

KA5Q1565RF

Fairchild Power Switch(FPS)

- 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

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.



The schematic diagram illustrates the internal architecture of a 100W LED driver IC. Key components and their connections include:

- Inputs:** SYNC (pin 5), FEEDBACK (pin 4), VCC (pin 3), and DRAIN (pin 1) are shown at the top. SOURCE (pin 2) is at the bottom.
- Internal Blocks:**
 - OSC (Oscillator):** Receives inputs from SYNC and FEEDBACK. It includes a 32V $\pm 1\%$ reference and a 11V on 12V off input.
 - VREF (Voltage Reference):** Provides a reference voltage to the OSC and other comparators.
 - LEB (LED Error Block):** A 450ns delay block that processes the feedback signal.
 - Thermal Shut Down:** A block that monitors the device temperature and shuts down the driver if it exceeds a threshold.
 - Power on Reset (VCC=6.5V):** A block that ensures the driver is in a known state when power is applied.
- Comparators and Logic:**
 - Normal Mode (4.6V/2.6V) and Burst Mode (3.5V/1.25V):** These comparators determine the operating mode based on the feedback signal.
 - OSC (Oscillator):** Generates a square wave signal that drives the MOSFET.
 - LEB (LED Error Block):** A 450ns delay block that processes the feedback signal.
 - Thermal Shut Down:** A block that monitors the device temperature and shuts down the driver if it exceeds a threshold.
 - Power on Reset (VCC=6.5V):** A block that ensures the driver is in a known state when power is applied.
- Output Stage:**
 - MOSFET:** The main power transistor, with Ron (on-resistance) and Roff (off-resistance) parameters.
 - Diode:** A Schottky diode used for freewheeling the inductive load.
 - Resistors:** Various resistors are used for current sensing (Rsense), feedback (R), and timing (2.5R, 1V, 1V).
 - Capacitors:** A 1V capacitor is used for timing or filtering.

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} (EAS)	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	R _{thjc}	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} (EAS)	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	R _{thjc}	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 Avalanche Current(Energy ⁽²⁾)	I _{AS} (EAS)	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	R _{thjc}	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 Avalanche Current(Energy ⁽²⁾)	I _{AS} (EAS)	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	R _{thjc}	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 T_J = 25°C
3. L = 13uH, starting T_J = 25°C

Electrical Characteristics (SFET part)

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
KA5Q0765RT						
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 ⁽¹⁾	RDS(on)	VGS=10V, ID=4.0A	-	1.3	1.6	Ω
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	74	nC
Gate-Source Charge	Qgs		-	9.3	-	
Gate-Drain (Miller) Charge	Qgd		-	29.3	-	
KA5Q12656RT/KA5Q1265RF						
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 ⁽¹⁾	RDS(on)	VGS=10V, ID=6A	-	0.7	0.9	Ω
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	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	BVDSS	V _{GS} =0V, I _D =50μA	650	-	-	V
Zero Gate Voltage Drain Current	IDSS	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)	RDS(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} =0.5BVDSS, 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} =0.8BVDSS (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	VSTART	VFB=GND	14	15	16	V
Stop Threshold Voltage	VSTOP	VFB=GND	8	9	10	V
OSCILLATOR SECTION						
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	%
FEEDBACK SECTION						
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
SYNC. SECTION						
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
BURST MODE SECTION						
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
CURRENT LIMIT(SELF-PROTECTION)SECTION						
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	
PROTECTION SECTION						
Over Voltage Protection	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) (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

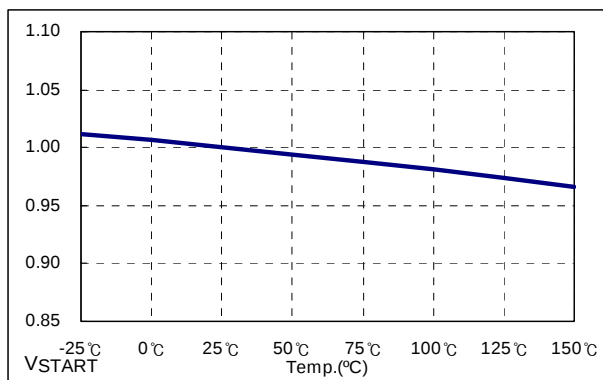


Figure 1. Start Threshold Voltage

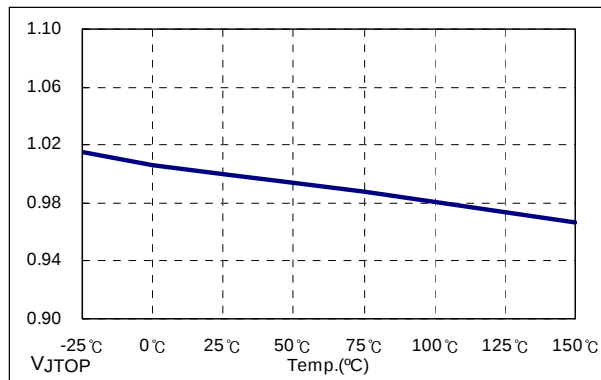


Figure 2. Stop Threshold Voltage

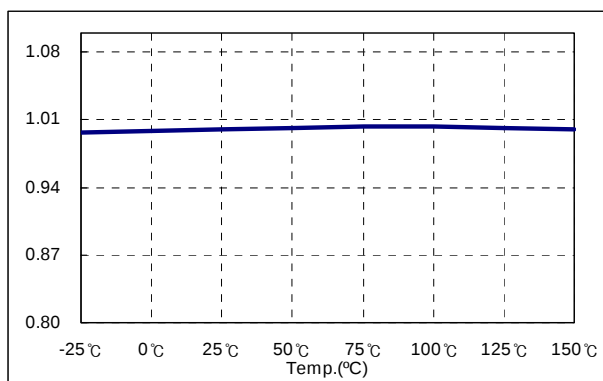


Figure 3. Start Up Current

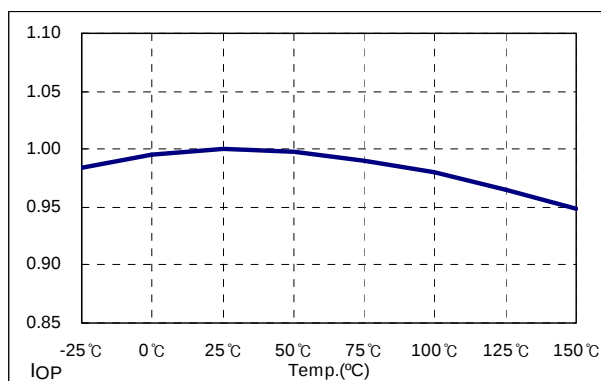


Figure 4. Operating Supply Current

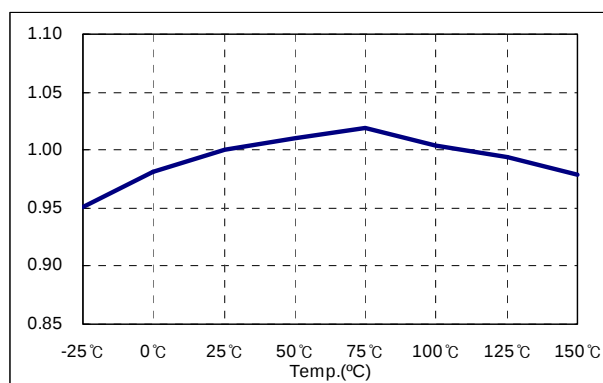


Figure 5. Initial Frequency

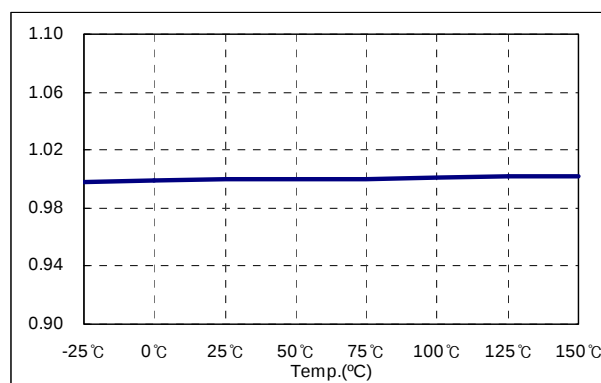
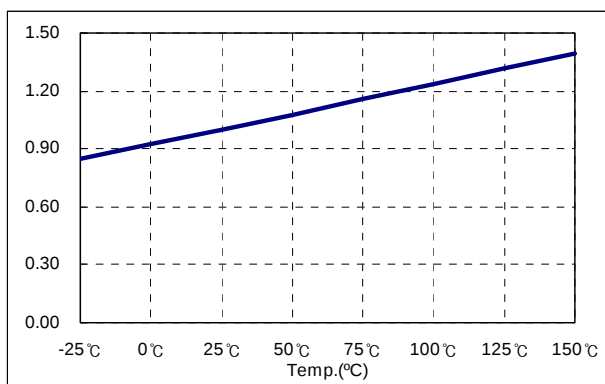
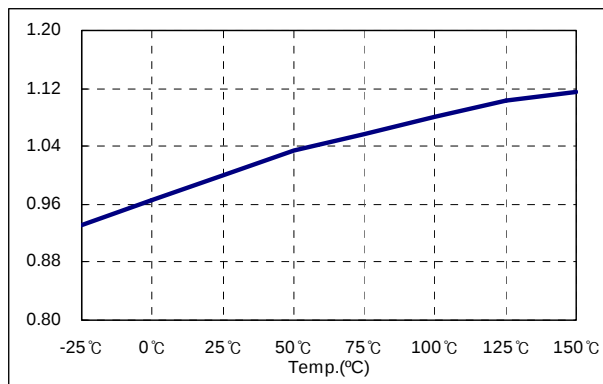
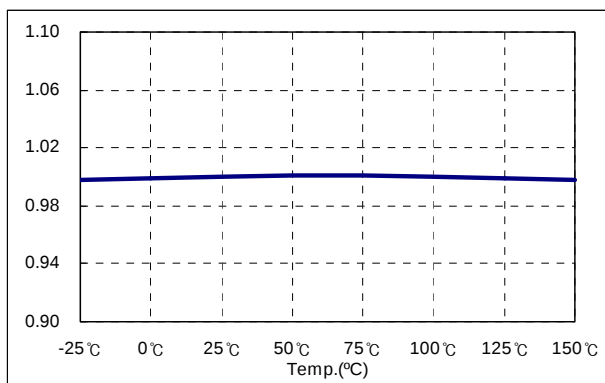
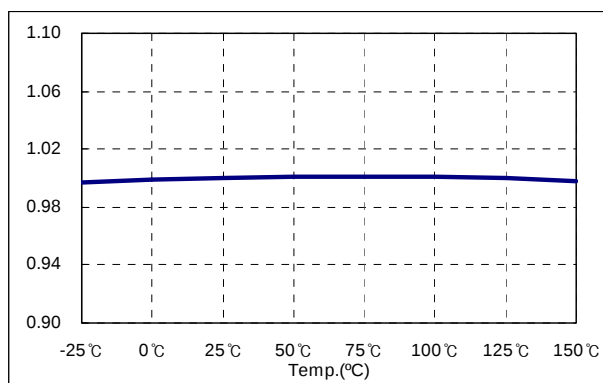
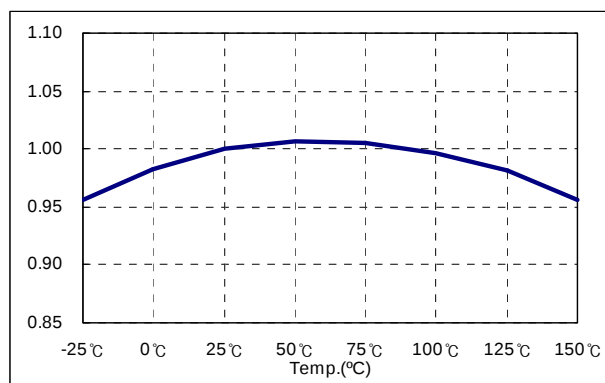
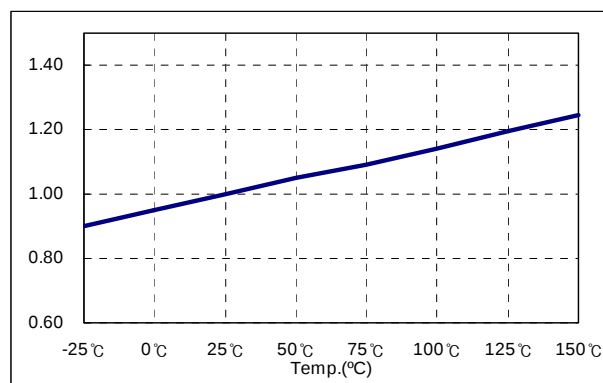


Figure 6. Maximum Duty

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)

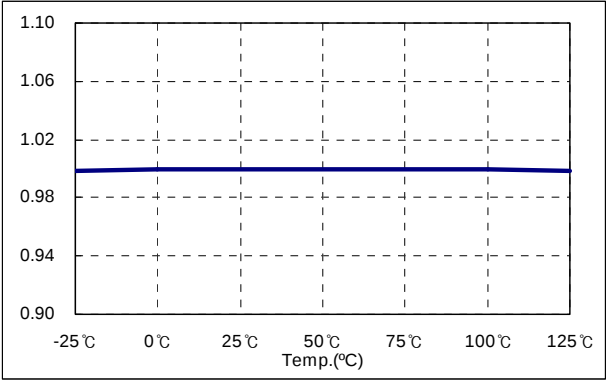


Figure 13. Burst mode Low Threshold Voltage

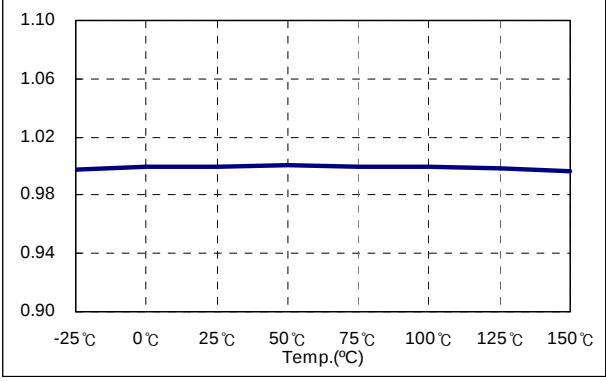


Figure 14. Burst mode High Threshold Voltage

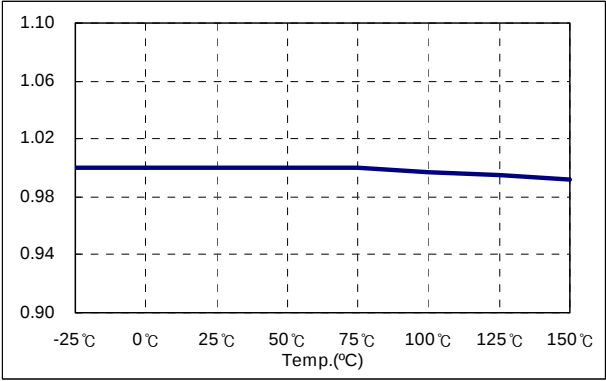


Figure 15. Burst Sync. High Threshold Voltage

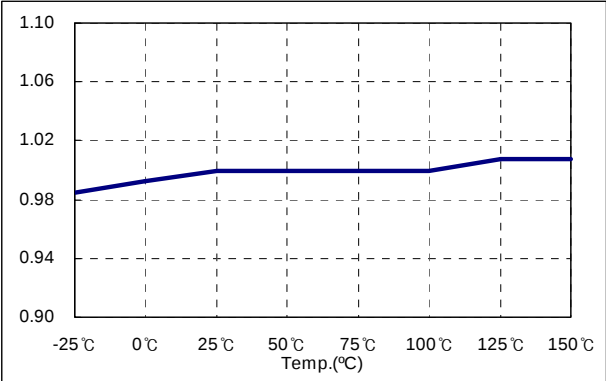


Figure 16. Burst Sync. Low Threshold Voltage

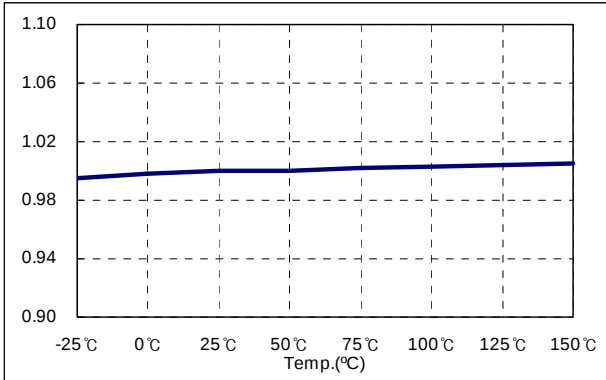


Figure 17. Primary Regulation Threshold Voltage

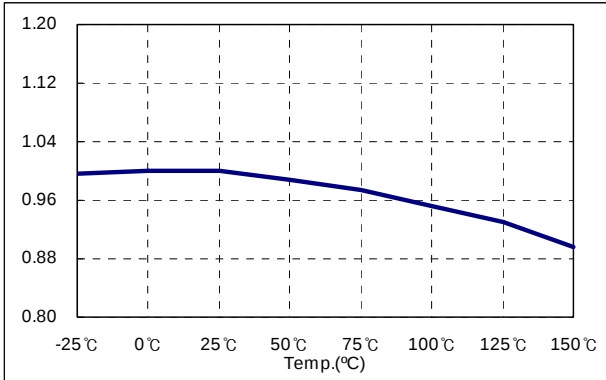


Figure 18. Primary Regulation Transconductance

Typical Performance Characteristics (Continued)

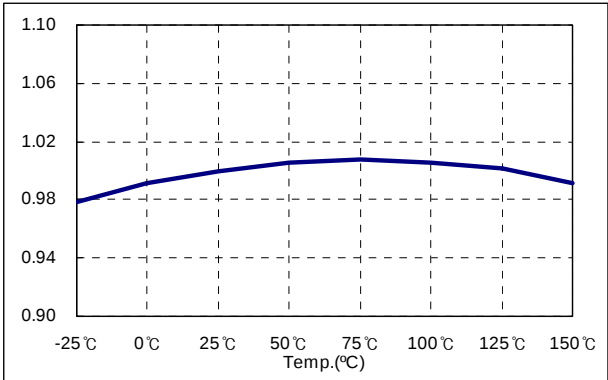


Figure 19. Peak Current Limit

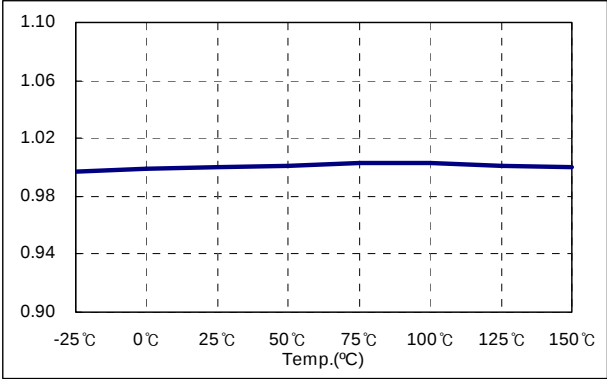


Figure 20. Burst mode Peak Current Limit

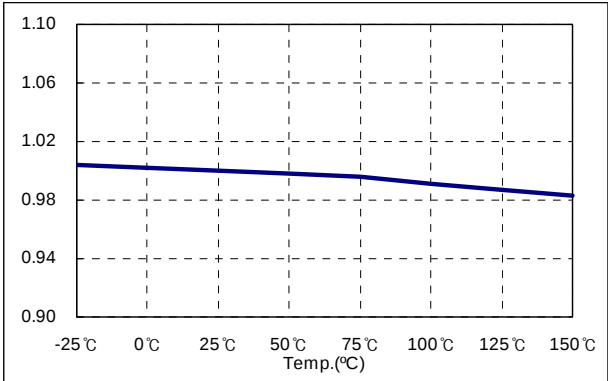


Figure 21. Normal Sync. High Threshold Voltage

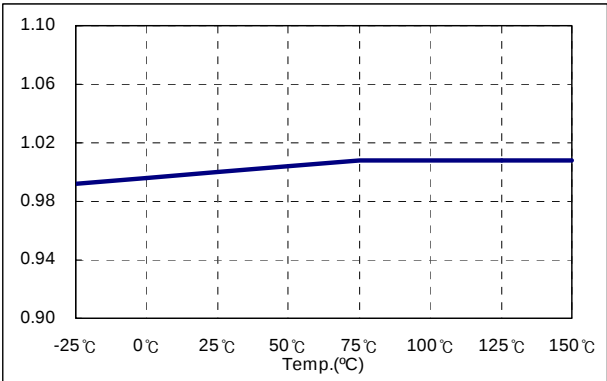
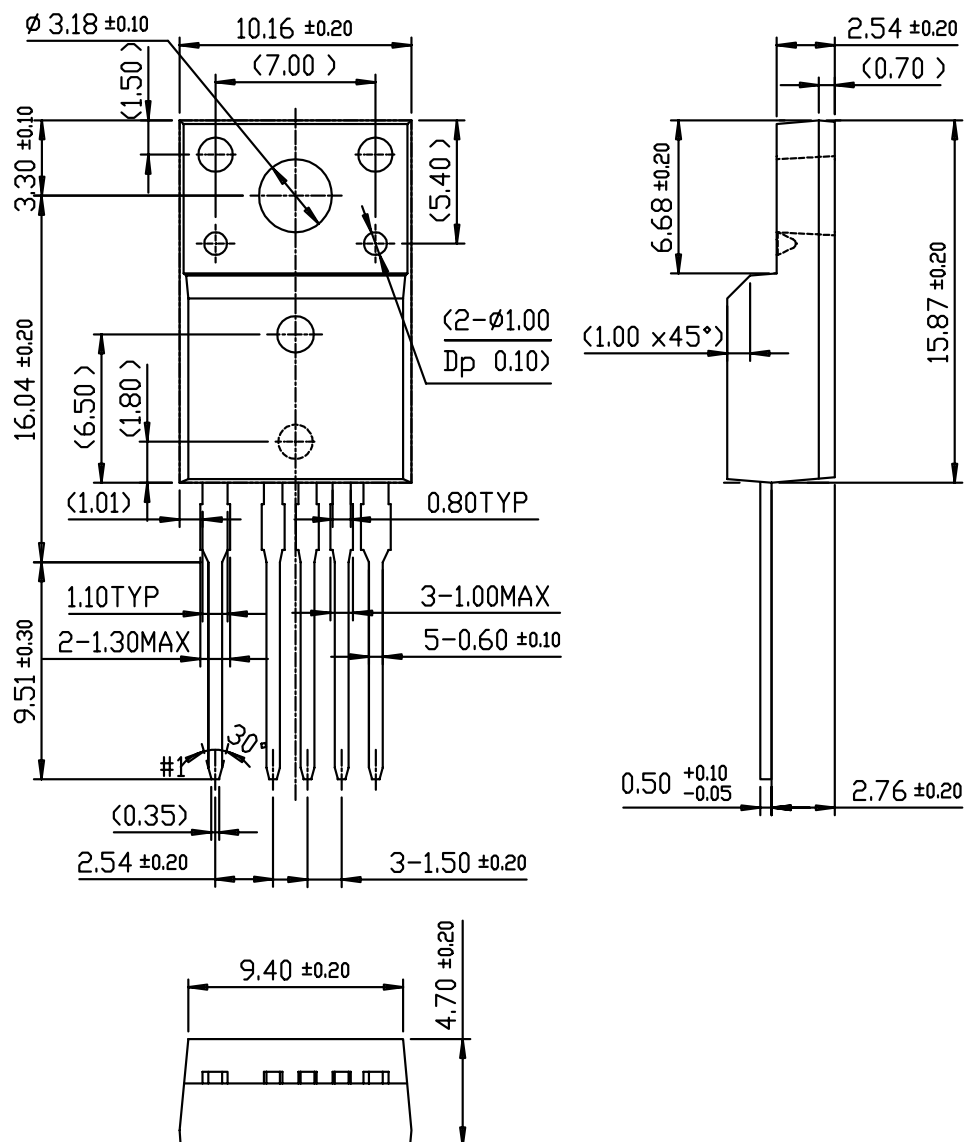


Figure 22. Normal Sync. Low Threshold Voltage

Package Dimensions

TO-220F-5L



Technical drawing of a mechanical part showing three views: front, side, and top.

Front View Dimensions:

- Overall width: 10.16 ± 0.20
- Overall height: 15.87 ± 0.20
- Top hole diameter: $\phi 3.18 \pm 0.10$
- Top hole spacing: (7.00)
- Top hole diameter: (1.50)
- Top hole diameter: (5.40)
- Top hole diameter: $(2-\phi 1.00)$
- Top hole diameter: $Dp 0.10$
- Top hole diameter: (6.50)
- Top hole diameter: (1.80)
- Top hole diameter: (1.01)
- Top hole diameter: 1.10 TYP
- Top hole diameter: 0.80 TYP
- Top hole diameter: $2-1.30 \text{ MAX}$
- Top hole diameter: $(\#1, \#5)$
- Top hole diameter: $3-1.00 \text{ MAX}$
- Top hole diameter: $(\#2, \#3, \#4)$
- Top hole diameter: $5-0.60 \pm 0.10$
- Top hole diameter: 2.54 TYP
- Top hole diameter: $[2.54 \pm 0.20]$
- Top hole diameter: $3-1.50 \text{ TYP}$
- Top hole diameter: $[3-1.50 \pm 0.20]$

Side View Dimensions:

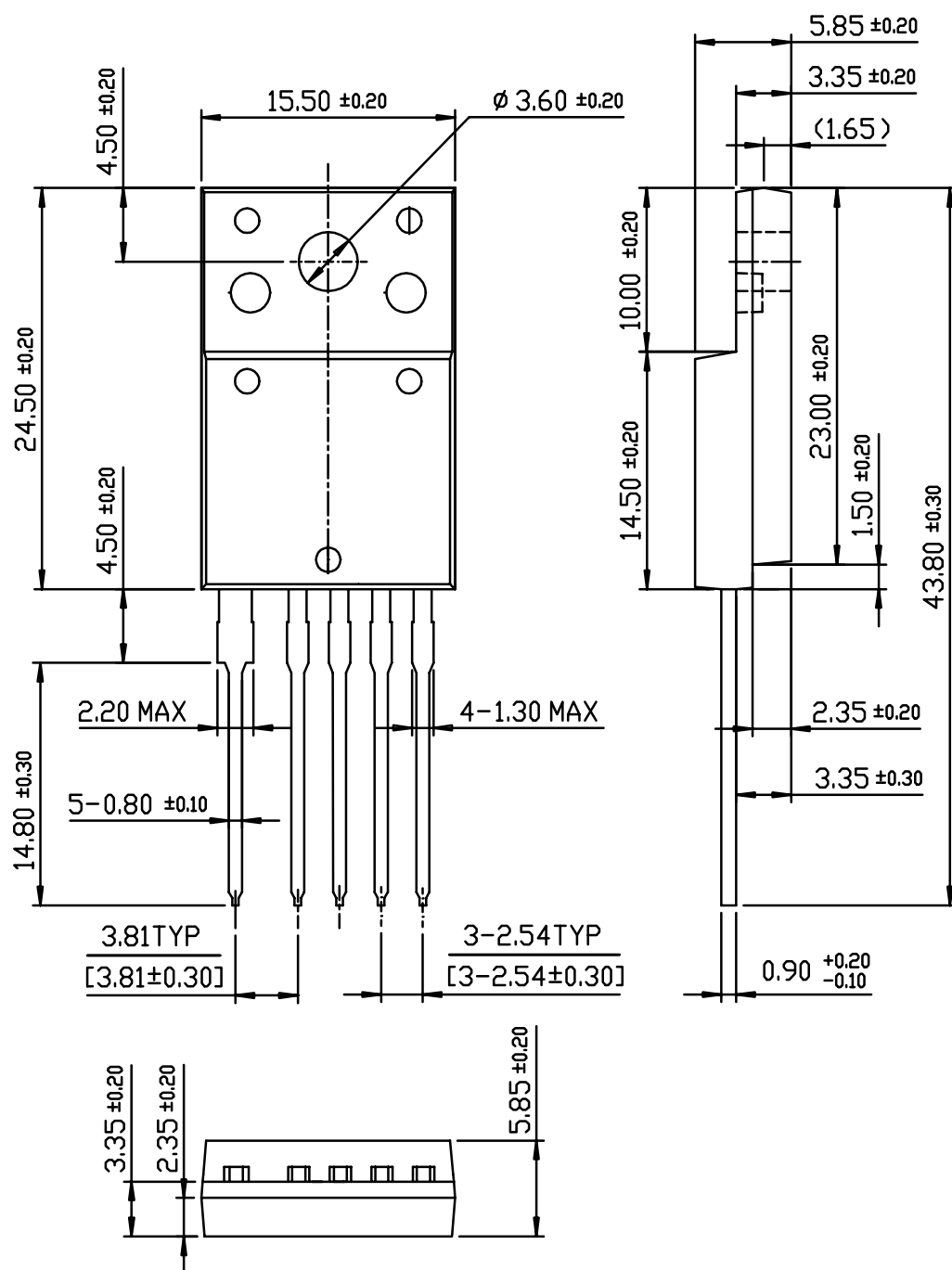
- Overall height: 18.20 ± 0.50
- Top hole diameter: 2.54 ± 0.20
- Top hole diameter: (0.70)
- Top hole diameter: 6.68 ± 0.20
- Top hole diameter: $(1.00 \times 45^\circ)$
- Top hole diameter: 16.08
- Top hole diameter: (3.50)
- Top hole diameter: 2.76 ± 0.30
- Top hole diameter: 5.63 ± 0.50
- Top hole diameter: 5.00 ± 0.50
- Top hole diameter: $(\#2, \#4)$
- Top hole diameter: $(\#1, \#3, \#5)$
- Top hole diameter: $0.50^{+0.10}_{-0.05}$
- Top hole diameter: 3.18 ± 0.30

Top View Dimensions:

- Overall width: 9.40 ± 0.20
- Overall height: 4.70 ± 0.20

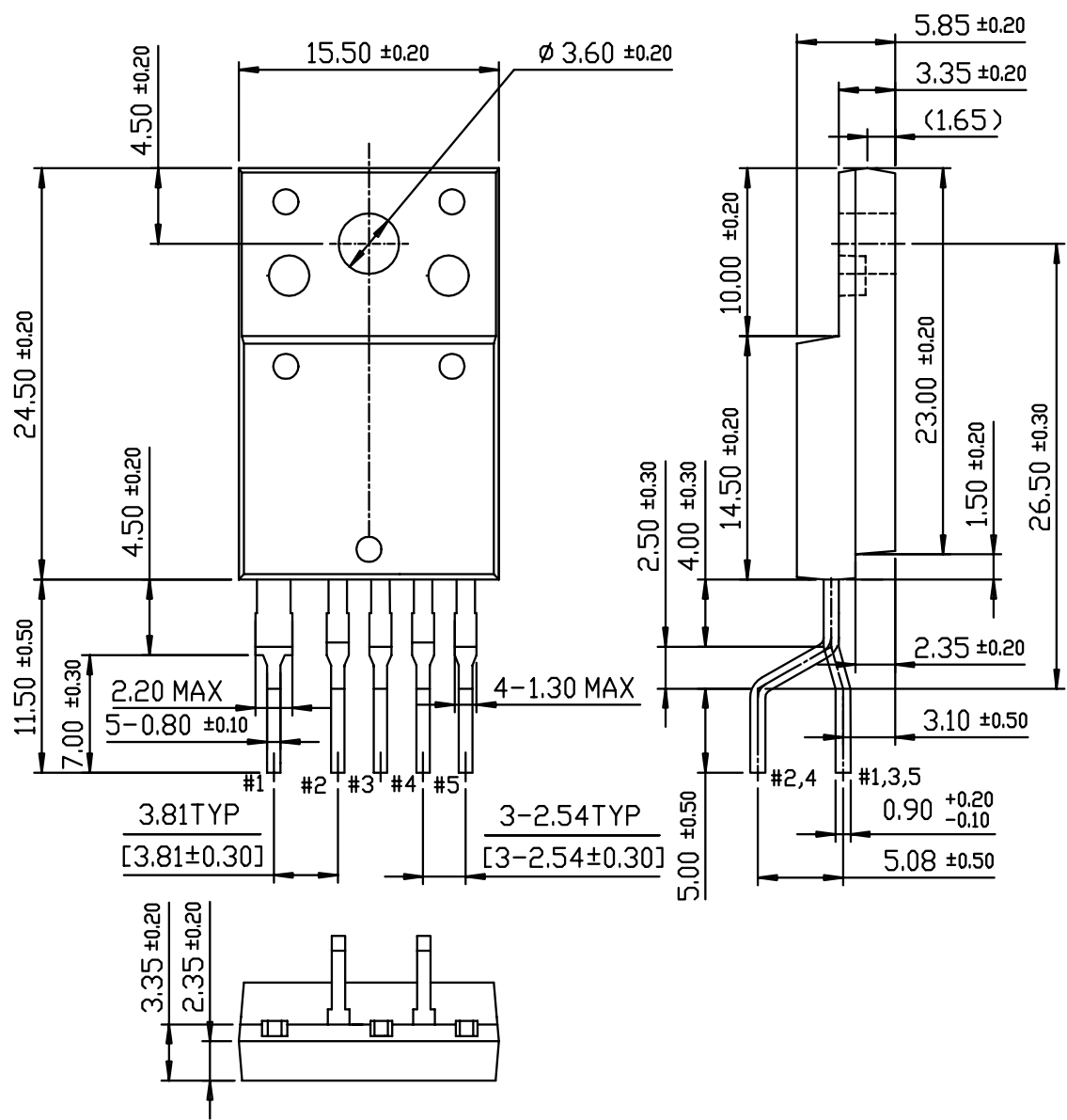
Package Dimensions (Continued)

TO-3PF-5L



Package Dimensions (Continued)

TO-3PF-5L(Forming)



Ordering Information

Product Number	Package	Rating	IOVER
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

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