# 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

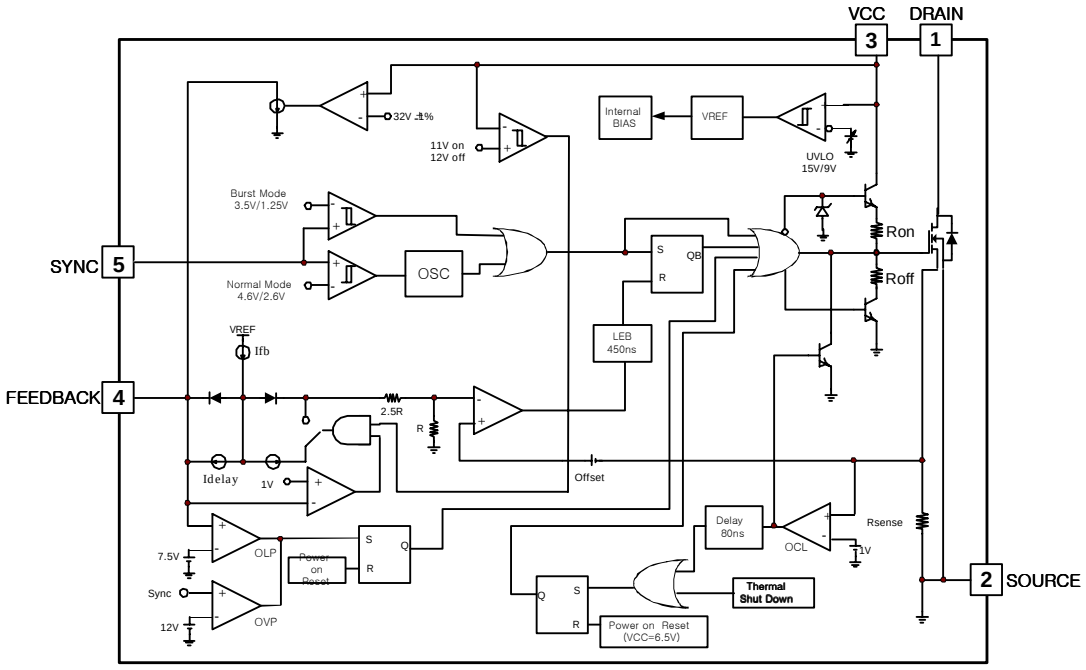
### Description

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) | $V_{DD}$=0.5$BV_{DSS}$, $I_D$=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, $V_{DS}$=0.5$BV_{DSS}$(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) | $V_{DD}$=0.5$BV_{DSS}$, $I_D$=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, $V_{DS}$=0.5$BV_{DSS}$(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) | $V_{DD}$=0.5$BV_{DSS}$, $I_D$=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, $V_{DS}$=0.8$BV_{DSS}$ (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) | $\Delta F_{OSC}$ | -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

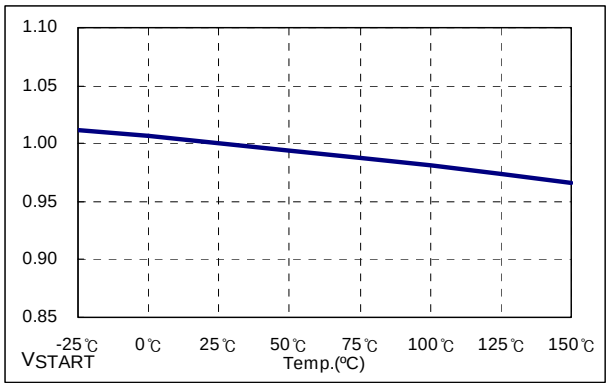



**Figure 1. Start Threshold Voltage**

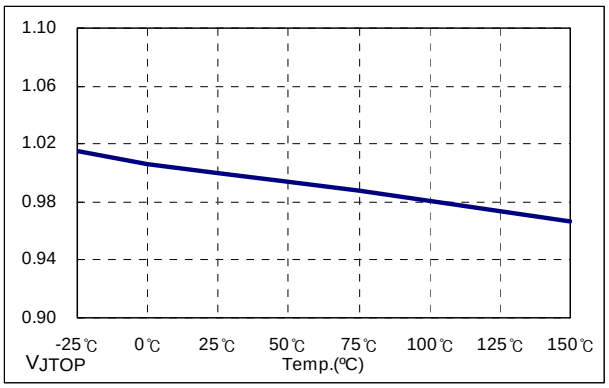



**Figure 2. Stop Threshold Voltage**

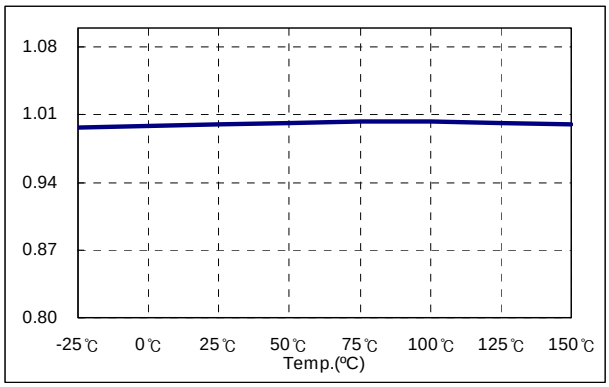



**Figure 3. Start Up Current**

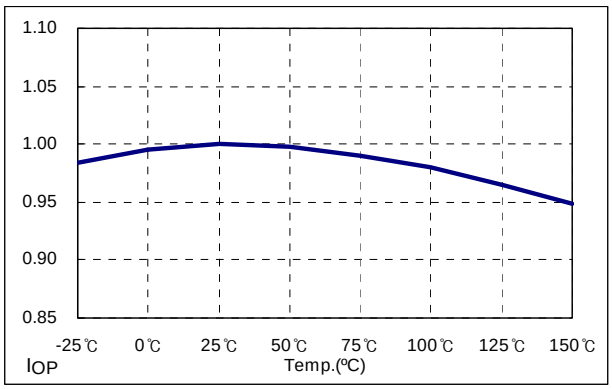



**Figure 4. Operting Supply Current**

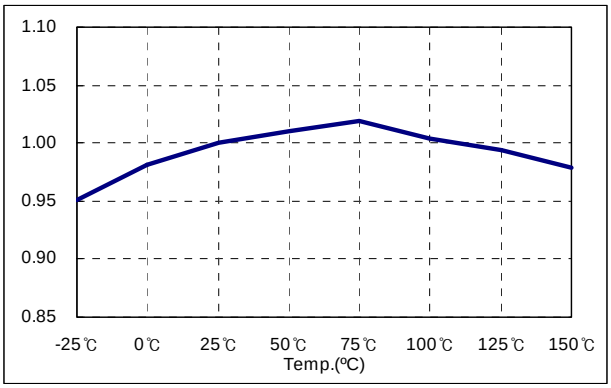



**Figure 5. Initial Freqency**

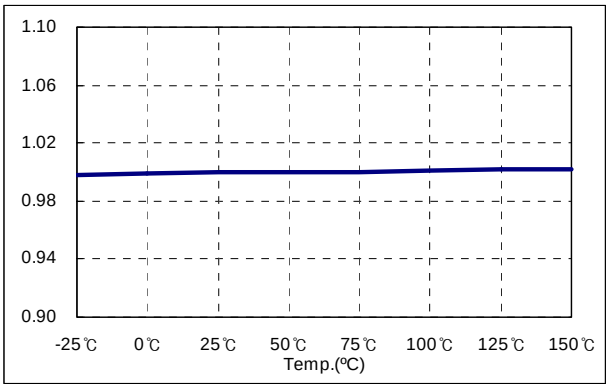



**Figure 6. Maximum Duty**

## Typical Performance Characteristics (Continued)

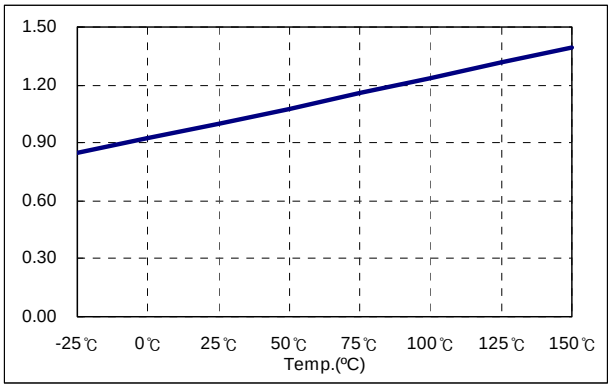



**Figure 7. Feedback Offset Voltage**

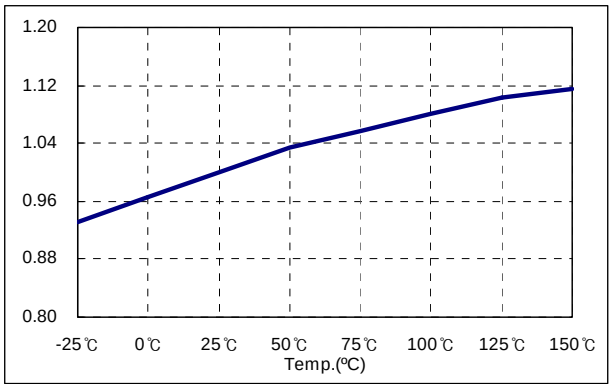



**Figure 8. Feedback Source Current**

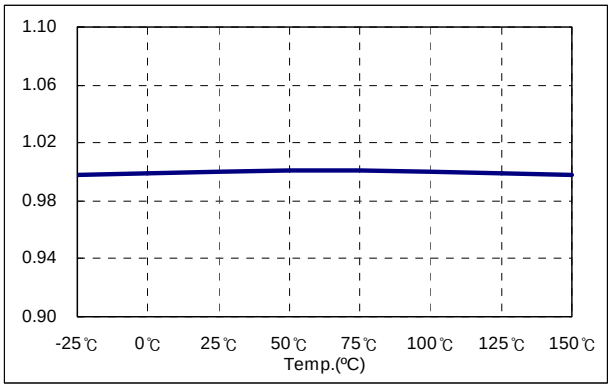



**Figure 9. Over Voltage Protection**

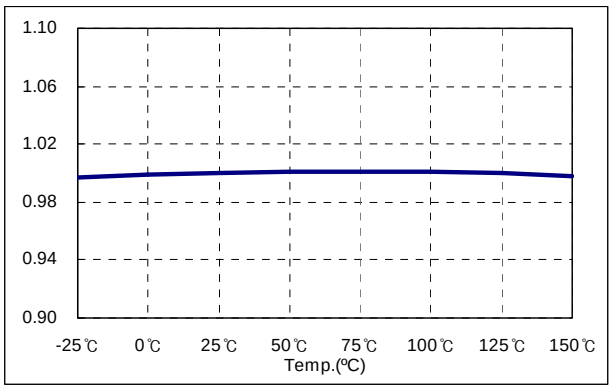



**Figure 10. Shutdown Feedback Voltage**

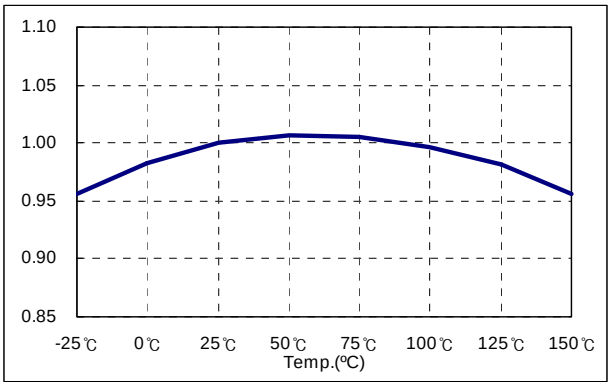



**Figure 11. Shutdown Delay Current**

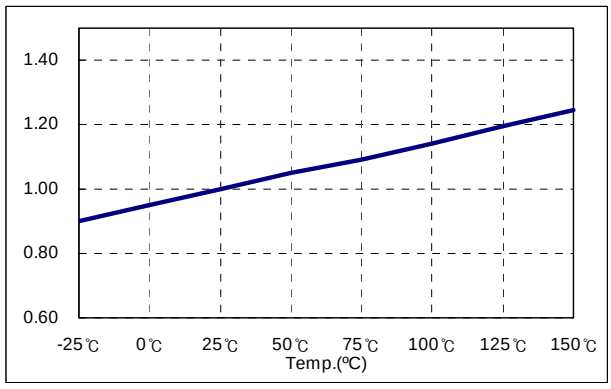



**Figure 12. Burst mode Enable Feedback Voltage**

## Typical Performance Characteristics (Continued)

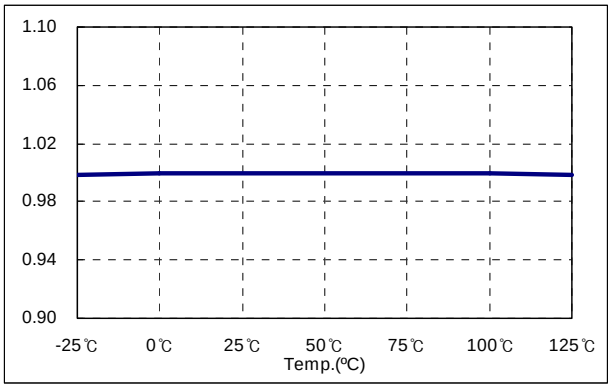



**Figure 13. Burst mode Low Threshold Voltage**

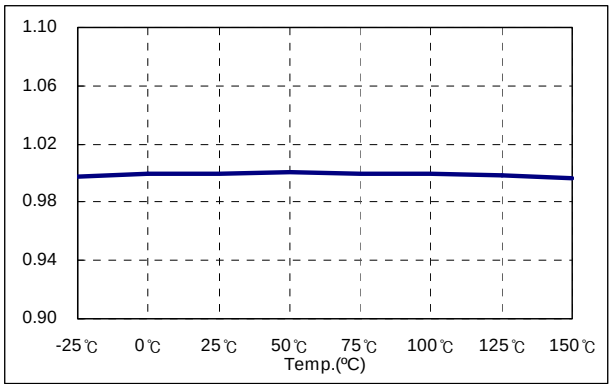



**Figure 14. Burst mode HighThreshold Voltage**

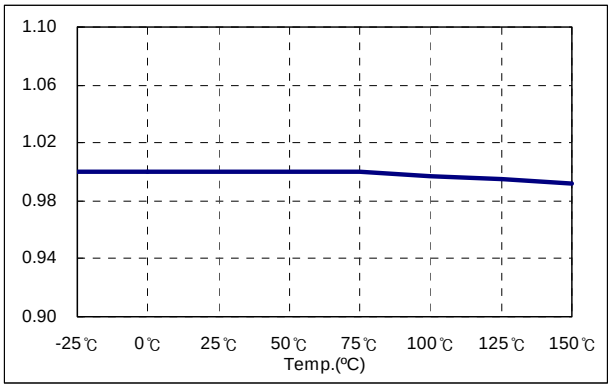



**Figure 15. Burst Sync. High Threshold Voltage**

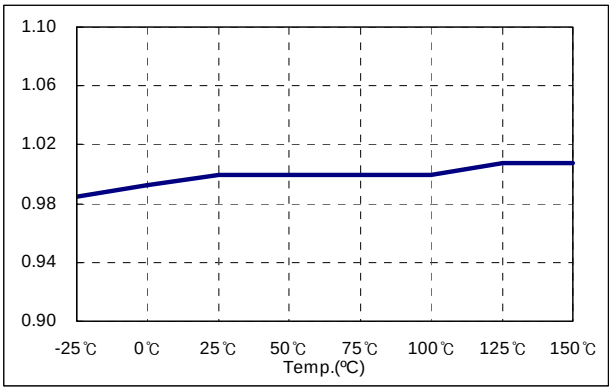



**Figure 16. Burst Sync. Low Threshold Voltage**

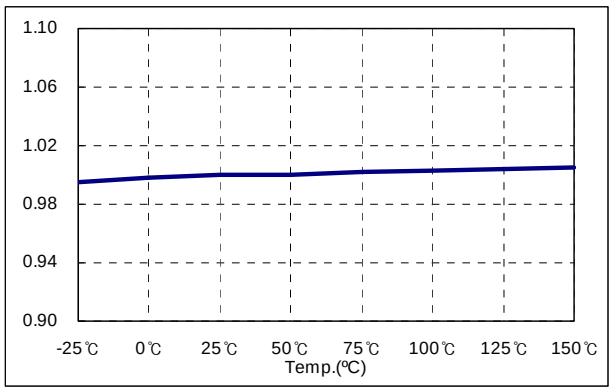



**Figure17. Primary Regulation Threshold Voltage**

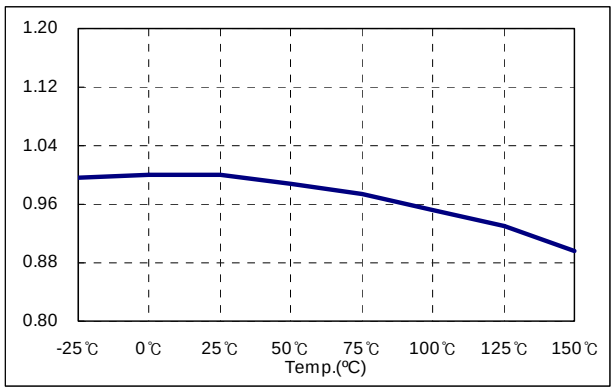



**Figure 18. Primary Regulation Transconductance**

## Typical Performance Characteristics (Continued)

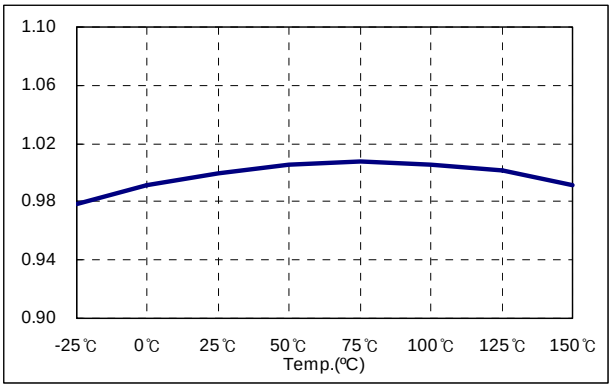



**Figure 19. Peak Current Limit**

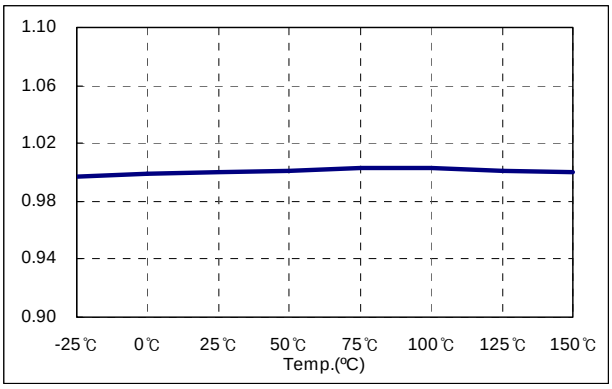



**Figure 20. Burst mode Peak Current Limit**

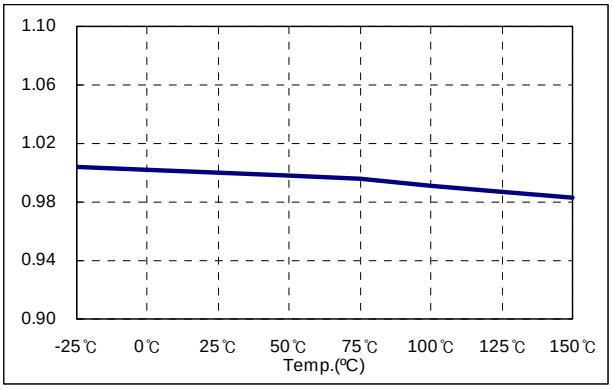



**Figure 21. Normal Sync. High Threshold Voltage**

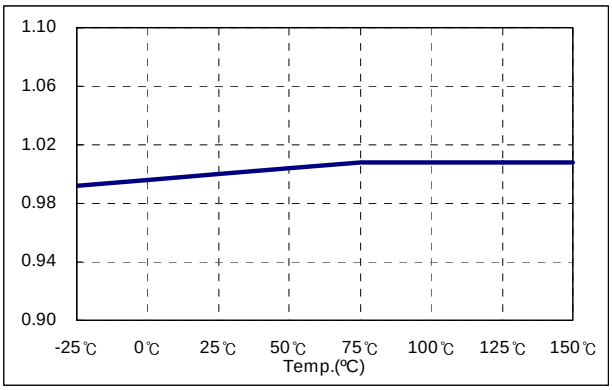
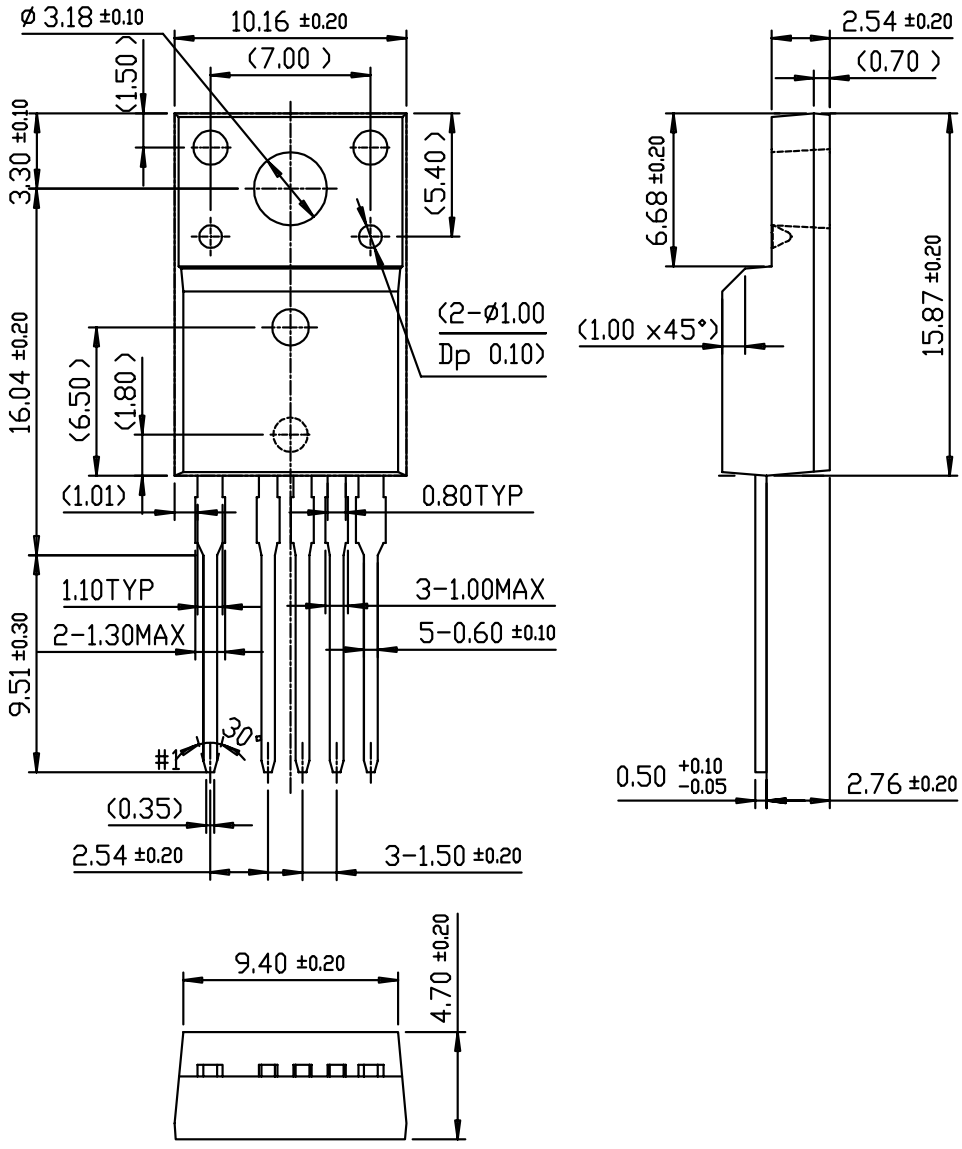



**Figure 22. Normal Sync. Low Threshold Voltage**

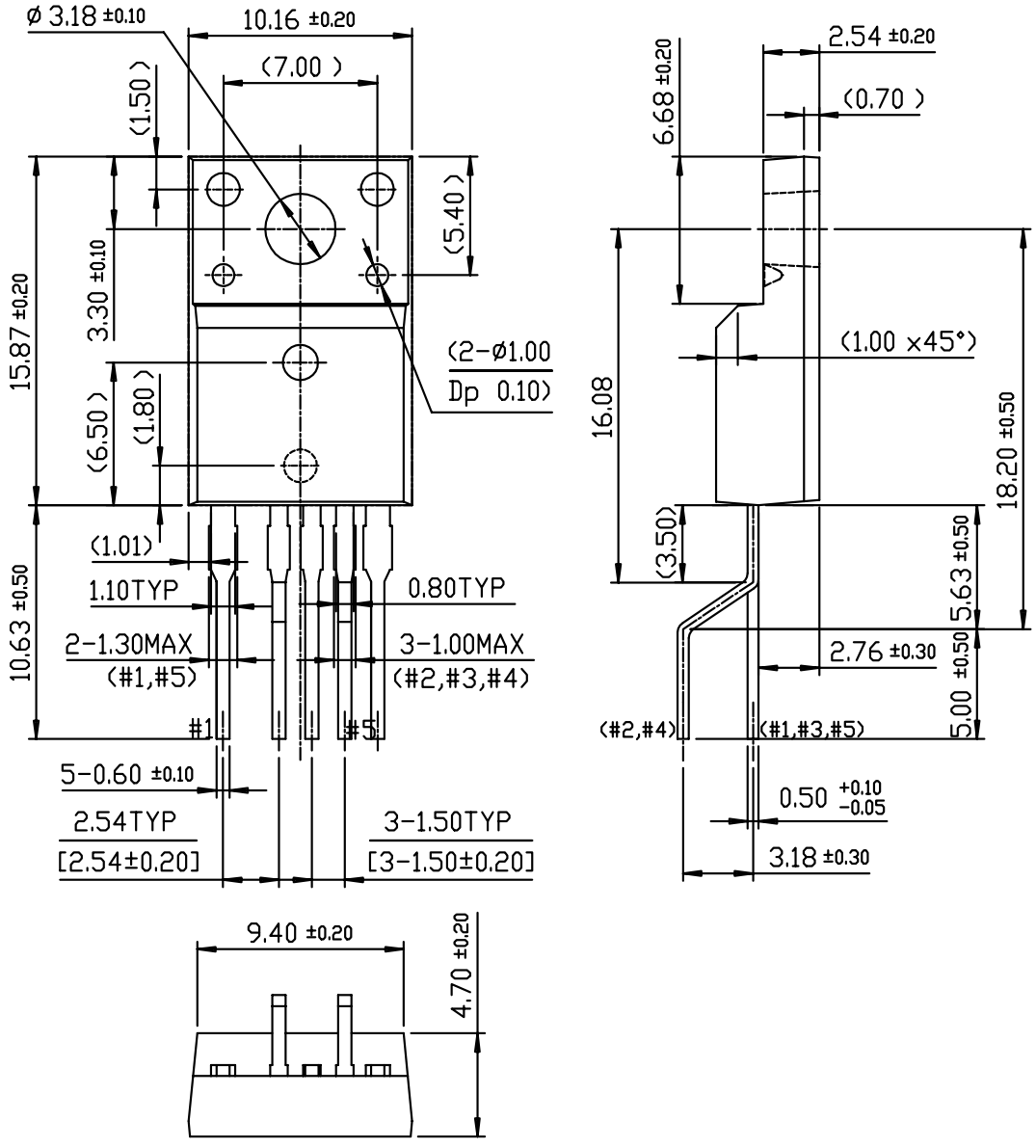
## Package Dimensions

# TO-220F-5L



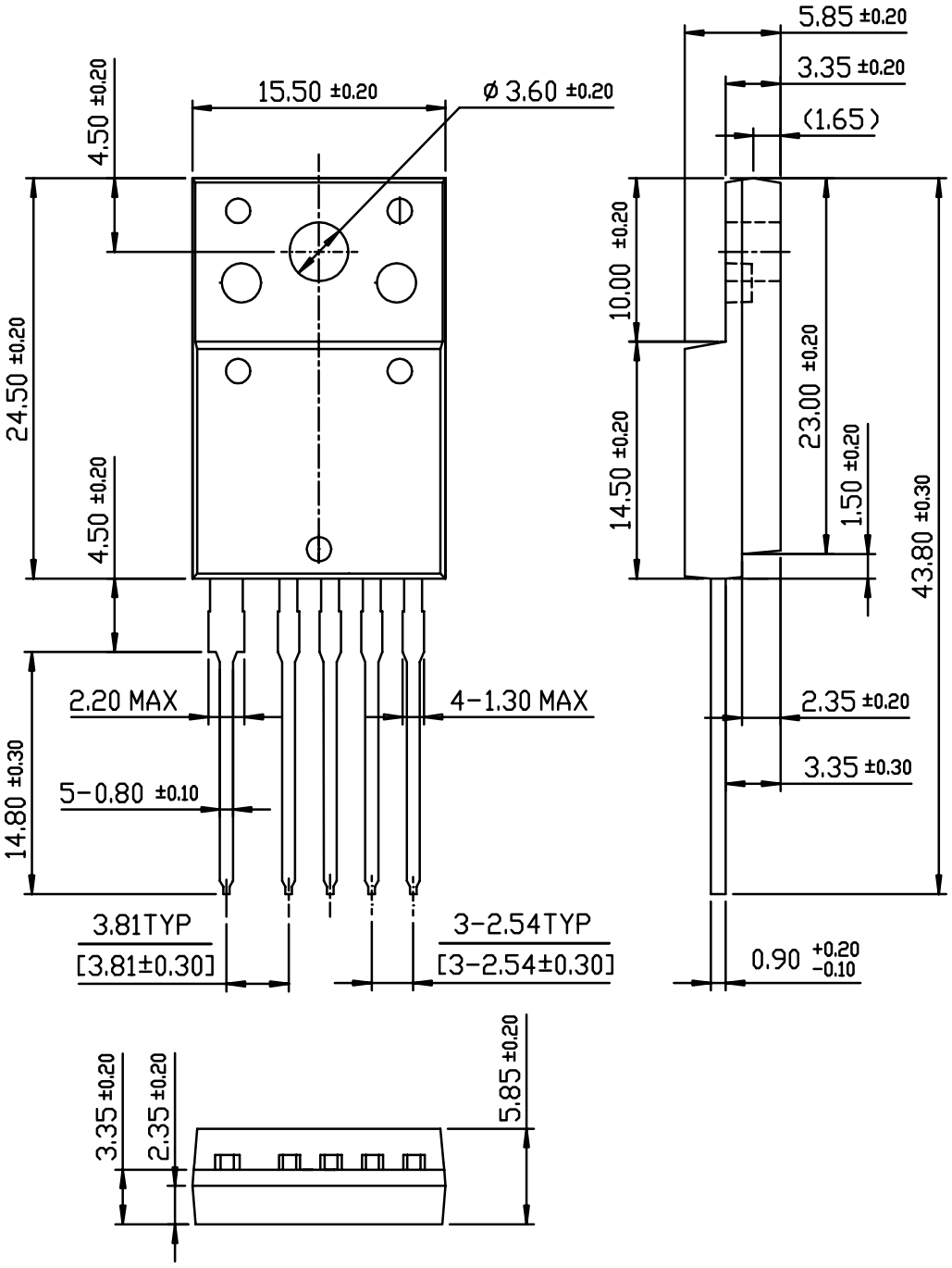
## Package Dimensions (Continued)

# TO-220F-5L(Forming)



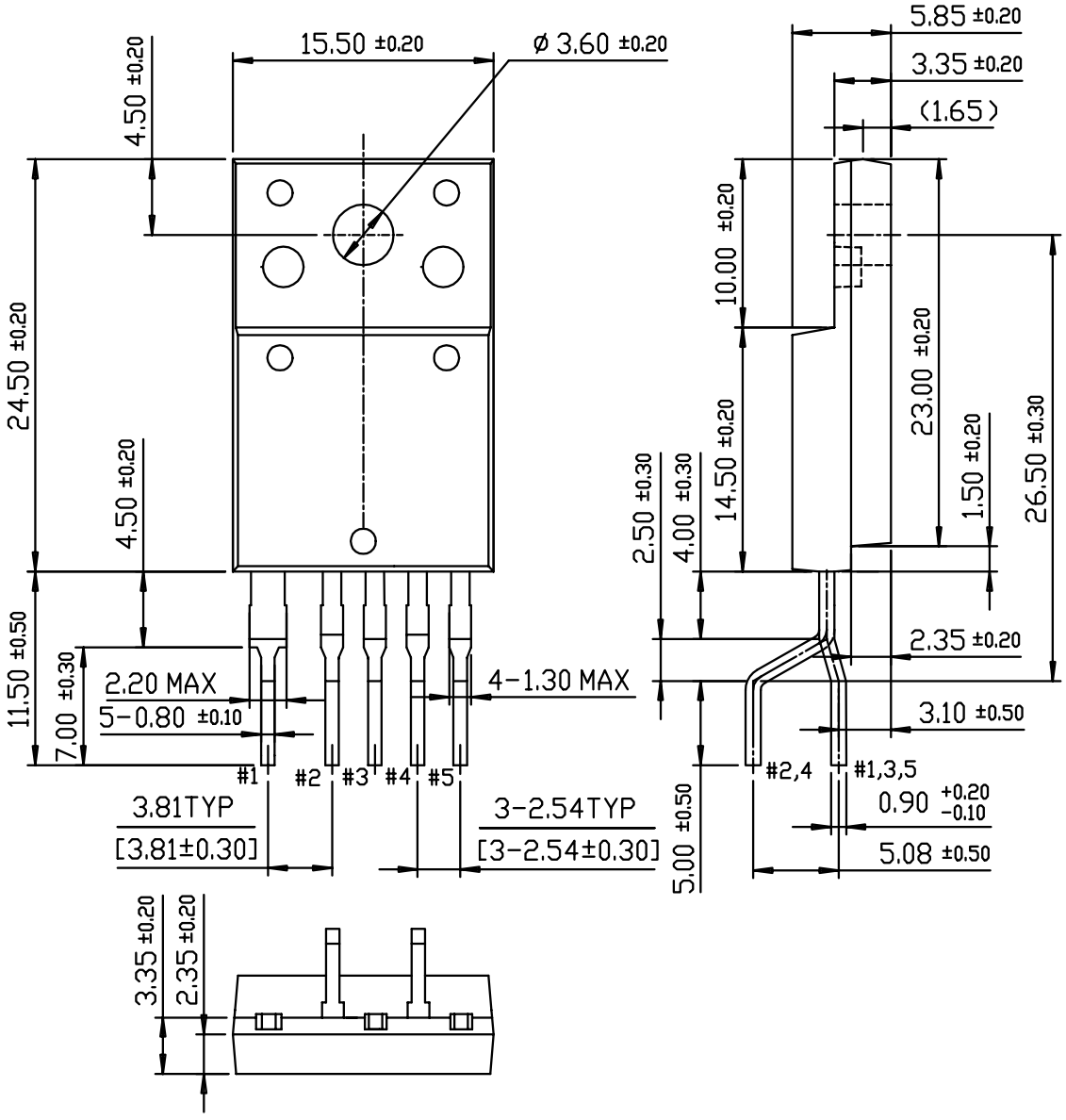
## Package Dimensions (Continued)

# TO-3PF-5L



## Package Dimensions (Continued)

# TO-3PF-5L(Forming)



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| 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

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