FAIRCHILD SEMICONDUCTOR®

June 2006

FSCM0465R
Green Mode Fairchild Power Switch (FPS™)

Features

- Internal Avalanche Rugged SenseFET
- Low Start-up Current (max. 40μA)
- Low Power Consumption; under 1W at 240VAC and 0.4W Load
- Precise Fixed Operating Frequency (66kHz)
- Frequency Modulation for Low EMI
- Pulse-by-Pulse Current Limiting (Adjustable)
- Over-Voltage Protection (OVP)
- Overload Protection (OLP)
- Thermal Shutdown Function (TSD)
- Auto-Restart Mode
- Under-Voltage Lock Out (UVLO) with Hysteresis
- Built-in Soft-Start (15ms)

Applications

- SMPS for VCR, SVR, STB, DVD, and DVCD
- Adaptor
- SMPS for LCD Monitor

Related Application Notes

- **AN-4137**: Design Guidelines for Off-line Flyback Converters Using Fairchild Power Switch (FPS)
- **AN-4140**: Transformer Design Consideration for Off-line Flyback Converters using Fairchild Power Switch
- **AN-4141**: Troubleshooting and Design Tips for Fairchild Power Switch Flyback Applications
- **AN-4148**: Audible Noise Reduction Techniques for FPS Applications

Description

The FSCM0465R is an integrated Pulse-Width Modulator (PWM) and SenseFET specifically designed for high-performance offline Switch Mode Power Supplies (SMPS) with minimal external components. This device is an integrated high-voltage power-switching regulator that combines an avalanche rugged SenseFET with a current mode PWM control block. The PWM controller includes an integrated fixed-frequency oscillator, under-voltage lockout, leading edge blanking (LEB), optimized gate driver, internal soft-start, temperature-compensated precise current sources for a loop compensation, and self-protection circuitry. Compared with a discrete MOSFET and PWM controller solution, it can reduce total cost, component count, size, and weight while simultaneously increasing efficiency, productivity, and system reliability. This device is a basic platform well suited for cost-effective designs of flyback converters.

Ordering Information

Product Number	Package	Pb-Free	Marking Code	BV_{DSS}	$R_{DS(ON)}$ Max.	Packing Method
FSCM0465RJ	D2-PAK-6L	Yes	CM0465R	650V	2.6 Ω	Tube
FSCM0465RJX	D2-PAK-6L	Yes				Tape & Reel
FSCM0465RIWDTU(1)	I2-PAK-6L	Yes				Tube
FSCM0465RGWDTU(1)	TO-220-6L	Yes				Tube

Note:
1. WDTU: Forming Type

FPS™ is a trademark of Fairchild Semiconductor Corporation.

Typical Circuit

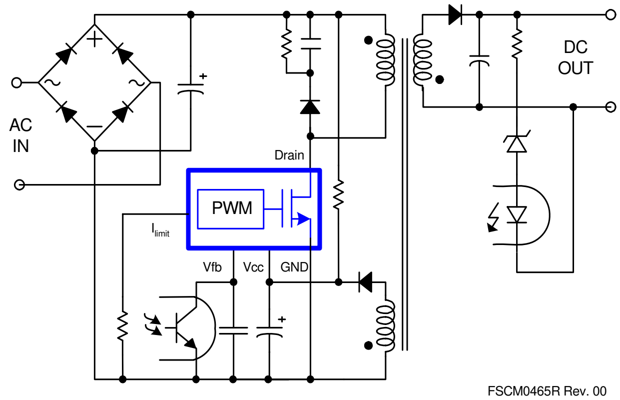


Figure 1. Typical Flyback Application

Output Power Table

Product	230VAC ±15%(3)		85–265VAC	
	Adapter(1)	Open Frame(2)	Adapter(1)	Open Frame(2)
FSCM0465RJ	40W	55W	30W	40W
FSCM0565RJ	50W	65W	40W	50W
FSCM0765RJ	65W	70W	50W	60W
FSCM0465RI	60W	70W	40W	50W
FSCM0465RG	60W	70W	40W	50W
FSCM0565RG	70W	85W	60W	70W
FSCM0765RG	85W	95W	70W	85W

Notes:
1. Typical continuous power in a non-ventilated enclosed adapter measured at 50°C ambient
2. Maximum practical continuous power in an open-frame design at 50°C ambient
3. 230 VAC or 100/115 VAC with doubler

Internal Block Diagram

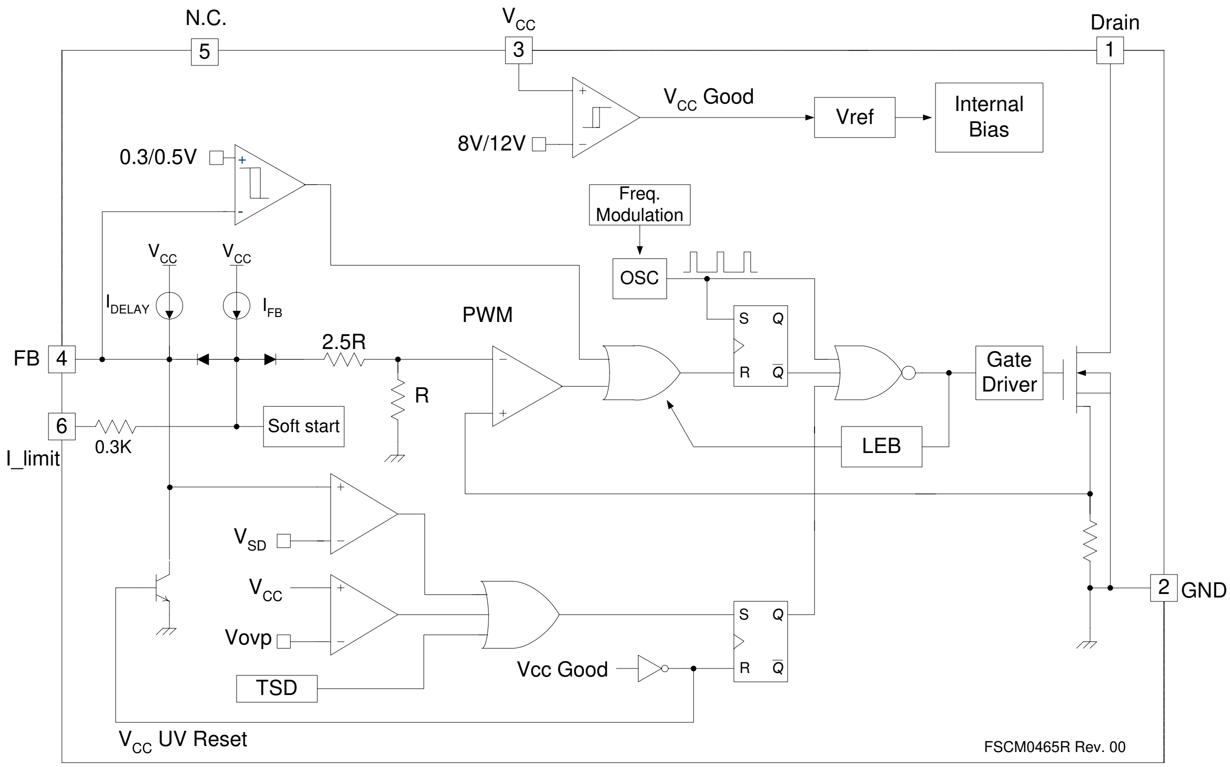
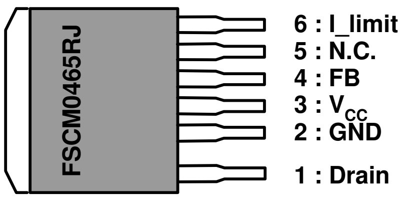


Figure 2. Functional Block Diagram of FSCM0465R

Pin Configuration

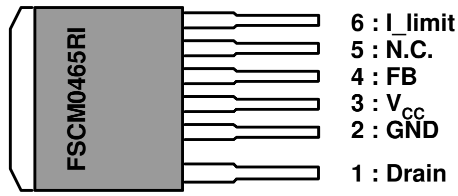
FSCM0465RJ

D2-PAK-6L



FSCM0465RI

I2-PAK-6L



FSCM0465RG

TO-220-6L

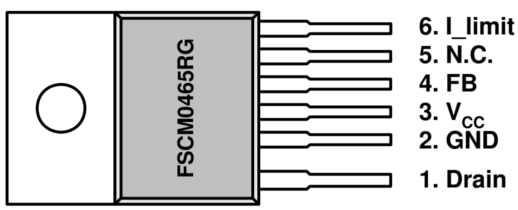


Figure 3. Pin Configuration (Top View)

Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	Drain	**SenseFET Drain.** This pin is the high-voltage power SenseFET drain. It is designed to drive the transformer directly.
2	GND	**Ground.** This pin is the control ground and the SenseFET source.
3	V_{CC}	**Power Supply.** This pin is the positive supply voltage input. During startup, the power is supplied through the startup resistor from DC link. When V_{CC} reaches 12V, the power is supplied from the auxiliary transformer winding.
4	Feedback (FB)	**Feedback.** This pin is internally connected to the inverting input of the PWM comparator. The collector of an opto-coupler is typically tied to this pin. For stable operation, a capacitor should be placed between this pin and GND. If the voltage of this pin reaches 6.0V, the overload protection is activated, resulting in shutdown of the FPS.
5	N.C.	This pin is not connected.
6	I_limit	**Current Limit.** This pin is for the pulse-by-pulse current limit level programming. By using a resistor to GND on this pin, the current limit level can be changed. If this pin is left floating, the typical current limit is 2.0A.

Absolute Maximum Ratings

The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings.

T_A = 25°C unless otherwise specified.

Symbol	Parameter		Value	Unit
BV_{DSS}	Drain-Source Breakdown Voltage[1]		650	V
V_{DGR}	Drain-Gate Voltage (R_{GS}=1MΩ)		650	V
V_{GS}	Gate-Source (GND) Voltage		±30	V
I_{DM}	Drain Current Pulsed[2]		16	A_{DC}
I_D	Continuous Drain Current (TO-220-6L, I2-PAK-6L)	T_C = 25°C	4.0	A_{DC}
		T_C = 100°C	2.5	A_{DC}
	Continuous Drain Current (D2-PAK-6L)	T_C = 25°C	2.3	A_{DC}
		T_C = 100°C	1.4	A_{DC}
V_{CC}	Supply Voltage		20	V
V_{FB}	Feedback Voltage Range		-0.3 to V_{CC}	V
P_D	Total Power Dissipation (TO-220-6L)		140	W
Derating			-1.1	W/°C
P_D	Total Power Dissipation (I2-PAK-6L)		75	W
Derating			-1.5	W/°C
P_D	Total Power Dissipation (D2-PAK-6L)		80	W
Derating			-0.64	W/°C
T_J	Operating Junction Temperature		Internally limited	°C
T_A	Operating Ambient Temperature		-25 to +85	°C
T_{STG}	Storage Temperature		-55 to +150	°C
	ESD Capability, HBM Model (All pins except Vfb)		2.0 (GND-Vfb = 1.5kV) (V_{CC}-Vfb = 1.0kV)	kV
	ESD Capability, Machine Model (All pins except Vfb)		300 (GND-Vfb = 250V) (V_{CC}-Vfb = 100V)	V

Notes:
1. T_j = 25°C to 150°C
2. Repetitive rating: Pulse-width limited by maximum junction temperature
3. T_C: Case back surface temperature with infinite heat sink

Electrical Characteristics

T_A = 25°C unless otherwise specified.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
SenseFET SECTION						
I_{DSS}	Zero Gate Voltage Current	V_{DS} = Max, Rating V_{GS} = 0V	-	-	250	µA
$R_{DS(ON)}$	Static Drain Source on Resistance(1)	V_{GS} = 10V, I_D = 2.3A	-	2.2	2.6	Ω
C_{OSS}	Output Capacitance	V_{GS} = 0V, V_{DS} = 25V, f = 1MHz	-	60	-	pF
$t_{d(on)}$	Turn-on Delay Time	V_{DD} = 325V, I_D = 3.2A(4)	-	23	-	ns
t_r	Rise Time		-	20	-	
$t_{d(off)}$	Turn-off Delay Time		-	65	-	
t_f	Fall Time		-	27	-	
CONTROL SECTION						
f_{OSC}	Switching Frequency	V_{CC} = 14V, V_{FB} = 5V	60	66	72	kHz
Δf_{MOD}	Switching Frequency Modulation Range		-	±3	-	kHz
t_{MOD}	Switching Frequency Modulation Cycle		-	4	-	ms
f_{STABLE}	Switching Frequency Stability	10V ≤ V_{CC} ≤ 17V	0	1	3	%
Δf_{OSC}	Switching Frequency Variation(2)	–25°C ≤ T_A ≤ +85°C	-	±5	±10	%
D_{MAX}	Maximum Duty Cycle		75	80	85	%
D_{MIN}	Minimum Duty Cycle		-	-	0	%
V_{START}	UVLO Threshold Voltage	V_{FB} = GND	11	12	13	V
V_{STOP}			7	8	9	V
I_{FB}	Feedback Source Current	V_{FB} = GND	0.7	0.9	1.1	mA
$t_{S/S}$	Internal Soft-Start Time		10	15	20	ms
BURST MODE SECTION						
V_{BURH}	Burst Mode Voltages	V_{CC} = 14V	0.4	0.5	0.6	V
V_{BURL}		V_{CC} = 14V	0.24	0.3	0.36	V
PROTECTION SECTION						
I_{LIMIT}	Peak Current Limit(3)	V_{CC} = 14V, V_{FB} = 5V	2.2	2.5	2.8	A
V_{OVP}	Over-Voltage Protection		18	19	20	V
T_{SD}	Thermal Shutdown Temperature(2)		130	145	160	°C
I_{DELAY}	Shutdown Delay Current	V_{FB} = 4V	3.5	5.3	7	µA
V_{SD}	Shutdown Feedback Voltage	V_{FB} ≥ 5.5V	5.5	6	6.5	V
TOTAL DEVICE SECTION						
I_{start}	Startup Current		-	20	40	µA
$I_{OP(MIN)}$	Operating Supply Current	V_{CC} = 10V, V_{FB} = 0V	-	2.5	5	mA
$I_{OP(MAX)}$		V_{CC} = 20V, V_{FB} = 0V				

Notes:
1. Pulse Test: Pulse width ≤ 300µS, duty ≤ 2%
2. These parameters, although guaranteed at the design, are not tested in mass production.
3. These parameters indicate the inductor current. Where packages are I2PAK or D2PAK, this should be decreased to 2.0A by external resistor.
4. MOSFET switching time is essentially independent of operating temperature.

Comparison Between FSDM0465RB and FSCM0465R

Function	FSDM0465RB	FSCM0465R
Frequency Modulation	N/A	Available - Frequency modulation range (Δf_{MOD}) = ±3kHz - Frequency modulation cycle (t_{MOD}) = 4ms
Pulse-by-pulse Current Limit	Internally fixed (2.0A max.)	Programmable using external resistor (2.8A max.)
Internal Startup Circuit	Available	N/A (Requires a startup resistor) Startup current: 40µA (max.)
Packages	TO-220F-6L	TO-220-6L I2-PAK-6L D2-PAK-6L

Typical Performance Characteristics

These characteristic graphs are normalized at T_A= 25°C.

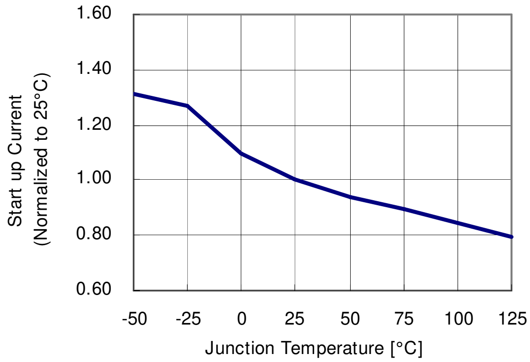


Figure 4. Startup Current vs. Temp.

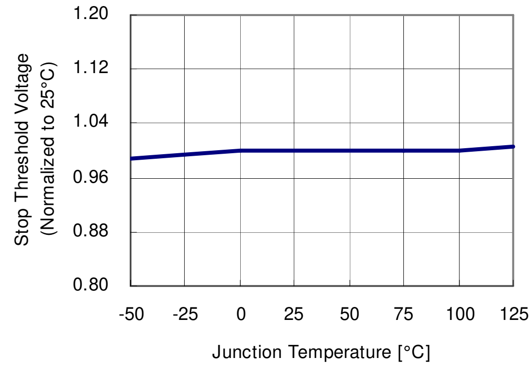


Figure 5. Stop Threshold voltage vs. Temp.

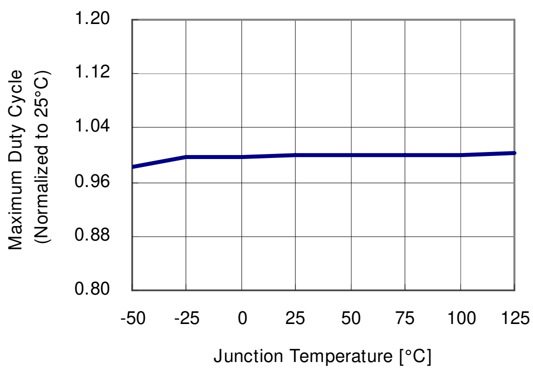


Figure 6. Maximum Duty Cycle vs. Temp.

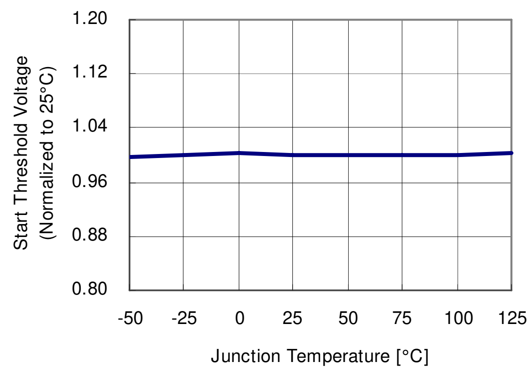


Figure 7. Start Threshold Voltage vs. Temp.

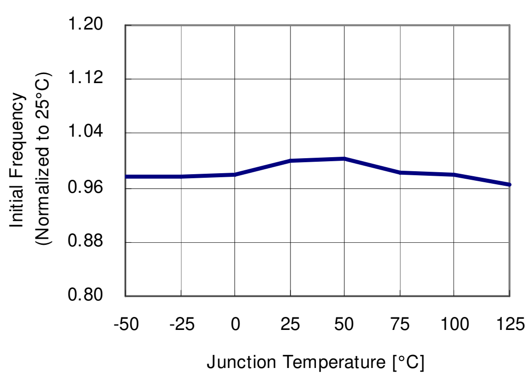


Figure 8. Initial Frequency vs. Temp.

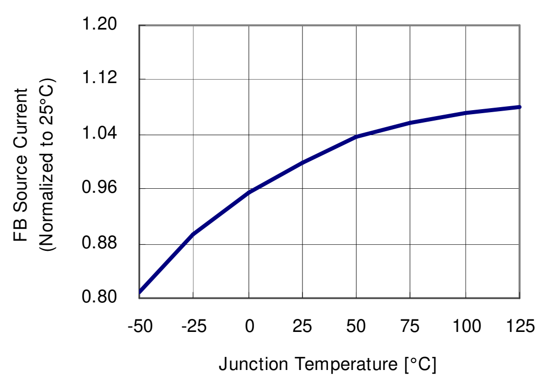


Figure 9. Feedback Source Current vs. Temp.

Typical Performance Characteristics (Continued)

These characteristic graphs are normalized at T_A= 25°C.

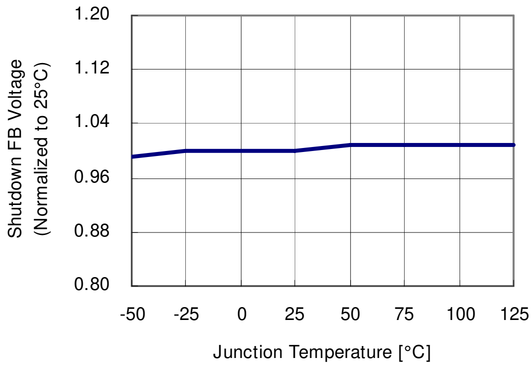


Figure 10. Shutdown Feedback voltage vs. Temp.

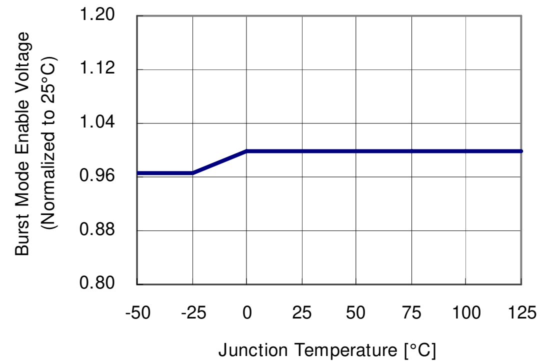


Figure 11. Burst Mode Enable Voltage vs. Temp.

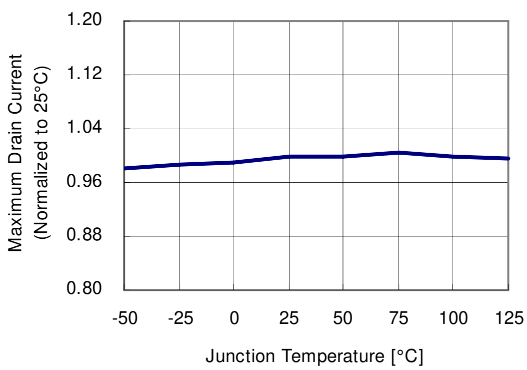


Figure 12. Maximum Drain Current vs. Temp.

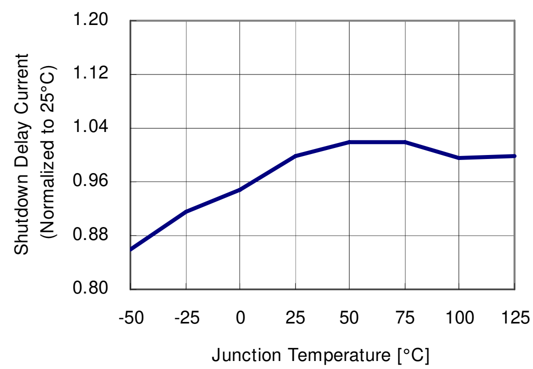


Figure 13. Shutdown Delay Current vs. Temp.

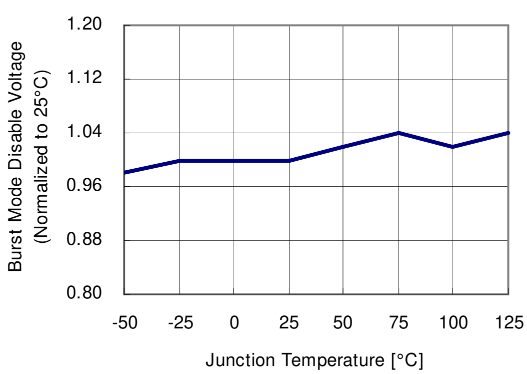


Figure 14. Burst Mode Disable Voltage vs. Temp.

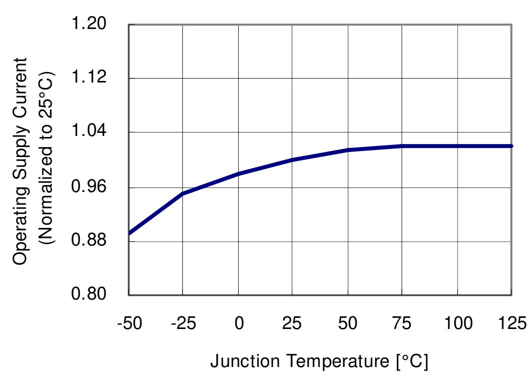


Figure 15. Operating Supply Current vs. Temp.

Functional Description

1. Startup: Figure 16 shows the typical startup circuit and transformer auxiliary winding for the FSCM0465R application. Before the FSCM0465R begins switching, it consumes only startup current (typically 20µA) and the current supplied from the DC link supply current consumed by the FPS (I_{CC}) and charges the external capacitor (C_a) connected to the V_{CC} pin. When V_{CC} reaches start voltage of 12V (V_{START}), the FSCM0465R begins switching and the current consumed by the FSCM0465R increases to 2.5mA. Then the FSCM0465R continues its normal switching operation and the power required for this device is supplied from the transformer auxiliary winding, unless V_{CC} drops below the stop voltage of 8V (V_{STOP}). To guarantee the stable operation of the control IC, V_{CC} has under-voltage lockout (UVLO) with 4V hysteresis. Figure 17 shows the relationship between the current consumed by the FPS (I_{CC}) and the supply voltage (V_{CC}).

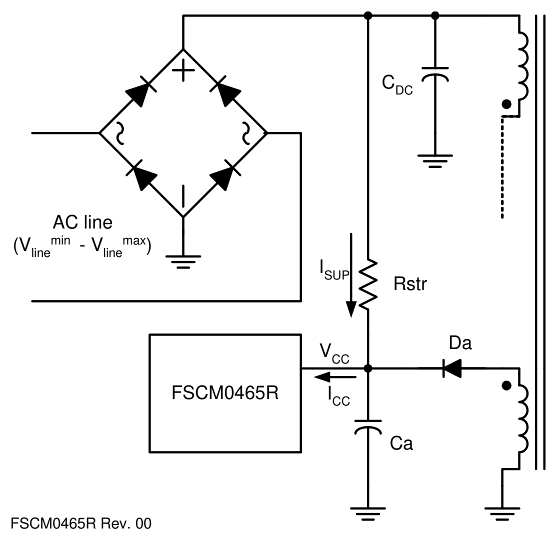


Figure 16. Startup Circuit

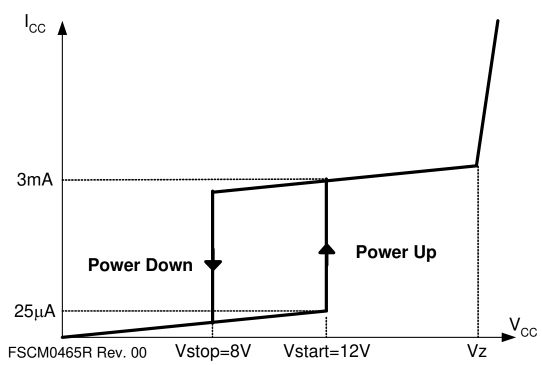


Figure 17. Relation Between Operating Supply Current and V_{CC} Voltage

The minimum current supplied through the startup resistor is given by:

$$I_{sup}^{min} = \left(\sqrt{2} \cdot V_{line}^{min} - V_{start}\right) \cdot \frac{1}{R_{str}} \quad (1)$$

where V_{line}^{min} is the minimum input voltage, V_{start} is the start voltage (12V) and R_{str} is the startup resistor. The startup resistor should be chosen so that I_{sup}^{min} is larger than the maximum startup current (40µA). If not, V_{CC} can not be charged to the start voltage and FPS fails to start.

2. Feedback Control: The FSCM0465R employs current mode control, as shown in Figure 18. An opto-coupler (such as the H11A817A) and a shunt regulator (such as the KA431) are typically used to implement the feedback network. Comparing the feedback voltage with the voltage across the Rsense resistor makes it possible to control the switching duty cycle. When the reference pin voltage of the KA431 exceeds the internal reference voltage of 2.5V, the H11A817A LED current increases, pulling down the feedback voltage and reducing the duty cycle. This event typically happens when the input voltage is increased or the output load is decreased.

2.1 Pulse-by-pulse Current Limit: Because current mode control is employed, the peak current through the SenseFET is determined by the inverting input of the PWM comparator (Vfb*) as shown in Figure 18. When the current through the opto-transistor is zero and the current limit pin (#5) is left floating, the feedback current source (I_{FB}) of 0.9mA flows only through the internal resistor (R+2.5R=2.8k). In this case, the cathode voltage of diode D2 and the peak drain current have maximum values of 2.5V and 2.5A, respectively. The pulse-by-pulse current limit can be adjusted using a resistor to GND on the current limit pin (#5). The current limit level using an external resistor (R_{LIM}) is given by:

$$I_{LIM} = \frac{R_{LIM} \cdot 2.5A}{2.8K\Omega + R_{LIM}} \quad (2)$$

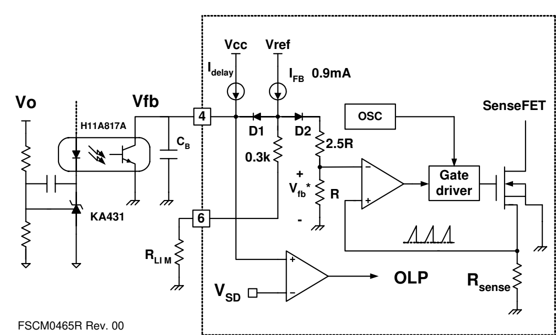


Figure 18. Pulse Width Modulation (PWM) Circuit

2.2 Constant Power Limit Circuit: Due to the circuit delay of FPS, the pulse-by-pulse limit current increases a little bit when the input voltage increases. This means unwanted excessive power is delivered to the secondary side. To compensate, the auxiliary power compensation network in Figure 19 can be used. R_{LIM} can adjust pulse-by-pulse current by absorbing internal current source (I_{FB}: typical value is 0.9mA), depending on the ratio between resistors. With the suggested compensation circuit, additional current from I_{FB} is absorbed more proportionally to the input voltage (V_{DC}) and achieves constant power in wide input range. Choose R_{LIM} for proper current to the application, then check the pulse-by-pulse current difference between minimum and maximum input voltage. To eliminate the difference (to gain constant power), R_y can be calculated by:

$$R_y \cong \frac{I_{lim\_spec} \times V_{dc} \times \frac{N_a}{N_p}}{I_{fb} \times \Delta I_{lim\_comp}} \quad (3)$$

where, I_{lim_spec} is the limit current stated on the specification; N_a and N_p are the number of turns for V_{CC} and primary side, respectively; I_{fb} is the internal current source at feedback pin with a typical value of 0.9mA; and ΔI_{lim_comp} is the current difference which must be eliminated. In case of capacitor in the circuit 1µF, 100V is good choice for all applications.

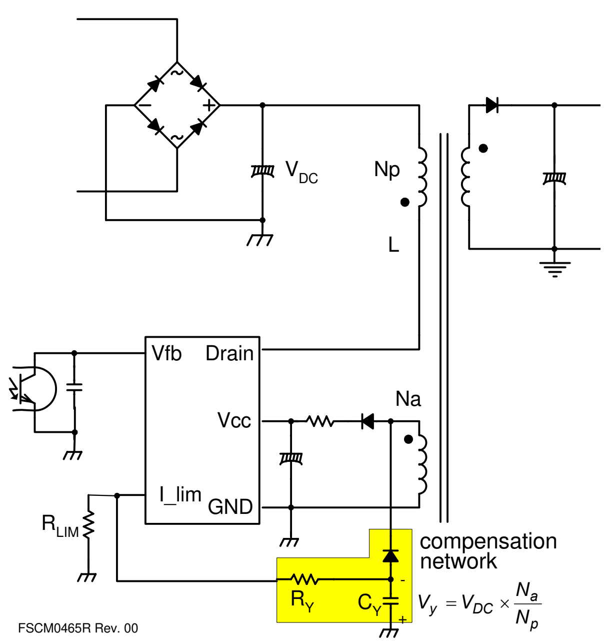


Figure 19. Constant power limit circuit

2.3 Leading Edge Blanking (LEB): At the instant the internal SenseFET is turned on, a high-current spike through the SenseFET usually occurs, caused by primary-side capacitance and secondary-side rectifier reverse recovery. Excessive voltage across the Rsense resistor can lead to incorrect feedback operation in the current mode PWM control. To counter this effect, the FSCM0465R employs a leading edge blanking (LEB) circuit. This circuit inhibits the PWM comparator for a short time after the SenseFET is turned on.

3. Protection Circuit: The FSCM0465R has several self-protective functions, such as overload protection (OLP), over-voltage protection (OVP) and thermal shutdown (TSD). Because these protection circuits are fully integrated into the IC without external components, the reliability is improved without increasing cost. Once the fault condition occurs, switching is terminated and the SenseFET remains off. This causes V_{CC} to fall. When V_{CC} reaches the UVLO stop voltage of 8V, the current consumed by the FSCM0465R decreases to the startup current (typically 20µA) and the current supplied from the DC link charges the external capacitor (C_a) connected to the V_{CC} pin. When V_{CC} reaches the start voltage of 12V, the FSCM0465R resumes normal operation. In this manner, the auto-restart can alternately enable and disable the switching of the power SenseFET until the fault condition is eliminated (see Figure 20).

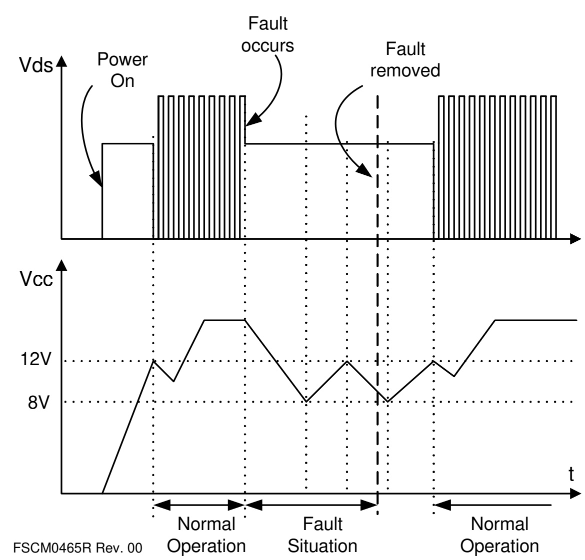


Figure 20. Auto Restart Operation

3.1 Overload Protection (OLP): Overload is defined as the load current exceeding a preset level due to an unexpected event. In this situation, the protection circuit should be activated to protect the SMPS. However, even when the SMPS is in the normal operation, the overload protection circuit can be activated during the load transition. To avoid this undesired operation, the overload protection circuit is designed to be activated after a specified time to determine whether it is a transient situation or an overload situation. Because of the pulse-by-pulse current limit capability, the maximum peak current through the SenseFET is limited and the maximum input power is restricted with a given input voltage. If the output consumes beyond this maximum power, the output voltage (V_O) decreases below the set voltage. This reduces the current through the opto-coupler LED, which also reduces the opto-coupler transistor current, increasing the feedback voltage (Vfb). If Vfb exceeds 2.5V, D1 is blocked and the 5.3µA current source (I_{delay}) starts to charge C_B slowly up to V_{CC}. In this condition, Vfb continues increasing until it reaches 6V, when the switching operation is terminated as shown in Figure 21. The delay time for shutdown is the time required to charge C_B from 2.5V to 6.0V with 5.3µA (I_{delay}). A 10 ~ 50ms delay time is typical for most applications.

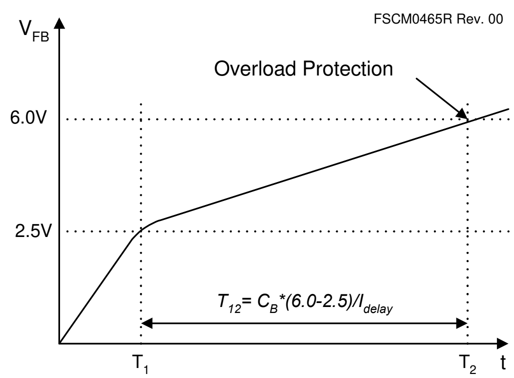


Figure 21. Overload Protection

3.2 Over-Voltage Protection (OVP): If the secondary-side feedback circuit were to malfunction or a solder defect causes an opening in the feedback path, the current through the opto-coupler transistor becomes almost zero. In this case, Vfb climbs up in a similar manner to the overload situation, forcing the preset maximum current to be supplied to the SMPS until the overload protection is activated. Because more energy than required is provided to the output, the output voltage may exceed the rated voltage before the overload protection is activated, resulting in the breakdown of the devices in the secondary side. To prevent this situation, an over- voltage protection (OVP) circuit is employed. In general, V_{CC} is proportional to the output voltage and the FSCM0465R uses V_{CC} instead of directly monitoring the output voltage. If V_{CC} exceeds 19V, an OVP circuit is activated, resulting in the termination of the switching operation. To avoid undesired activation of OVP during normal operation, V_{CC} should be designed to be below 19V.

3.3 Thermal Shutdown (TSD): The SenseFET and the control IC are built in one package. This makes it easy for the control IC to detect the heat generation from the SenseFET. When the temperature exceeds approximately 145°C, the thermal protection is triggered, resulting in shutdown of the FPS.

4. Frequency Modulation: EMI reduction can be accomplished by modulating the switching frequency of a switched power supply. Frequency modulation can reduce EMI by spreading the energy over a wider frequency range than the bandwidth measured by the EMI test equipment. The amount of EMI reduction is directly related to the depth of the reference frequency. As can be seen in Figure 22, the frequency changes from 63KHz to 69KHz in 4ms.

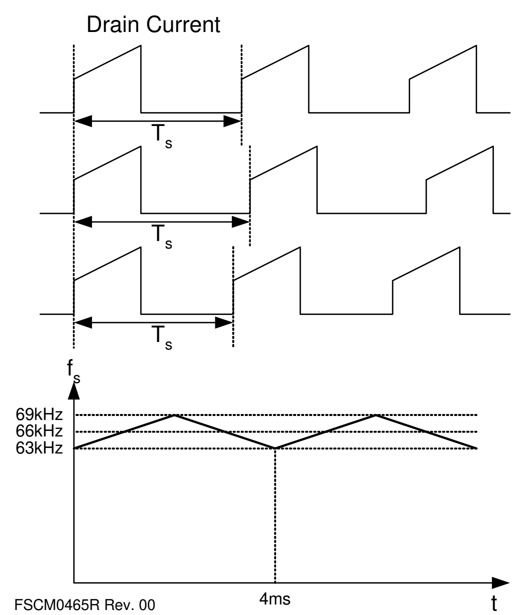


Figure 22. Frequency Modulation

5. Soft-Start: The FSCM0465R has an internal soft-start circuit that increases PWM comparator inverting input voltage, together with the SenseFET current, slowly after it starts up. The typical soft-start time is15ms. The pulse width to the power switching device is progressively increased to establish the correct working conditions for transformers, rectifier diodes, and capacitors. The voltage on the output capacitors is progressively increased with the intention of smoothly establishing the required output voltage. Preventing transformer saturation and reducing stress on the secondary diode during startup is also helpful.

6. Burst Operation: To minimize power dissipation in standby mode, the FSCM0465R enters into burst-mode operation at light load condition. As the load decreases, the feedback voltage decreases. As shown in Figure 23, the device automatically enters burst mode when the feedback voltage drops below V_{BURL} (300mV). At this point, switching stops and the output voltages start to drop at a rate dependent on standby current load. This causes the feedback voltage to rise. Once it passes V_{BURH} (500mV), switching resumes. The feedback voltage then falls and the process repeats. Burst mode operation alternately enables and disables switching of the power SenseFET, thereby reducing switching loss in standby mode.

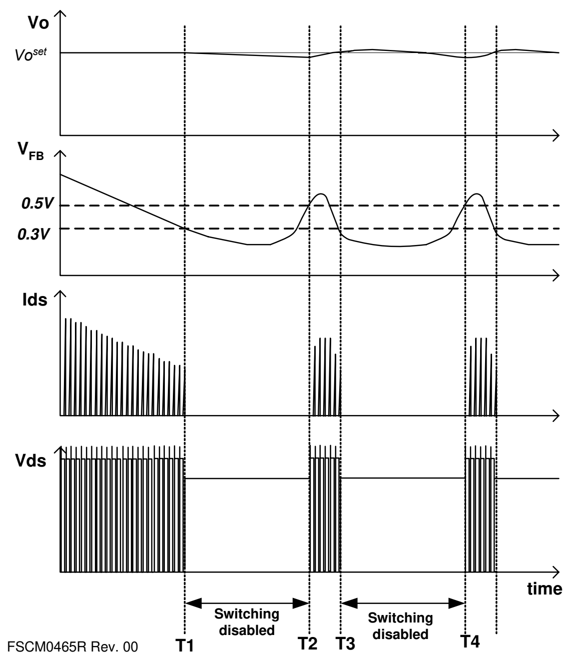


Figure 23. Waveforms of Burst Operation

Typical Application Circuit

Application	Output Power	Input Voltage	Output Voltage (Max. Current)
LCD Monitor	40W	Universal Input (85-265Vac)	5V (2.0A) 12V (2.5A)

Features

- High efficiency (>81% at 85Vac input)
- Low standby mode power consumption (<1W at 240Vac input and 0.4W load)
- Low component count
- Enhanced system reliability through various protection functions
- Low EMI through frequency modulation
- Internal soft-start (15ms)

Key Design Notes

- Resistors R107 and R108 are employed to prevent startup at low input voltage
- The delay time for overload protection is designed to be about 50ms with C106 of 100nF. If a faster triggering of OLP is required, C106 can be reduced to 22nF.

1. Schematic

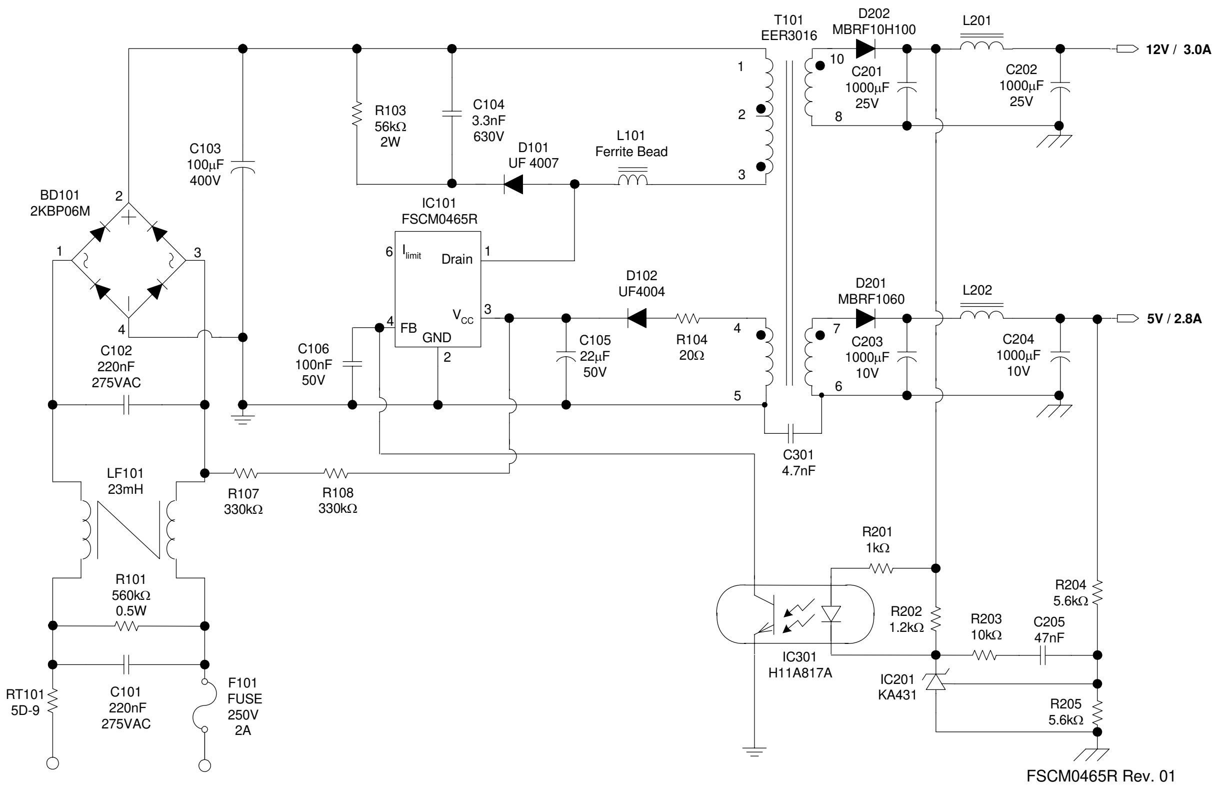


Figure 24. Demo Circuit

2. Transformer

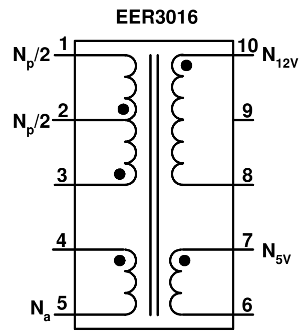


Figure 25. Transformer Schematic Diagram

3. Winding Specification

No	Pin (s→f)	Wire	Turns	Winding Method
Na	4 → 5	$0.2^{\phi} \times 1$	8	Center Winding
Insulation: Polyester Tape t = 0.050mm, 2 Layers				
Np/2	2 → 1	$0.4^{\phi} \times 1$	18	Solenoid Winding
Insulation: Polyester Tape t = 0.050mm, 2 Layers				
N_{12V}	10 → 8	$0.3^{\phi} \times 3$	7	Center Winding
Insulation: Polyester Tape t = 0.050mm, 2 Layers				
N5V	7 → 6	$0.3^{\phi} \times 3$	3	Center Winding
Insulation: Polyester Tape t = 0.050mm, 2 Layers				
Np/2	3 → 2	$0.4^{\phi} \times 1$	18	Solenoid Winding
Outer Insulation: Polyester Tape t = 0.050mm, 2 Layers				

4. Electrical Characteristics

	Pin	Specification	Remarks
Inductance	1 - 3	520µH ± 10%	100kHz, 1V
Leakage Inductance	1 - 3	10µH Max	2^{nd} all Short

5. Core & Bobbin

- Core: EER 3016
- Bobbin: EER3016
- Ae(mm^2): 96

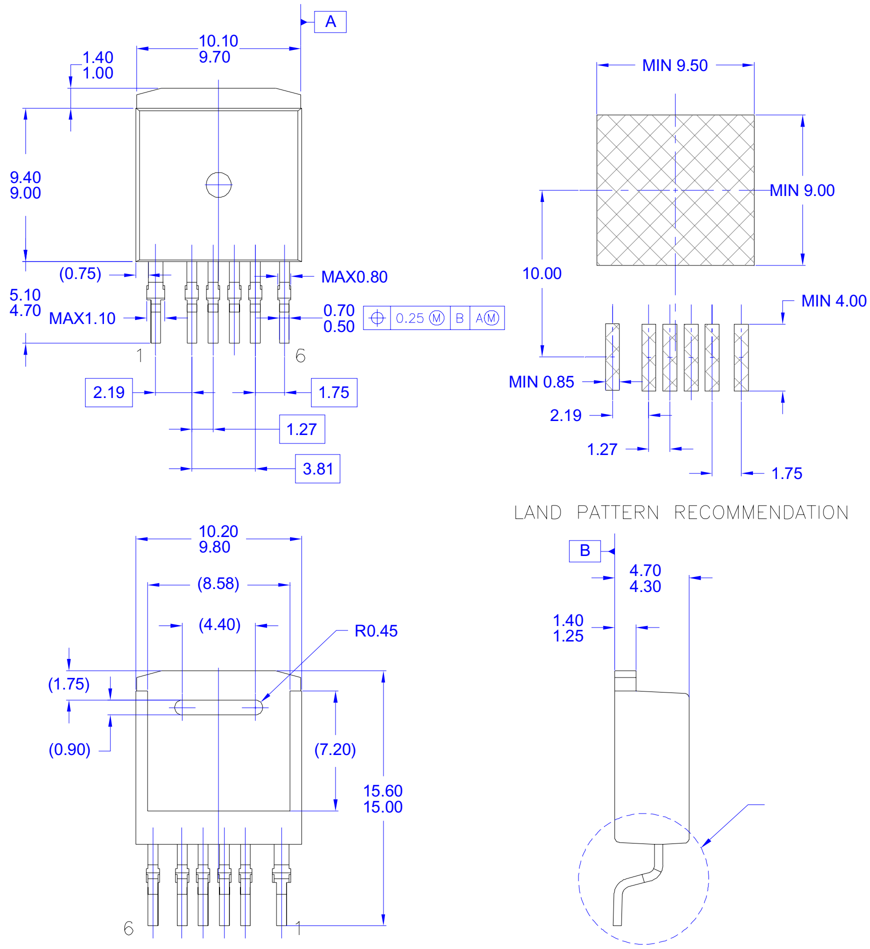
6. Demo Circuit Part List

Part	Value	Note	Part	Value	Note
Fuse			C301	4.7nF	Polyester Film Cap.
F101	2A/250V				
NTC			**Inductor**		
RT101	5D-9		L201	5μH	Wire 1.2mm
Resistor			L202	5μH	Wire 1.2mm
R101	560kΩ	0.5W			
R103	56kΩ	2W			
R104	20Ω	1/4W	**Diode**		
R107	330kΩ	1/4W	D101	UF4007	
R108	330kΩ	1/4W	D102	UF4004	
R201	1kΩ	1/4W	D201	MBRF1060	
R202	1.2kΩ	1/4W	D202	MBRF10H100	
R203	10kΩ	1/4W			
R204	5.6kΩ	1/4W			
R205	5.6kΩ	1/4W	**Bridge Diode**		
			BD101	2KBP06M 3N257	Bridge Diode
Capacitor					
C101	220nF/275VAC	Box Capacitor	**Line Filter**		
C102	220nF/275VAC	Box Capacitor	LF101	23mH	Wire 0.4mm
C103	100μF/400V	Electrolytic Capacitor	**IC**		
C104	3.3nF/630V	Ceramic Capacitor	IC101	FSCM0465R	FPS™ (2.5A, 650V)
C105	22μF/50V	Electrolytic Capacitor	IC201	KA431(TL431)	Voltage Reference
C106	100nF/50V	Ceramic Capacitor	IC301	H11A817A	Opto-coupler
C201	1000μF/25V	Electrolytic Capacitor			
C202	1000μF/25V	Electrolytic Capacitor			
C203	1000μF/10V	Electrolytic Capacitor			
C204	1000μF/10V	Electrolytic Capacitor			
C205	47nF/50V	Ceramic Capacitor			

Package Dimensions

D2-PAK-6L

Dimensions are in millimeters unless otherwise specified.



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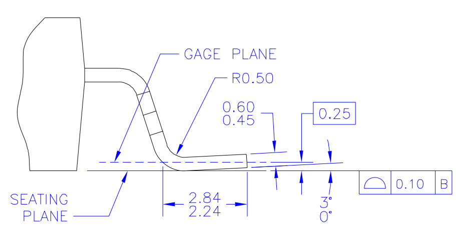

DETAIL A, ROTATED 90°
SCALE: 2X

MKT-TO263A6

Package Dimensions (Continued)

I2-PAK-6L (Forming)

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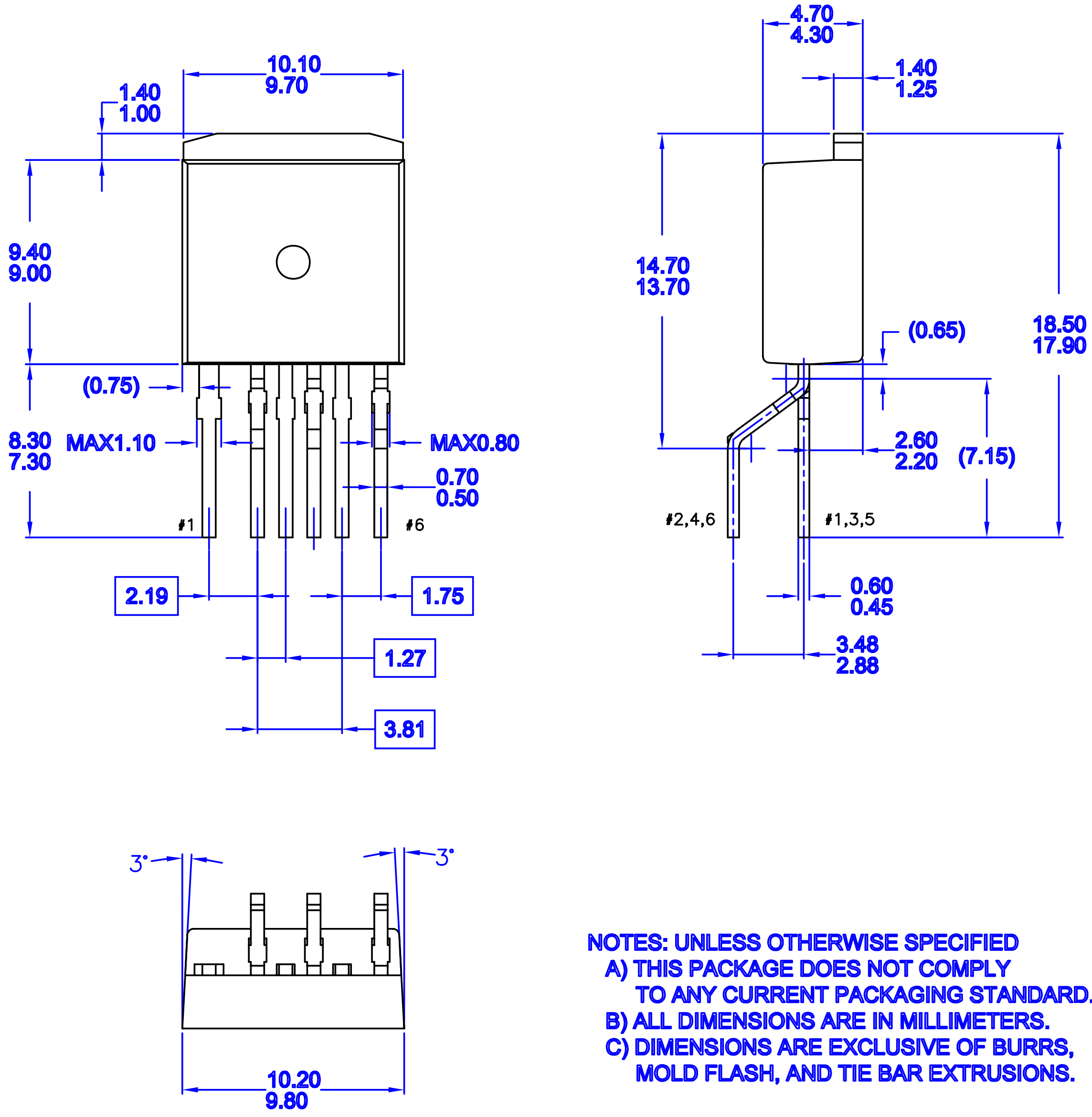

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MKT-TO262A6

Package Dimensions (Continued)

TO-220-6L (Forming)

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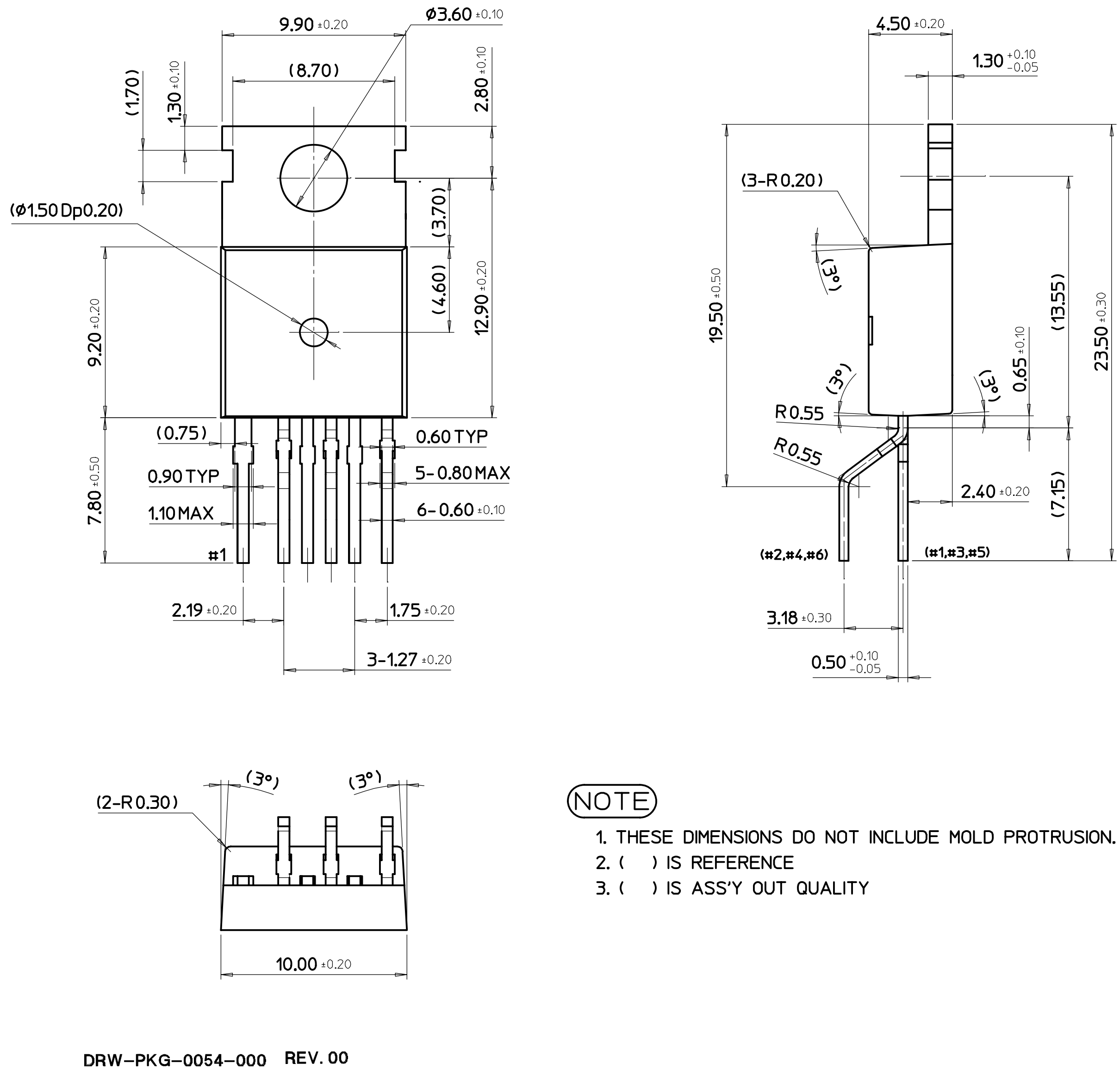

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