FS6S-SERIES

FS6S0965R/FS6S0965RT/FS6S1265R/FS6S15658R

Fairchild Power Switch(SPS)

Features

- Wide Operating Frequency Range Up to 150Khz
- Lowest Cost SMPS Solution
- Lowest External Components
- Low Start-up Current (max:170uA)
- Low Operating Current (max:15mA)
- Internal High Voltage SenseFET
- Built-in Auto-Restart Circuit
- Over Voltage Protection (Auto Restart Mode)
- Over Load Protection (Auto Restart Mode)
- Over Current Protection With Latch Mode
- Internal Thermal Protection With Latch Mode
- Pulse By Pulse Over Current Limiting
- Internal Burst Mode Controller for Stand-by Mode
- Under Voltage Lockout With Hysteresis
- External Sync. Terminal

TO-3P-5L

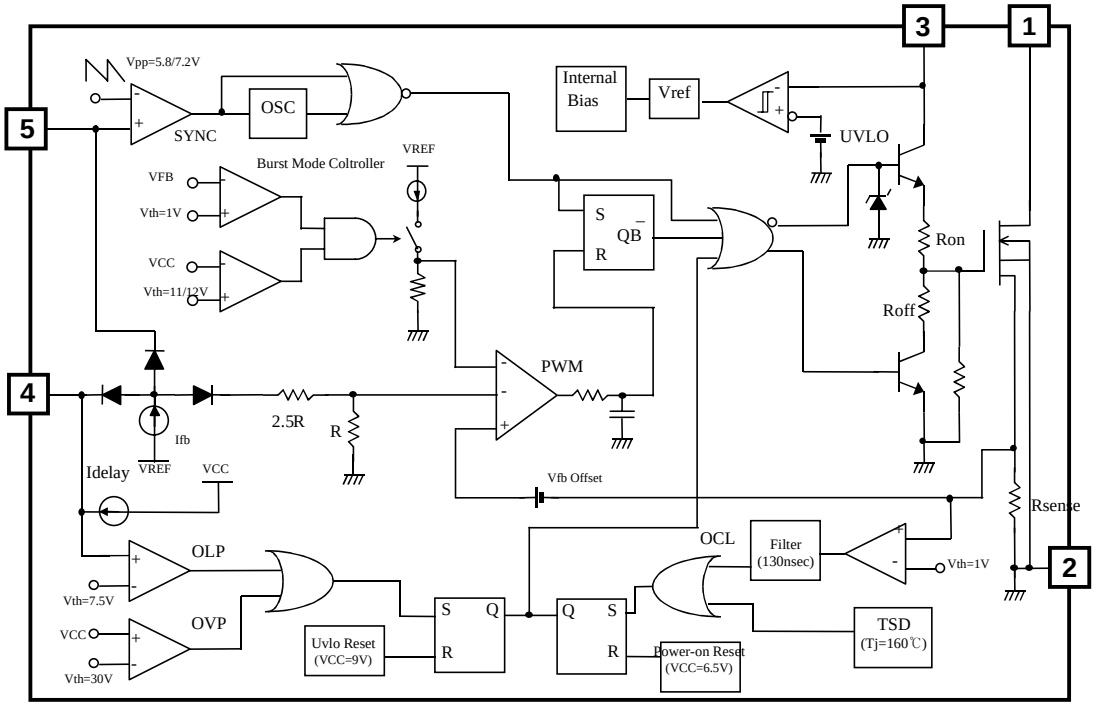
1

TO-220F-5L

1

1. Drain 2. Gnd 3. V_{CC} 4. FeedBack 5. Sync.

Internal Block Diagram



Rev.1.0.1

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Absolute Maximum Ratings

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value		Unit
FS6S0965RT/FS6S0965R				
Drain to PKG Breakdown Voltage	BV_{PKG}	FS6S0965RT	3500	V
Maximum Drain Voltage	$V_{D,MAX}$	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	9		ADC
Continuous Drain Current (Tc = 100°C)	I_D	7.2		ADC
Single Pulsed Avalanch Current(Energy (2))	I_{AS}(E_{AS})	25(950)		A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	35		V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}		V
	V_{SS}	-0.3 to 10		V
Total Power Dissipation	P_D (Watt H/S)	**FS6S0965RT**	48	W
		FS6S0965R	170	
	Derating	**FS6S0965RT**	0.385	W / °C
		FS6S0965R	1.33	
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
FS6S1265R				
Maximum Drain Voltage	$V_{D,MAX}$	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}	48		ADC
Continuous Drain Current (Tc = 25°C)	I_D	12		ADC
Continuous Drain Current (Tc = 100°C)	I_D	8.4		ADC
Single Pulsed Avalanch Current(Energy (2))	I_{AS}(E_{AS})	30(950)		A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	35		V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}		V
	V_{SS}	-0.3 to 10		V
Total Power Dissipation	P_D (Watt H/S)	240		W
	Derating	1.92		W / °C
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

Absolute Maximum Ratings (Continued)

(Ta=25°C, unless otherwise specified)

Characteristic	Symbol	Value	Unit
FS6S15658R			
Maximum Drain Voltage	$V_{D,MAX}$	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	15	ADC
Continuous Drain Current (Tc = 100°C)	I_D	12.0	ADC
Single Pulsed Avalanch Current(Energy (2))	I_{AS}(E_{AS})	37(--)	A(mJ)
Maximum Supply Voltage	$V_{CC,MAX}$	35	V
Input Voltage Range	V_{FB}	-0.3 to V_{CC}	V
	V_{SS}	-0.3 to 10	V
Total Power Dissipation	P_D (Watt H/S)	280	W
	Derating	2.22	W / °C
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

Notes :

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
FS6S0965RT/FS6S0965R						
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=125°C	-	-	300	μA
Static Drain-Source On Resistance (1)	$R_{DS(on)}$	V_{GS}=10V, I_D=4.5A	-	1.1	1.2	Ω
Forward transconductance(1)	gfs	V_{DS}=50V, I_D=4.5A	-	-	-	S
Input capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f = 1MHz	-	1300	-	pF
Output capacitance	Coss		-	135	-	
Reverse transfer capacitance	Crss		-	25	-	
Turn on delay time	td(on)	V_{DD}=0.5BV_{DSS}, I_D=9.0A (MOSFET switching time are essentially independent of operating temperature)	-	25	-	nS
Rise time	tr		-	75	-	
Turn off delay time	td(off)		-	130	-	
Fall time	tf		-	70	-	
Total gate charge (gate-source+gate-drain)	Qg	V_{GS}=10V, I_D=9.0A, V_{DS}=0.5BV_{DSS}(MOSFET Switching time are Essentially independent of Operating temperature)	-	45	-	nC
Gate-source charge	Qgs		-	8	-	
Gate-drain (Miller) charge	Qgd		-	22	-	
FS6S1265R						
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=125°C	-	-	300	μA
Static Drain-Source On Resistance (1)	$R_{DS(on)}$	V_{GS}=10V, I_D=4.5A	-	0.7	0.9	Ω
Forward transconductance(1)	gfs	V_{DS}=50V, I_D=4.5A	-	-	-	S
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	-	nC
Gate-source charge	Qgs		-	10	-	
Gate-drain (Miller) charge	Qgd		-	30	-	

Electrical Characteristics (SFET Part; Continued)

(Ta = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
FS6S15658R						
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=125°C	-	-	300	μA
Static Drain-Source On Resistance (1)	$R_{DS(on)}$	V_{GS}=10V, I_D=4.5A	-	0.5	0.65	Ω
Forward transconductance(1)	gfs	V_{DS}=50V, I_D=4.5A	-	-	-	S
Input capacitance	Ciss	V_{GS}=0V, V_{DS}=25V, f = 1MHz	-	2590	-	pF
Output capacitance	Coss		-	270	-	
Reverse transfer capacitance	Crss		-	50	-	
Turn on delay time	td(on)	V_{DD}=0.5BV_{DSS}, I_D=15.0A (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=15.0A, V_{DS}=0.5BV_{DSS}(MOSFET Switching time are Essentially independent of Operating temperature)	-	90	-	nC
Gate-source charge	Qgs		-	15	-	
Gate-drain (Miller) charge	Qgd		-	45	-	

Note:

(1) Pulse Test : Pulse width ≤300uS, Duty Cycle ≤ 2 %

(2) $S = \frac{1}{R}$

Electrical Characteristics (CONTROL Part)

(V_{CC}=16V, Tamb = 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}	-	22	25	28	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	1.6	2.0	2.4	μA
SYNC. & SOFTSTART SECTION						
Softstart Voltage	V_{SS}	V_{FB}=2V	4.7	5.0	5.3	V
Softstart Current	I_{SS}	V_{SS}=0V	0.8	1.0	1.2	mA
Sync High Threshold Voltage(Note3)	V_{SYNCH}	V_{CC}=16V , V_{FB}=5V	-	7.2	-	V
Sync Low Threshold Voltage(Note3)	V_{SYNCL}	V_{CC}=16V , V_{FB}=5V	-	5.8	-	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	0.6	0.85	1.1	A
Burst Mode Freqency	F_{BUR}	V_{CC}=10.5V , V_{FB}=0V	40	50	60	kHz
CURRENT LIMIT(SELF-PROTECTION)SECTION						
Peak Current Limit (Note4)	I_{OVER}	**FS6S0965R**	5.28	6.0	6.72	A
		FS6S1265R	7.04	8.0	8.96	
		FS6S15658R	7.04	8.0	8.96	
PROTECTION SECTION						
Over Voltage Protcetion	V_{OVP}	V_{CC} ≥ 27V	27	30	33	V
Over Current Latch voltage(Note3)	V_{OCL}	-	0.9	1.0	1.1	V
Thermal Shutdown Tempature(Note2)	TSD	-	140	160	-	°C
TOTAL DEVICE SECTION						
Start Up Current	I_{START}	V_{FB}=GND, V_{CC}=14V	-	0.1	0.17	mA
Operating Supply Current(Note1)	I_{OP}	V_{FB}=GND, V_{CC}=16V	-	10	15	mA
	$I_{OP(MIN)}$	V_{FB}=GND, V_{CC}=12V				
	$I_{OP(MAX)}$	V_{FB}=GND, V_{CC}=30V				

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

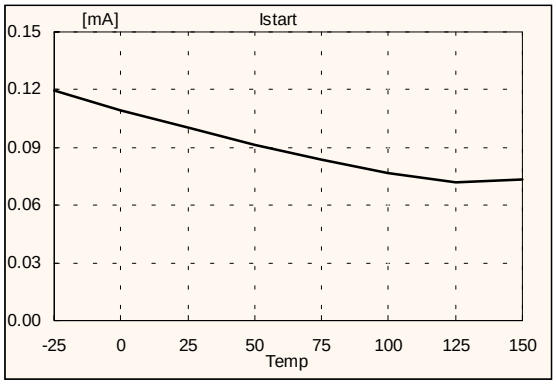


Figure 1. Start Up Current vs. Temp.

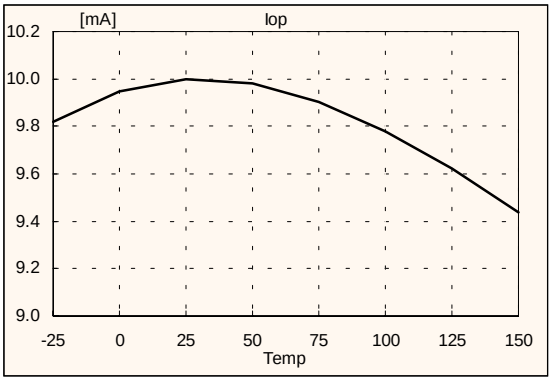


Figure 2. Operating Supply Current vs. Temp.

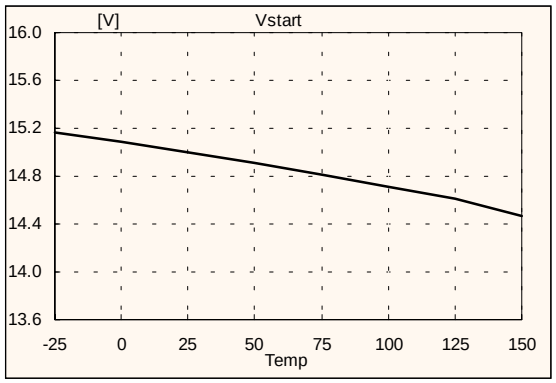


Figure 3. Start Threshold Voltage vs. Temp.

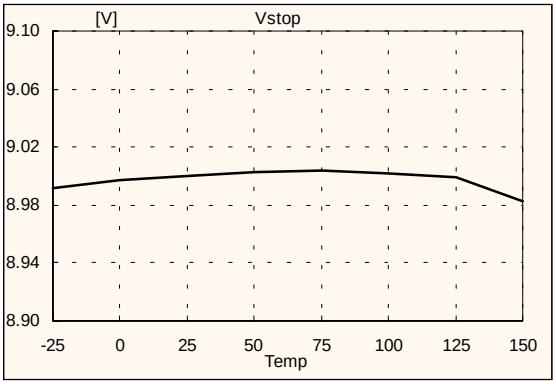


Figure 4. Stop Threshold Voltage vs. Temp.

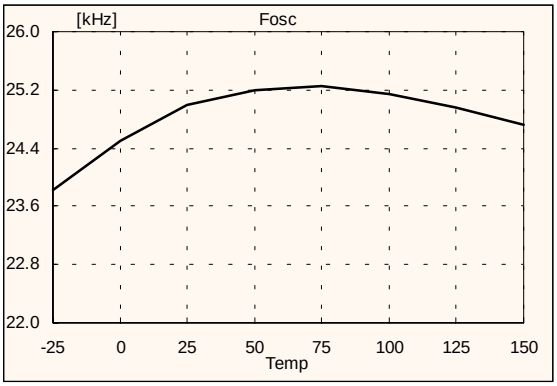


Figure 5. Initial Frequency vs. Temp.

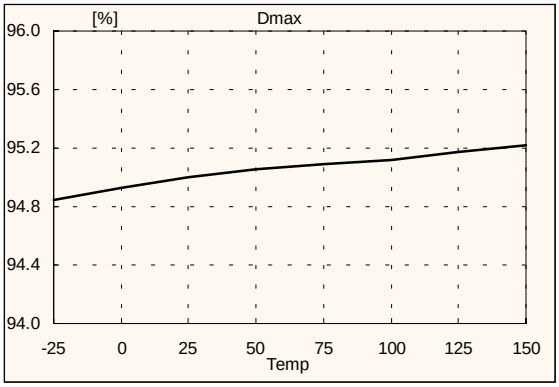


Figure 6. Maximum Duty vs. Temp.

Typical Performance Characteristics (Continued)

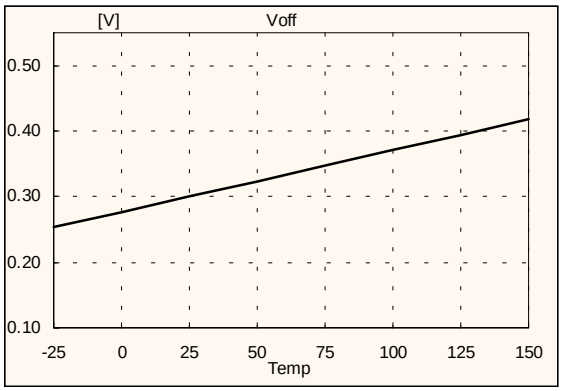


Figure 7. Feedback Offset Voltage vs. Temp.

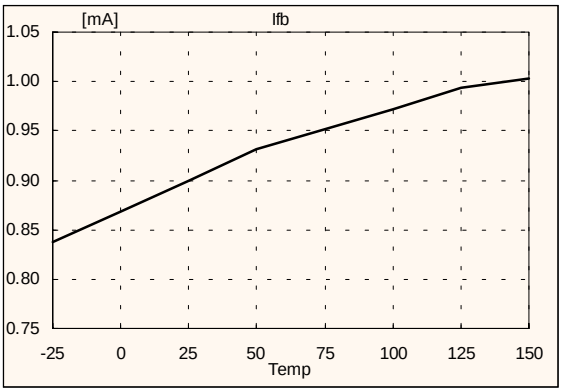


Figure 8. Feedback Source Current vs. Temp.

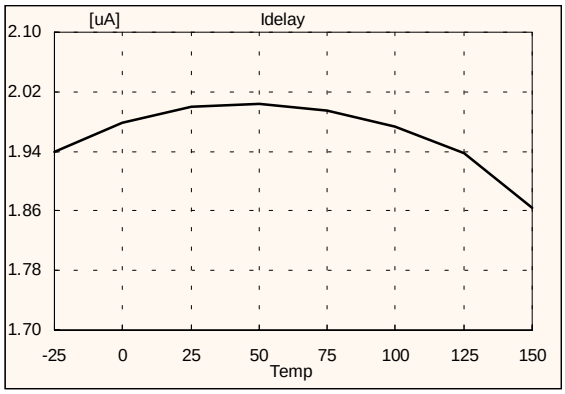


Figure 9. Shutdown Delay Current vs. Temp.

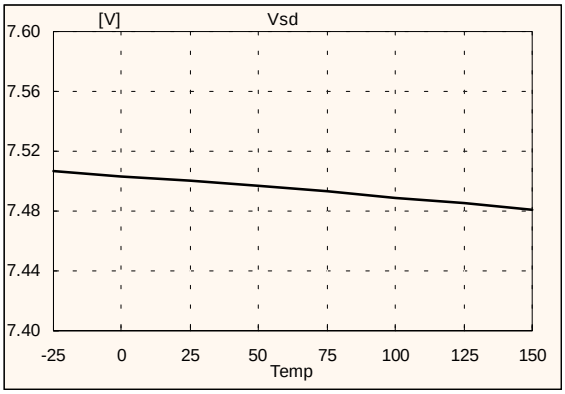


Figure 10. Shutdown Feedback Voltage vs. Temp.

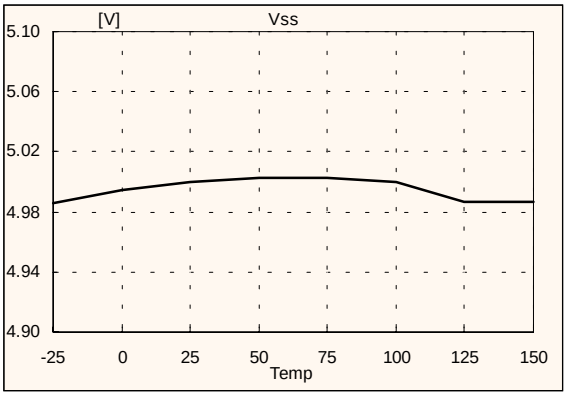


Figure 11. Softstart Voltage vs. Temp.

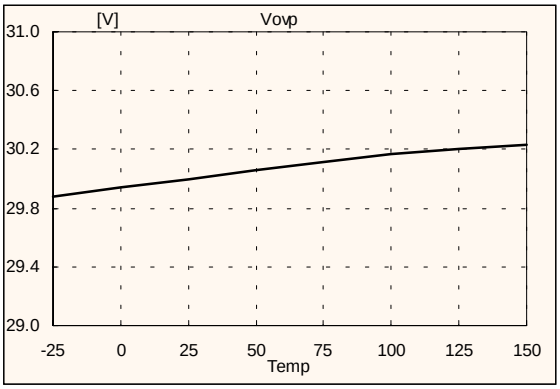


Figure 12. Over Voltage Protection vs. Temp.

Typical Performance Characteristics (Continued)

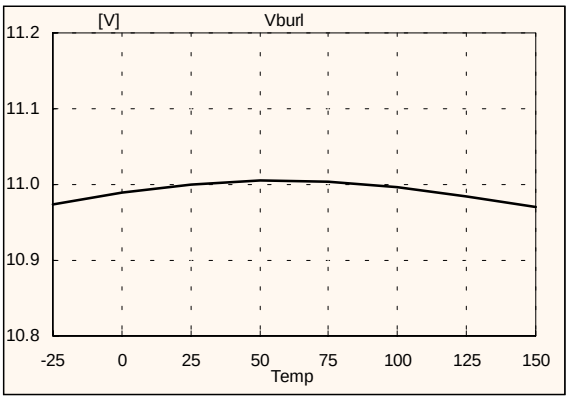


Figure 13. Burst Mode Low Voltage vs. Temp.

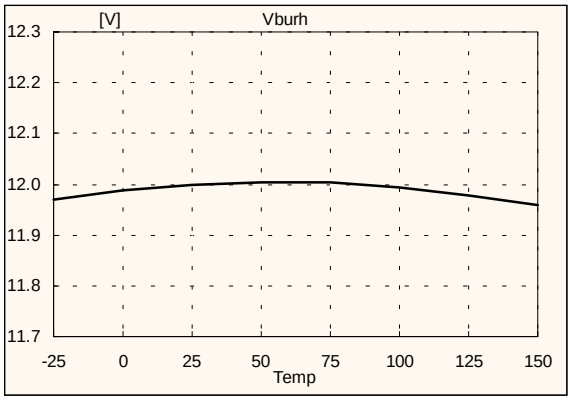


Figure 14. Burst Mode High Voltage vs. Temp.

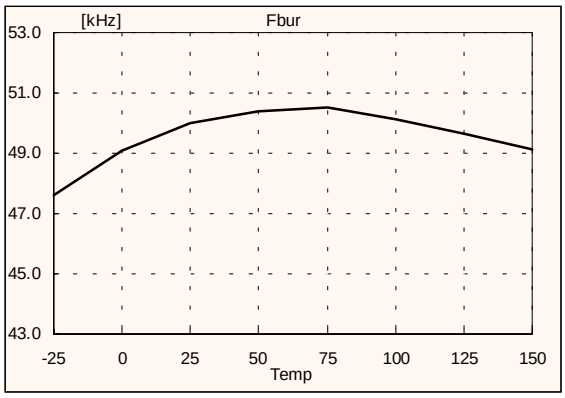


Figure 15. Burst Mode Frequency vs. Temp.

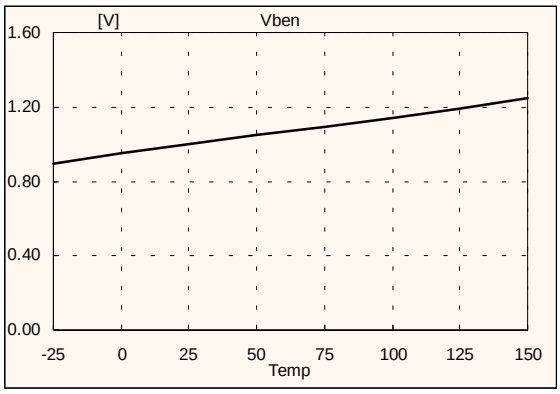


Figure 16. Burst Mode Enable Voltage vs. Temp.

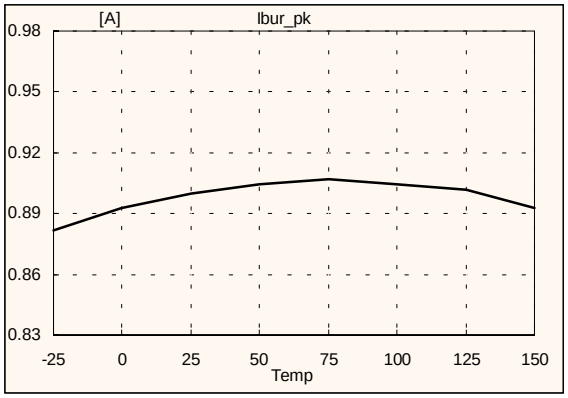


Figure 17. Burst Mode Peak Current vs. Temp.

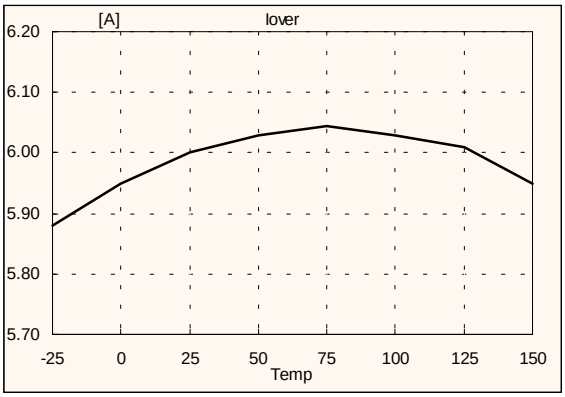
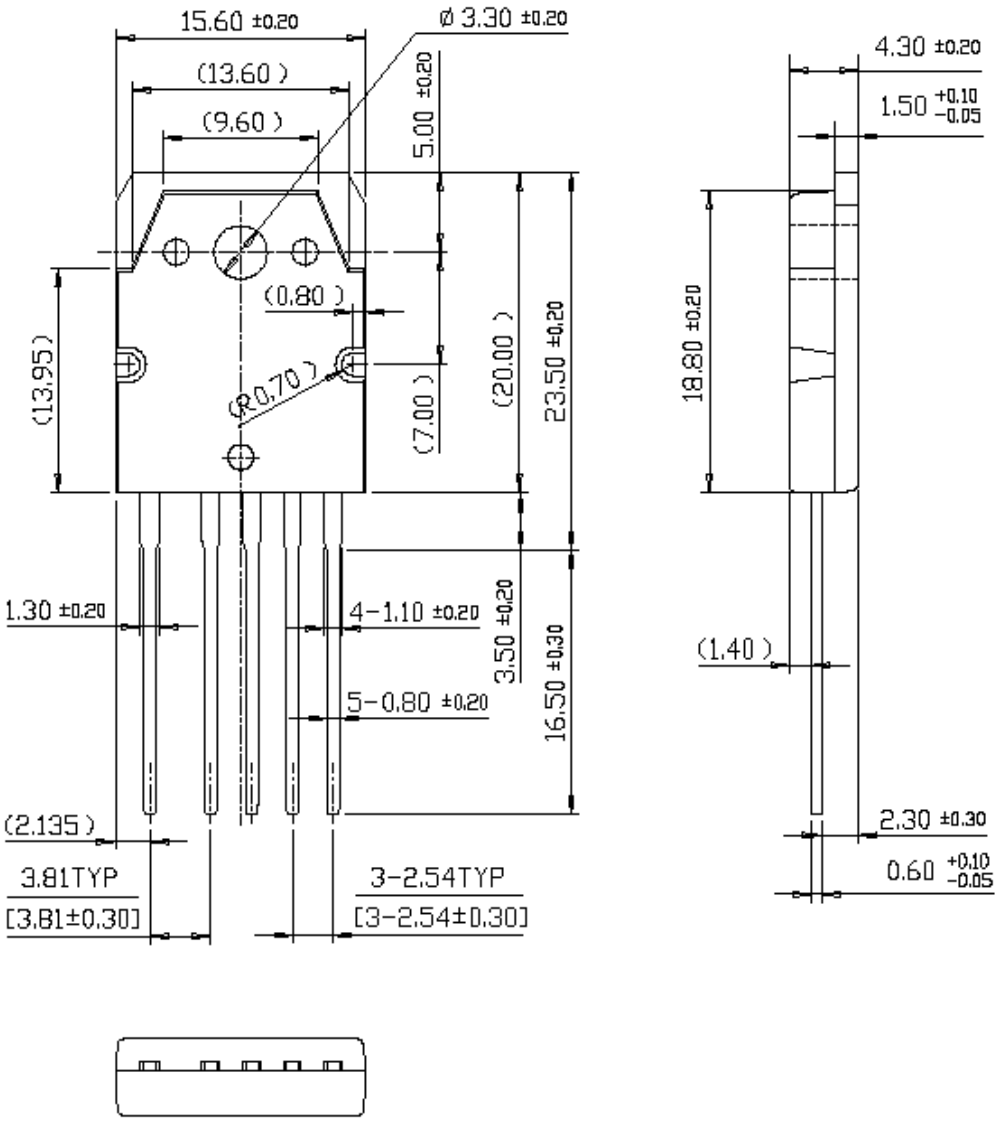


Figure 18. Peak Current Limit vs. Temp.

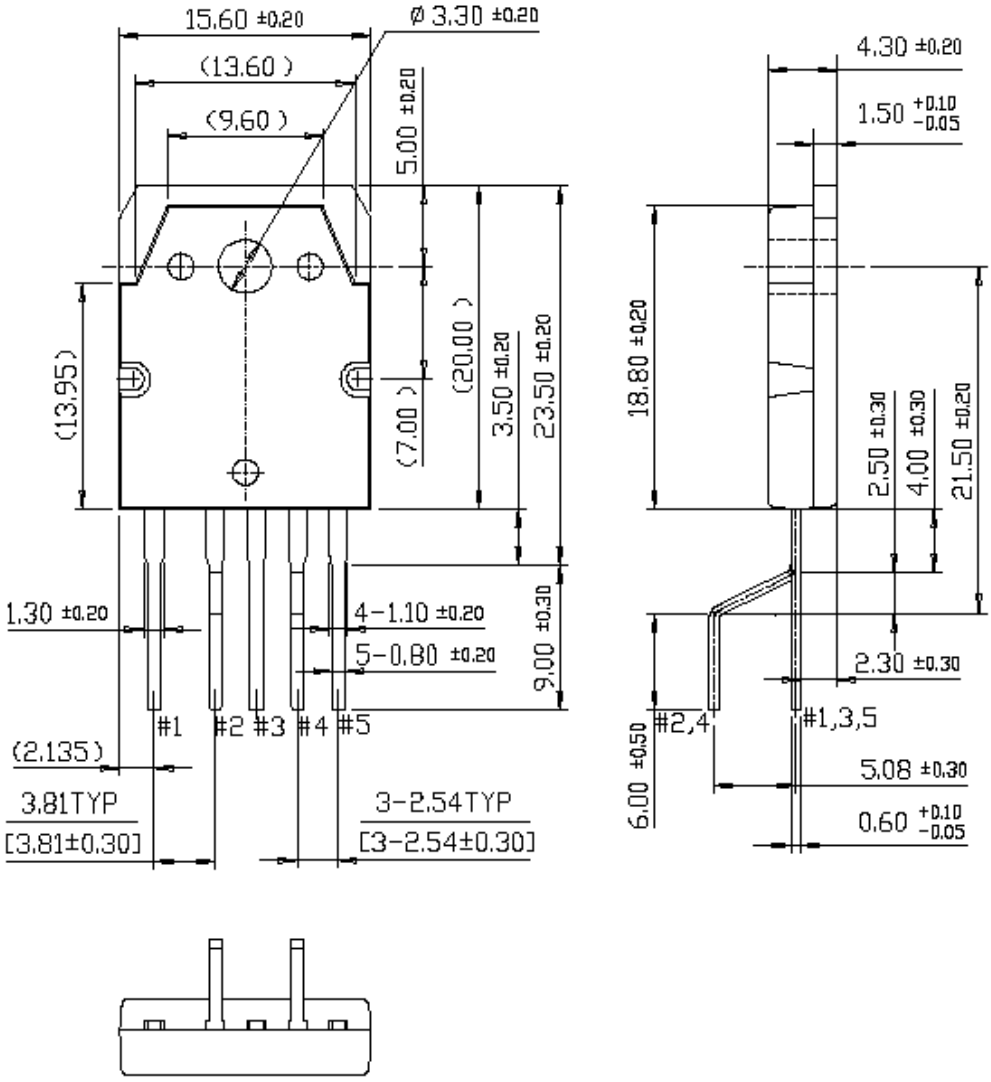
Package Dimensions

TO-3P-5L



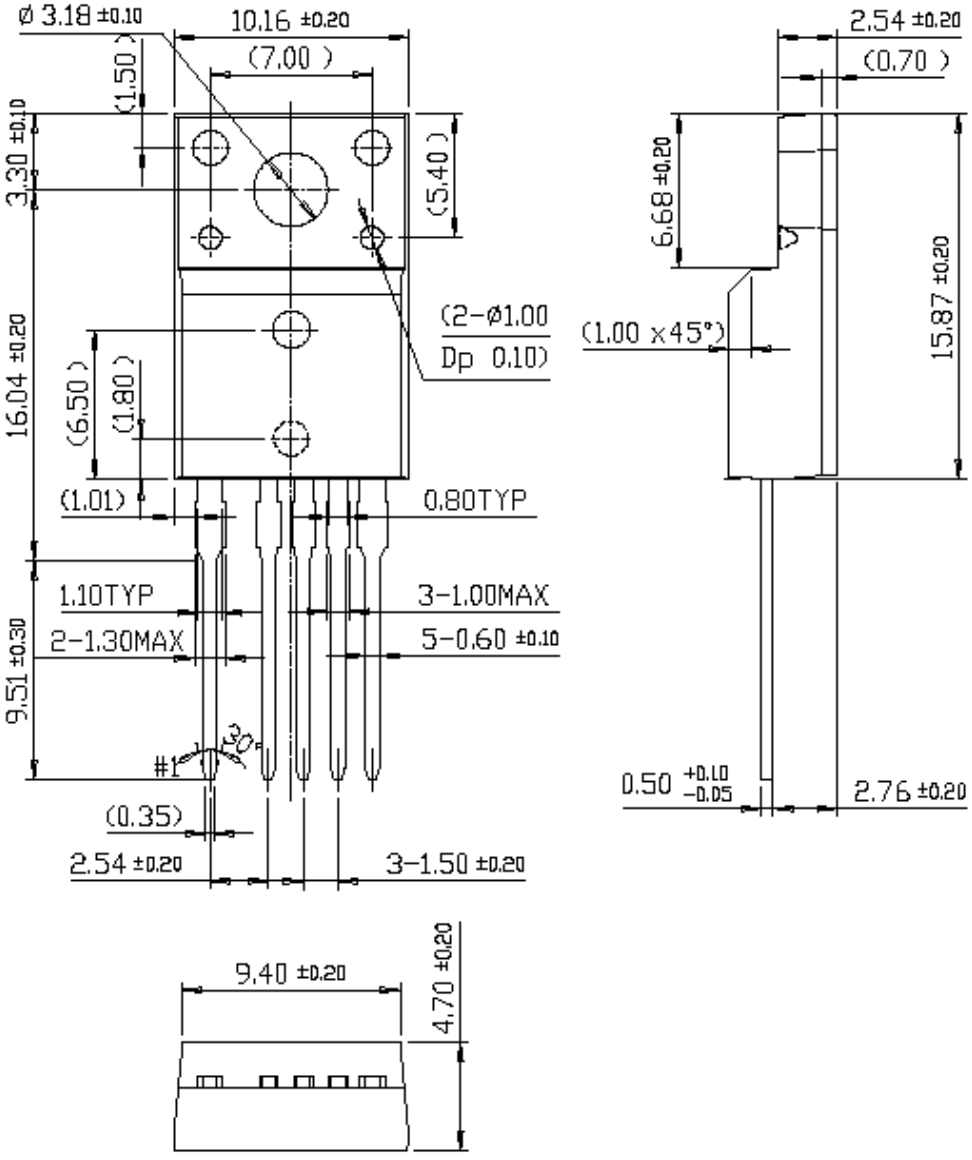
Package Dimensions (Continued)

TO-3P-5L (Forming)



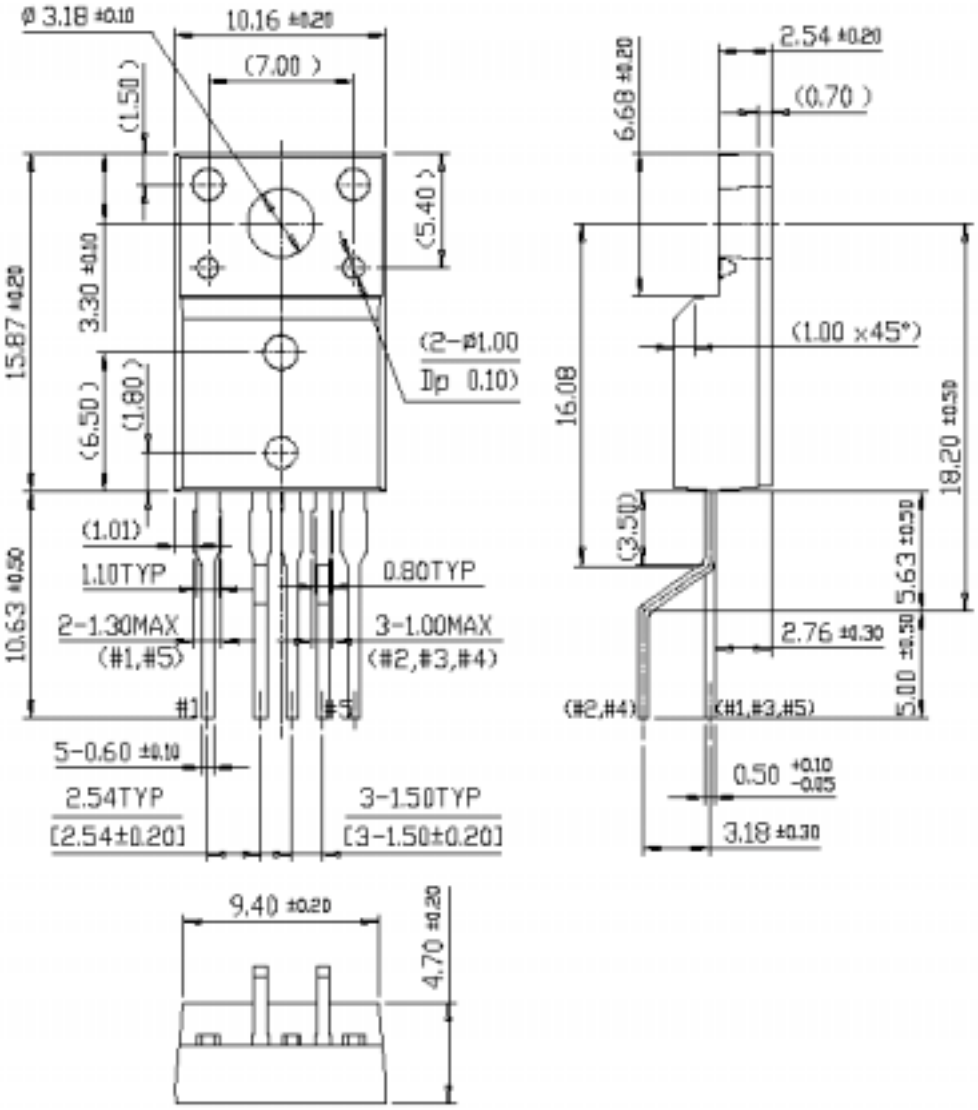
Package Dimensions (Continued)

TO-220F-5L

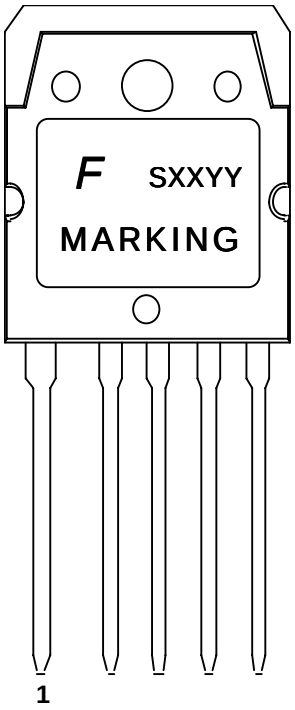


Package Dimensions (Continued)

TO-220F-5L (Forming)



TOP Mark and Pinout Information



Pin No.	Symbol	Description
1	Drain	SenseFET Drain
2	GND	Ground (Source)
3	V_{CC}	Control Part Supply Input
4	F/B	PWM Non Inverting Input
5	S/S	Soft start & External Sync.

Device	MARKING
FS6S0965R	6S0965R
FS6S0965RT	
FS6S1265R	6S1265R
FS6S15658R	6S15658R

Notes ;
(1) *F* ; Fairchild Semiconductor
(2) 6S0965R, 6S1265R, 6S15658R ; Device Marking Name
(3) S: Plant Code (SPS: S)
(4) XX: Patweek Based on Fairchild Semiconductor Work Month Calender
(5) YY: Last Two Digit of Calender Year

Ordering Information

Product Number	Package	Marking Code	BVdss	Rds(on)
FS6S0965R-TU	TO-3P-5L	6S0965R	650V	1.1Ω
FS6S0965R-YDTU	TO-3P-5L(Forming)			
FS6S0965RT-TU	TO-220F-5L	6S0965R	650V	1.1Ω
FS6S0965RT-YDTU	TO-220F-5L(Forming)			
FS6S1265R-TU	TO-3P-5L	6S1265R	650V	0.7Ω
FS6S1265R-YDTU	TO-3P-5L(Forming)			
FS6S15658R-TU	TO-3P-5L	6S15658R	650V	0.5Ω
FS6S15658R-YDTU	TO-3P-5L(Forming)			

TU : Non Forming Type
YDTU : Forming Type

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