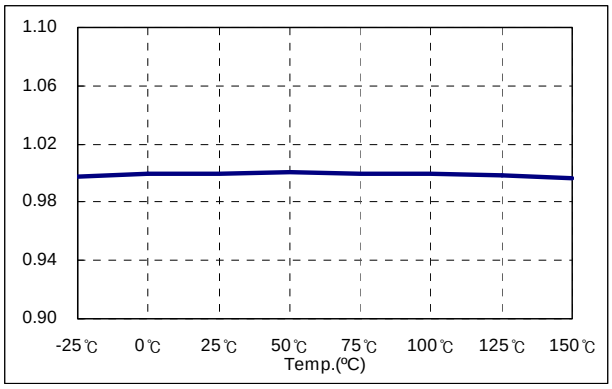


Figure 14. Burst mode HighThreshold Voltage

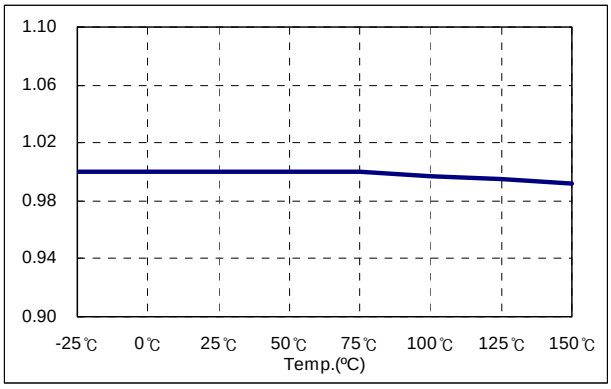


Figure 15. Burst Sync. High Threshold Voltage

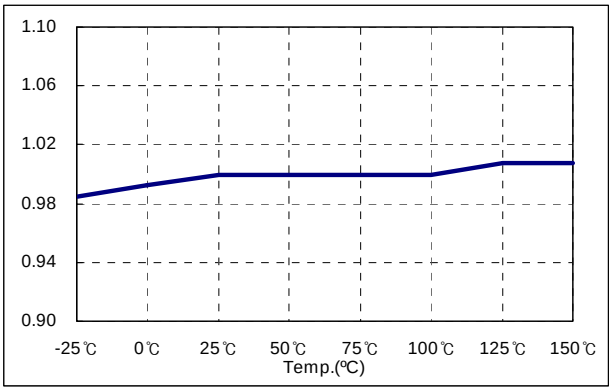


Figure 16. Burst Sync. Low Threshold Voltage

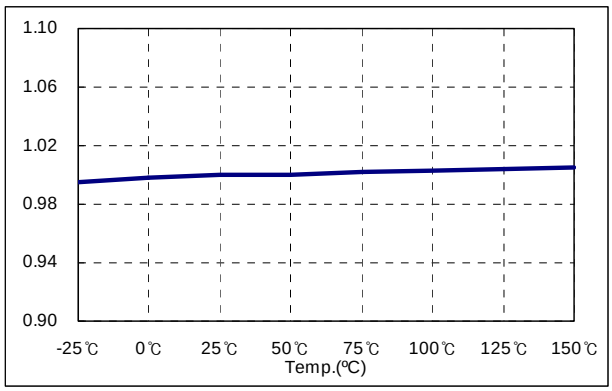


Figure17. Primary Regulation Threshold Voltage

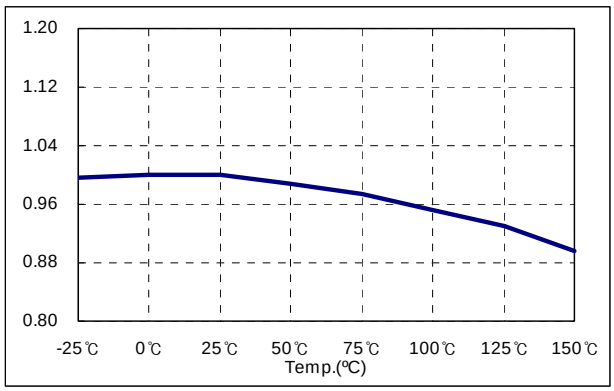


Figure 18. Primary Regulation Transconductance

Typical Performance Characteristics (Continued)

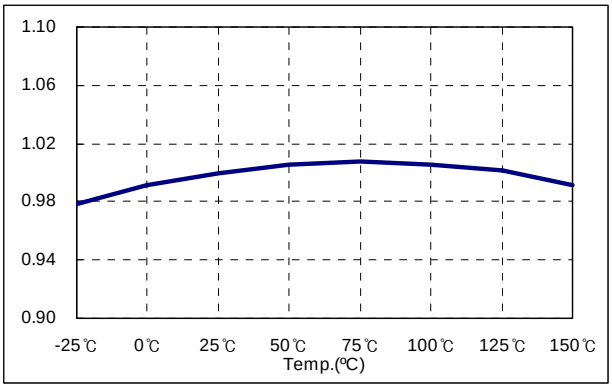


Figure 19. Peak Current Limit

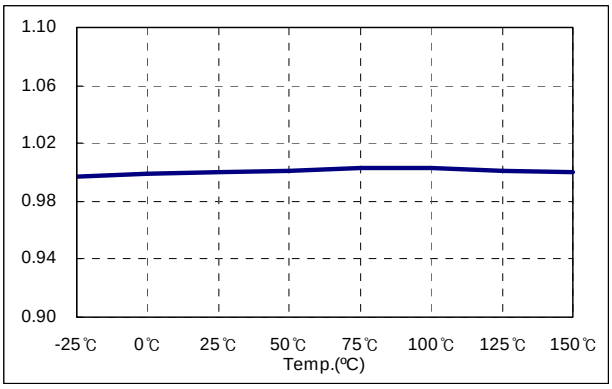


Figure 20. Burst mode Peak Current Limit

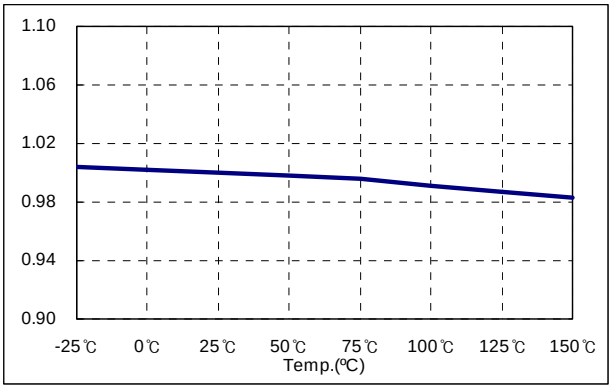


Figure 21. Normal Sync. High Threshold Voltage

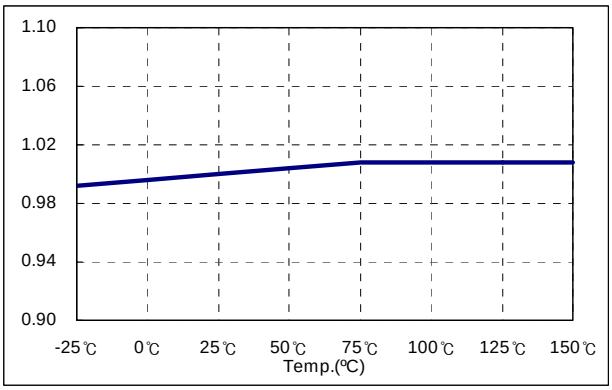
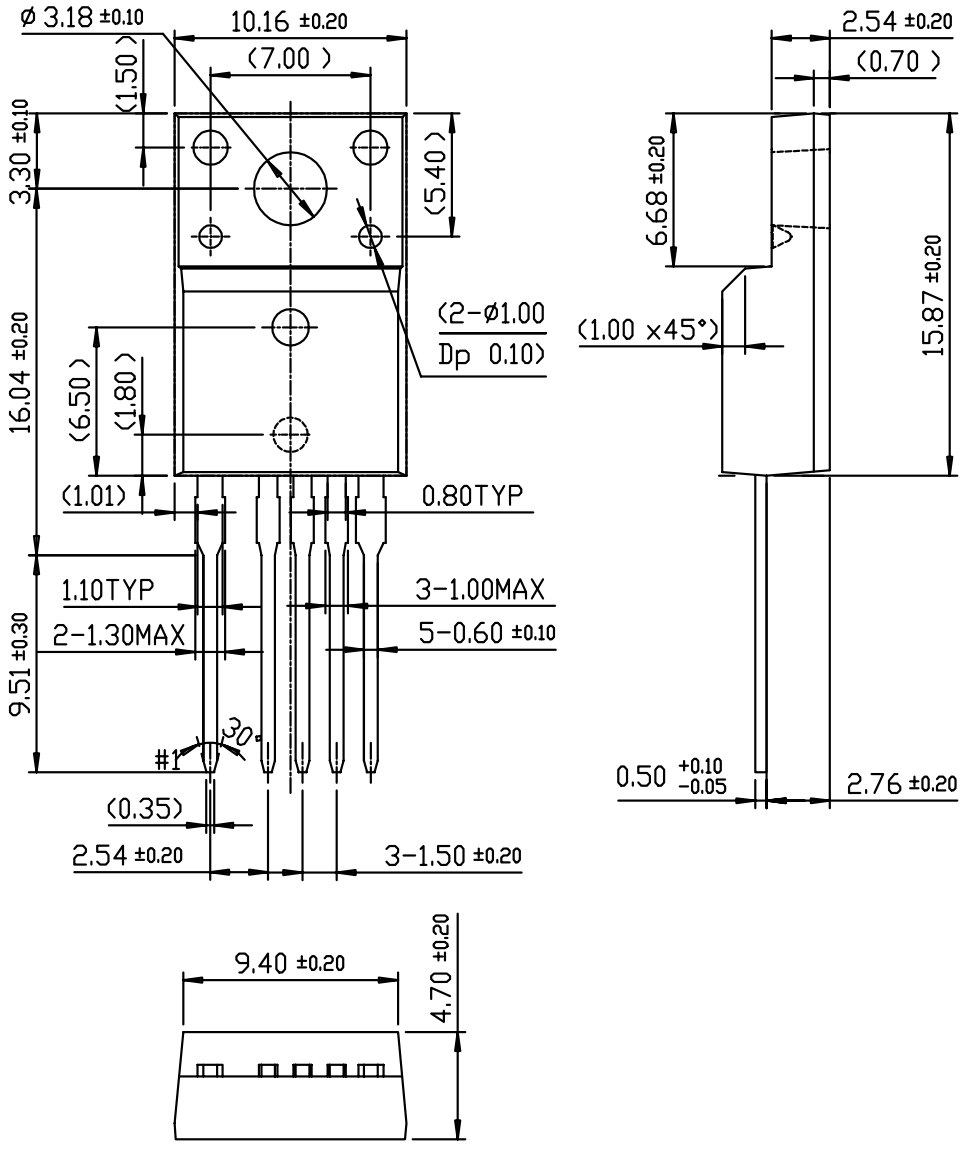


Figure 22. Normal Sync. Low Threshold Voltage

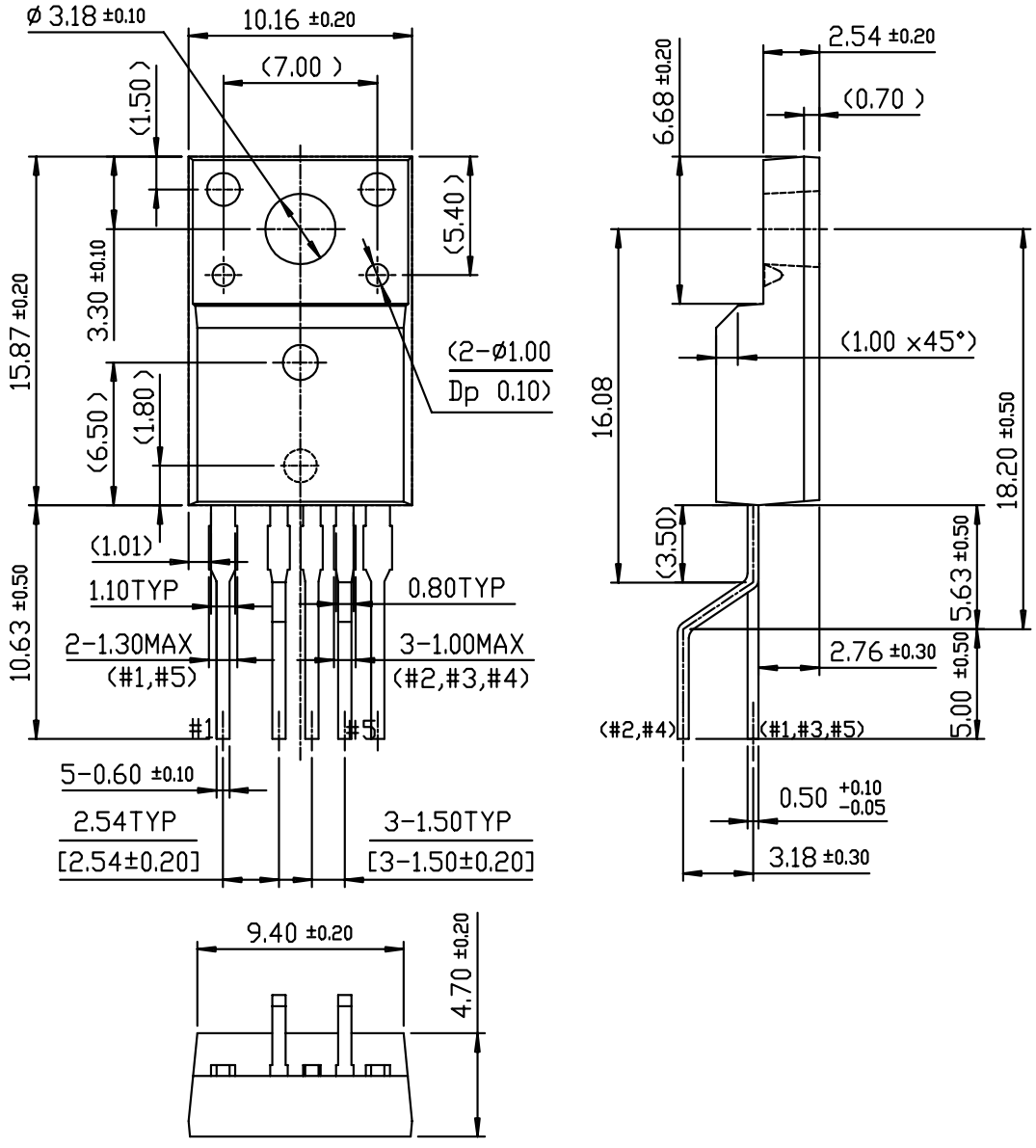
Package Dimensions

TO-220F-5L



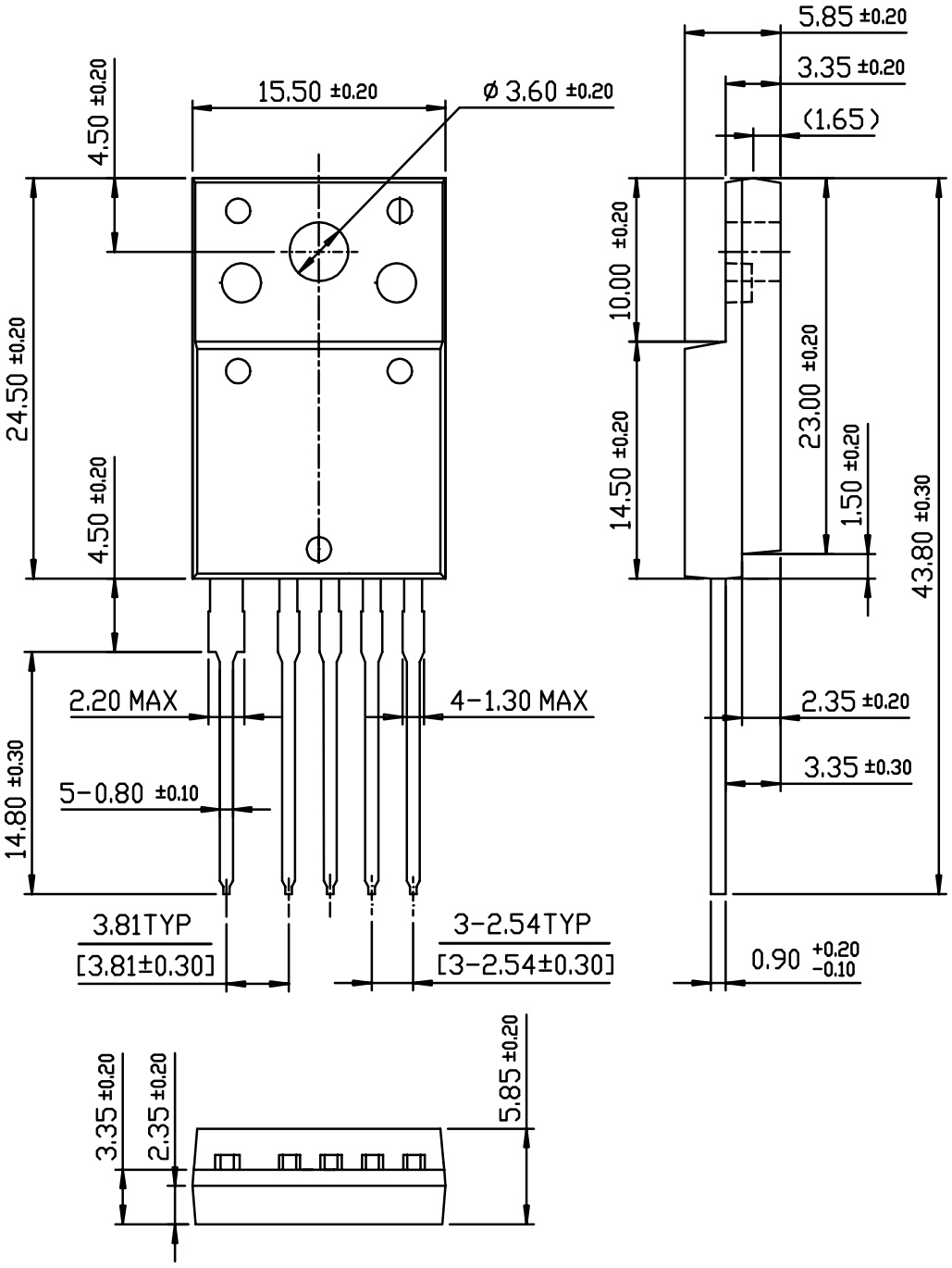
Package Dimensions (Continued)

TO-220F-5L(Forming)



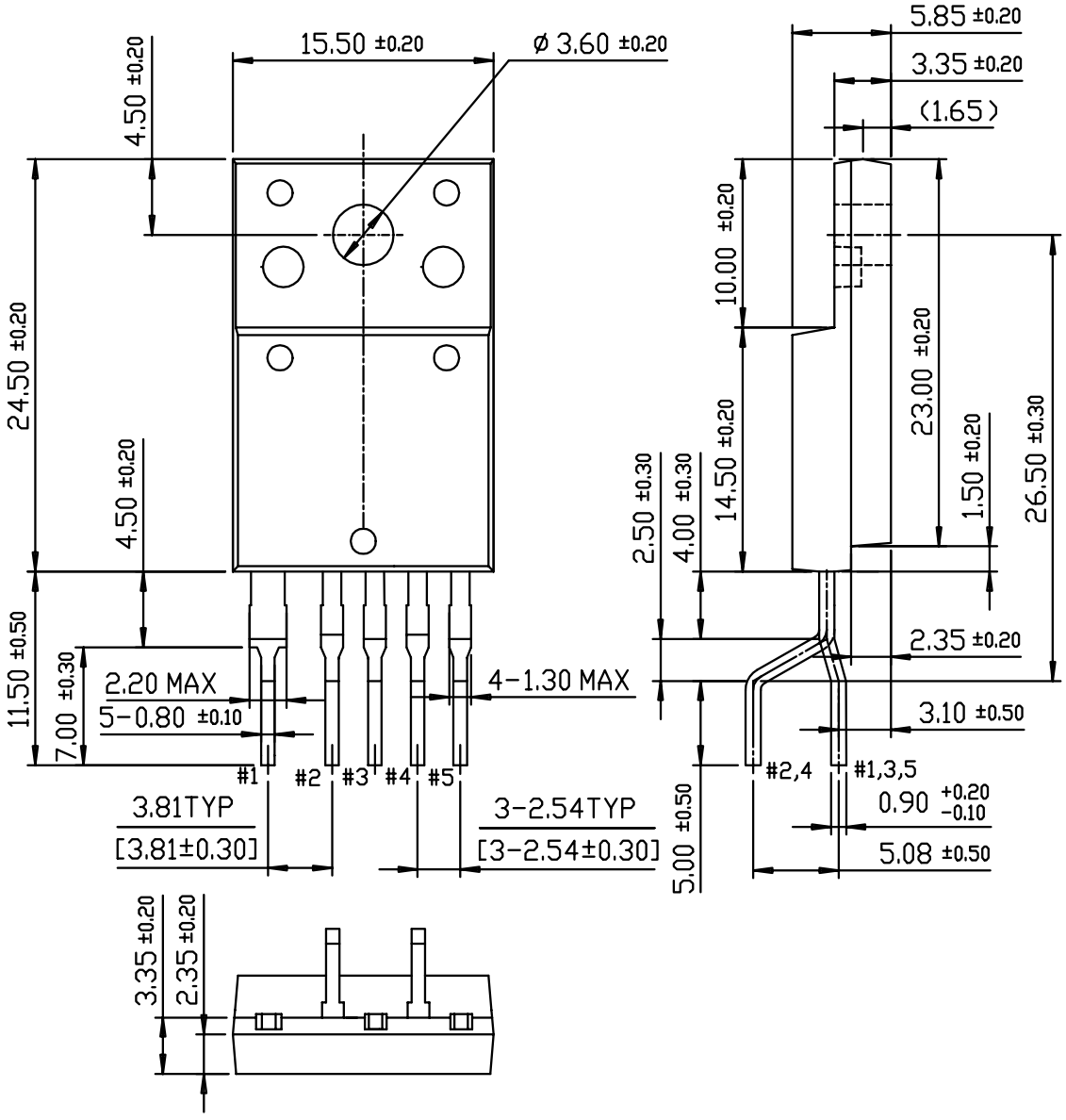
Package Dimensions (Continued)

TO-3PF-5L



Package Dimensions (Continued)

TO-3PF-5L(Forming)



Ordering Information

Product Number	Package	Rating	I_{OVER}
KA5Q0765RTTU	TO-220F-5L	650V, 7A	5A
KA5Q0765RTYDTU	TO-220F-5L (Forming)		
KA5Q12656RTTU	TO-220F-5L	650V,12A	6A
KA5Q12656RTYDTU	TO-220F-5L (Forming)		
KA5Q1265RFTU	TO-3PF-5L	650V,12A	8A
KA5Q1265RFYDTU	TO-3PF-5L (Forming)		
KA5Q1565RFTU	TO-3PF-5L	650V,15A	11.5A
KA5Q1565RFYDTU	TO-3PF-5L (Forming)		

TU : Non Forming Type
YDTU : Forming Type