

:G8A\$(*)F9ž':G8A\$)*)F9ž':G8A\$+*)&F9
;fYYb`AcXY`DckYf`Gk]hW\`

:G8A\$(*)F9ž':G8A\$)*)F9ž':G8A\$+*)&F9 ;fYYb`AcXY`DckYf`Gk]hW\`

:YUhi fYg

- › Internal Avalanche-Rugged SenseFET
- › Advanced Burst-Mode Operation Consumes Under 1W at 240V_{AC} & 0.5W load
- › Precision Fixed Operating Frequency (66kHz)
- › Internal Start-up Circuit
- › Improved Pulse-by-Pulse Current Limiting
- › Over-Voltage Protection (OVP)
- › Overload Protection (OLP)
- › Internal Thermal Shutdown Function (TSD)
- › Auto-Restart Mode
- › Under-Voltage Lockout (UVLO) with hysteresis
- › Low Operating Current (2.5mA)
- › Built-in Soft-Start

5dd`]WUh]cbg

- › SMPS for LCD monitor and STB
- › Adaptor

8YgWf]dh]cb

The FSDM0465RE, FSDM0565RE and FSDM07652RE are 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

Hmd]WU`7]fW i]h

:][i fY%"Hmd]WU`:`mVUW_`5dd`]WU]cb

C i h d i h ` D c k Y f ` H U V ` Y

BchYg.`

- 2. Typical continuous power in a non-ventilated enclosed adapter measured at 50°C ambient.
- 3. Maximum practical continuous power in an open-frame design at 50°C ambient.
- 4. 230VJ@UBHBVA,6Ea%+B9d↑OUGHLX

:G8A\$(*)F9?:G8A\$(*)F9?:G8A\$+*)&F9`j` ;fyyb`AcXy`DcKyf`Gk]hw\`

:G8A\$(*)F9?:G8A\$)*F9?:G8A\$+*)&F9

:G8A\$(*)F9?:G8A\$)*F9?:G8A\$+*)&F9'ì':f

5Vgc` i hY` AUI] a i a `FUh]b [g

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. $T_A = 25^\circ\text{C}$, unless otherwise specified.

| Gm a Vc` | DUfU a YhYf | | JU` i Y | I b]h | |
|------------------|---|-------------|--|------------------|----------|
| BV_{DSS} | Drain Source Breakdown Voltage | | 650 | V | |
| V_{str} | Max. Voltage at Vstart pin | | 650 | V | |
| I_{DM} | Drain Current Pulsed ⁽⁵⁾ | FSDM0465RE | $T_C=25^\circ\text{C}$ | 9.6 | A_{DC} |
| | | FSDM0565RE | $T_C=25^\circ\text{C}$ | 11 | |
| | | FSDM07652RE | $T_C=25^\circ\text{C}$ | 15 | |
| I_D | Continuous Drain Current | FSDM0465RE | $T_C=25^\circ\text{C}$ | 2.2 | A |
| | | | $T_C=100^\circ\text{C}$ | 1.4 | |
| | | FSDM0565RE | $T_C=25^\circ\text{C}$ | 2.8 | |
| | | | $T_C=100^\circ\text{C}$ | 1.7 | |
| | | FSDM07652RE | $T_C=25^\circ\text{C}$ | 3.8 | |
| | | | $T_C=100^\circ\text{C}$ | 2.4 | |
| E_{AS} | Single Pulsed Avalanche Energy ⁽⁶⁾ | FSDM0465RE | | | mJ |
| | | FSDM0565RE | 190 | | |
| | | FSDM07652RE | 370 | | |
| V_{CC} | Supply Voltage | | 20 | V | |
| V_{FB} | Input Voltage Range | | -0.3 to V_{CC} | V | |
| P_D (Watt H/S) | Total Power Dissipation ($T_C=25^\circ\text{C}$) | | 45 | W | |
| T_J | Operating Junction Temperature | | Internally limited | $^\circ\text{C}$ | |
| T_A | Operating Ambient Temperature | | -25 to +85 | $^\circ\text{C}$ | |
| T_{STG} | Storage Temperature | | -55 to +150 | $^\circ\text{C}$ | |
| | ESD Capability, HBM Model (All pins except V_{str} and FB) | | 2.0 ($GND-V_{str}/V_{FB}=1.5\text{kV}$) | kV | |
| | ESD Capability, Machine Model (All pins except V_{str} and FB) | | 300 ($GND-V_{str}/V_{FB}=225\text{V}$) | V | |

BchYg.

5. Repetitive rating: Pulse width limited by maximum junction temperature.

6. $L=14\text{mH}$, starting $T_J=25^\circ\text{C}$.

H\Yf a U` : a dYXUbWY

$T_A=25^\circ\text{C}$, unless otherwise specified.

| Gm a Vc` | DUfU a YhYf | JU` i Y | I b]h |
|------------------------------|--|---------|---------------------------|
| θ_{JA} ⁽⁷⁾ | Junction-to-Ambient Thermal Resistance | 49.90 | $^\circ\text{C}/\text{W}$ |
| θ_{JC} ⁽⁸⁾ | Junction-to-Case Thermal Resistance | 2.78 | $^\circ\text{C}/\text{W}$ |

BchYg.

7. Free-standing, with no heat-sink, under natural convection.

8. Infinite cooling condition - refer to the SEMI G30-88.

9`YWhf]WU`7\UfUWhYf]gh]Wg`

T_A = 25°C unless otherwise specified.

Gm a Vc` **DUfU a YhYf** **7cbX]h]cb** **A]b" Hmd" AUl" l b]h**
GYbgY : 9H`G97H-CB`

| | | | | | | | |
|---------------------|--|-------------|--|------|------|--|----|
| I _{DSS} | Zero Gate Voltage Drain Current | FSDM0465RE | V _{DS} = 650V, V _{GS} = 0V | 250 | | | |
| | | | V _{DS} = 520V, V _{GS} = 0V, T _C = 125°C | 250 | | | |
| | | FSDM0565RE | V _{DS} = 650V, V _{GS} = 0V | 500 | | | μA |
| | | | V _{DS} = 520V, V _{GS} = 0V, T _C = 125°C | 500 | | | |
| FSDM07652RE | V _{DS} = 650V, V _{GS} = 0V | 500 | | | | | |
| | V _{DS} = 520V, V _{GS} = 0V, T _C = 125°C | 500 | | | | | |
| R _{DS(ON)} | Static Drain Source on Resistance ⁽⁹⁾ | FSDM0465RE | | 2.20 | 2.60 | | |
| | | FSDM0565RE | V _{GS} = 10V, I _D = 2.5A | 1.76 | 2.20 | | Ω |
| | | FSDM07652RE | | 1.40 | 1.60 | | |
| C _{OSS} | Output Capacitance | FSDM0465RE | | 60 | | | |
| | | FSDM0565RE | V _{GS} = 0V, V _{DS} = 25V, f = 1MHz | 78 | | | pF |
| | | FSDM07652RE | | 100 | | | |
| t _{d(on)} | Turn-On Delay Time | FSDM0465RE | | 23 | | | |
| | | FSDM0565RE | V _{DD} = 325V, I _D = 5A | 22 | | | ns |
| | | FSDM07652RE | | 22 | | | |
| t _r | Rise Time | FSDM0465RE | | 20 | | | |
| | | FSDM0565RE | V _{DD} = 325V, I _D = 5A | 52 | | | ns |
| | | FSDM07652RE | | 60 | | | |
| t _{d(off)} | Turn-Off Delay Time | FSDM0465RE | | 65 | | | |
| | | FSDM0565RE | V _{DD} = 325V, I _D = 5A | 95 | | | ns |
| | | FSDM07652RE | | 115 | | | |
| t _f | Fall Time | FSDM0465RE | | 27 | | | |
| | | FSDM0565RE | V _{DD} = 325V, I _D = 5A | 50 | | | ns |
| | | FSDM07652RE | | 65 | | | |

7CBHFC@`G97H-CB`

| | | | | | | | |
|----------------------|---|-------------|-------------------------------|-----|-----|-----|-------------|
| f _{OSC} | Switching Frequency | | V _{FB} = 3V | 60 | 66 | 72 | kHz |
| Δf _{STABLE} | Switching Frequency Stability | | 13V ≤ V _{CC} ≤ 18V | 0 | 1 | 3 | % |
| Δf _{OSC} | Switching Frequency Variation ⁽¹⁰⁾ | | -25°C ≤ T _A ≤ 85°C | 0 | ±5 | ±10 | % |
| I _{FB} | Feedback Source Current | | V _{FB} = GND | 0.7 | 0.9 | 1.1 | mA |
| | | FSDM0465RE | | 77 | 82 | 87 | % |
| D _{MAX} | Maximum Duty Cycle | FSDM0565RE | | 77 | 82 | 87 | % |
| | | FSDM07652RE | | 75 | 80 | 85 | % |
| D _{MIN} | Minimum Duty Cycle | | | | | 0 | % |
| V _{START} | UVLO Threshold Vo1(e)]TJ41.054 0 TdILOV(g.0044 Tw 9 0 0 9 126.24 1610ta1 Tc°)-9.6(C)-8634(0)-229484 | | | | | | 221.5201 Tn |

9`YWhf]WU`7\UfUWhYf]gh]Wg` (Continued)

$T_A = 25^\circ\text{C}$ unless otherwise specified.

Gm a Vc`

DUfU a YhYf

7cbX]h]cb`

A]b" Hmd" AUl" I b]h

6 I FGH`AC89`G97H-CB`

V_{BURH}

BchYg.

9. Pulse test: Pulse width $\leq 300\mu\text{S}$, duty cycle $\leq 2\%$.
10. These parameters, although guaranteed at the design, are not tested in production.
11. These parameters indicate the inductor current.
12. This parameter is the current flowing into the control IC.

7c a dUf]gcb'6YhkYYb':G* A\$+*)FH7'UbX':G8A\$I*)F9

: i bWh]cb

:G* A\$+*)FH7

:G8A\$I*)F9

:G8A\$I*)F9'5XjUblU[Yg

Soft-Start

:G8A\$(*)F9':G8A\$)*F9':G8A\$+*)&F9'.';fYYb'AcX'DcKfGk]hW\

Hmd]WU`DYfZcf a UbWY'7 \UfUWhYf]gh]Wg

These characteristic graphs are normalized at $T_A = 25^\circ\text{C}$.

:][i fY' ("CdYfUh]b ['7 i ffYbh' jg"HY a d"

:][i fY' ""GhUfh'H \fYg\c'X' Jc`hU[Y' jg"HY a d"

:][i fY' *""Ghcd'H \fYg\c'X' Jc`hU[Y' jg"HY a d"

:][i fY' + "CdYfUh]b [: fYe iYbWm' jg"HY a d"

:G8A\$(*)F9':G8A\$(*)F9':G8A\$+*)&F9' ; fYyb'AcXy'DcKyf'Gk]hW\

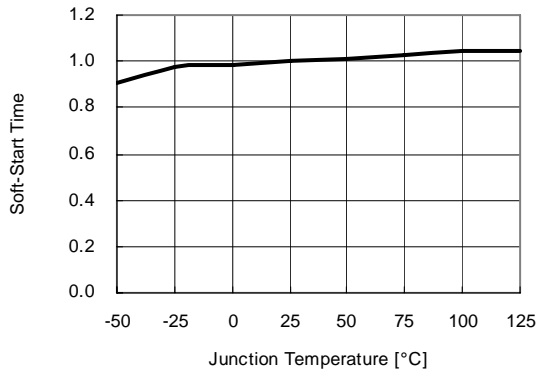
Hmd]WU`DYfZcf a UbWY'7 \UfUWhYf]gh]Wg` (Continued)

These characteristic graphs are normalized at $T_A = 25^\circ\text{C}$.

:G8A\$(*)F9:G8A\$*)F9:G8A\$+*)&F9`I` ;fyyb'AcXy'DcKyf'Gk]hw\`

Hmd]WU`DYfZcf a UbWY`7 \UfUWhYf]gh]Wg` (Continued)

These characteristic graphs are normalized at $T_A = 25^\circ\text{C}$.



:][i fY`%*""GcZh!GhUfh`H]a Y` jg`"HY a d"

:G8A\$(*)F9:G8A\$(*)F9:G8A\$+*)&F9`I` ;fyyb`AcXy`DcKyf`Gk]hw\

:G8A\$(*)F9?:G8A\$(*)F9?:G8A\$+*)&F9`!` ;fyyb'AcXy'DcKyf'Gk]hw\`

: i bWh]cbU` 8YgWf]dh]cb

% " GhUfh!id: In previous generations of Power Switches the V_{CC} pin had an external start-up resistor to the DC input voltage line. In this generation, the start-up resistor is replaced by an internal high-voltage current source. At start-up, the internal high-voltage current source supplies the internal bias and charges the external capacitor (C_{vcc}) connected to the V_{CC} pin, as illustrated in Figure 17. When V_{CC} reaches 12V, the FSDM0x65RE begins switching and the internal high-voltage current source is disabled. The FSDM0x65RE continues normal switching operation and the power is supplied from the auxiliary transformer winding unless V_{CC} goes below the stop voltage of 8V.

:][ifY%+"=bhYfbU`GhUfh!id'7]fWi]h

&" :YYXVUW_`7cbhfc` : FSDM0x65RE employs current-

:G8A\$(*)F9:G8A\$*)F9:G8A\$+*)&F9. ;fyybAcxyDcKyfGk]hw\

:][i fY'&\$"C jYf cUX DfchYWh]cb

:][i fY'%" 5 i hc' FYghUfh' CdYfUh]cb

"%" C jYf cUX DfchYWh]cb flC@DL: Overload is defined as the load current exceeding a pre-set level due to an unexpected event. In this situation, the protection circuit should be activated to protect the SMPS. Even when the SMPS is in 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 a true overload situation. Because of the pulse-by-pulse current limit capability, the maximum peak current through the SenseFET is limited, and therefore 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, thus increasing the feedback voltage (V_{FB}). If V_{FB} exceeds 2.5V, D1 is blocked and the 3.5 μ A current source starts to charge C_B slowly up to V_{CC} . In this condition, V_{FB} continues increasing until it reaches 6V, when the switching operation is terminated, as shown in Figure 20. The delay time for shutdown is the time required to charge C_B from 2.5V to 6.0V with 3.5 μ A. A 10 ~ 50ms delay time is typical for most applications.

"&" C jYf!Jc`hU[Y' DfchYWh]cb flCJD: If the secondary side feedback circuit were to malfunction or a solder defect caused an opening in the feedback path, the current through the opto-coupler transistor becomes almost zero. In this event, V_{FB} climbs 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-8uat insvat7ovat7ovat7ov ins s>h i in8a (i)12.3amn.ov in5ovat7ovnotecnu

)" 6 ifgh' CdYfUh
standby mode, r
operation. As the
decreases. As
automatically en
voltage drops b
switching stops a
rate dependent o
feedback voltage
switching resume
the process repe
enables and disa
thereby reducing

r dissipation in
ers burst-mode
feedback voltage
the device
the feedback
At this point,
start to drop at a
This causes the
BURH (700mV),
then falls and
alternately
over SenseFET,
mode.



:][ifY'&%" KUjYZcf a g'cZ'6 ifgh' CdYfUh]cb

:G8A\$(*)F9?:G8A\$(*)F9?:G8A\$+*)&F9'j';fyyb'AcXy'DcKyf'Gk]hw\

5dd`]WUh]cb'=bZcf a Uh]cb`

:YUh i fYg

- › High efficiency (>81% at 85V_{AC} input)
- › Low zero load power consumption (<300mW at 240V_{AC} input)
- › Low standby mode power consumption (<800mW at 240V_{AC} input and 0.3W load)
- › Low component count
- › Enhanced system reliability through various protection functions
- › Internal soft-start (10ms)

?Ym`8Yg][b`BchYg

- › Resistors R102 and R105 are employed to prevent start-up at low input voltage. After start-up, there is no power loss in these resistors since the start-up pin is internally disconnected after start-up.
- › The delay time for overload protection is designed to be about 50ms with C106 of 47nF. If a faster triggering of OLP is required, C106 can be reduced to 10nF.
- › Zener diode ZD102 is used for a safety test, such as UL. When the drain pin and feedback pin are shorted, the zener diode fails and remains short, which causes the fuse (F1) to be blown and prevents explosion of the opto-coupler (IC301). This zener diode also increases the immunity against line surge.

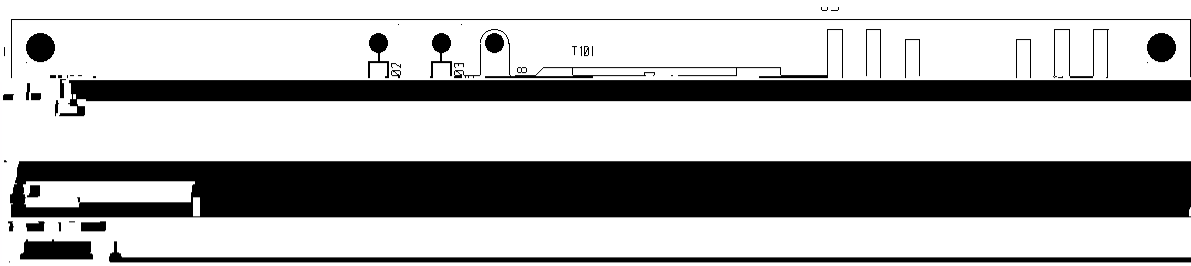
%" GW\Y a Uh]W

:][i fY'&&"8Y a c'7]fWi]h`

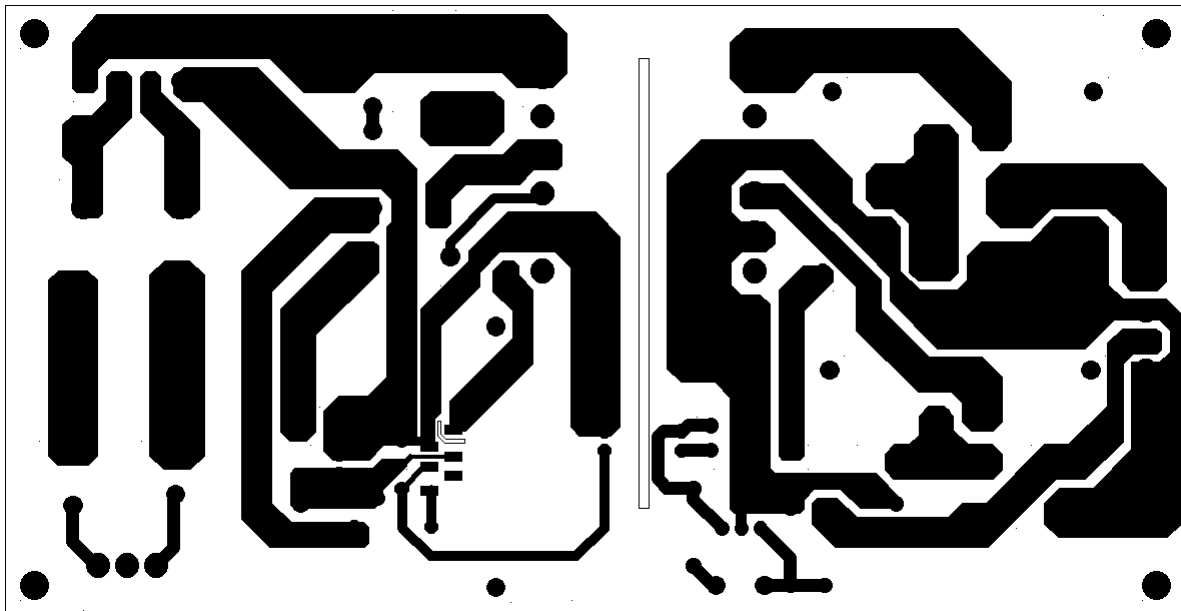
:G8A\$(*)F9':G8A\$)*F9':G8A\$+*)&F9.ĭ';fVyb'AcXy'DcKyfGk]hW\`

:G8A\$(*)F9?:G8A\$*)(F9?:G8A\$+*)&F9'ì':f

+ " @Umc ih



:][i fY' & (" @Umc ih '7 cbg]XYfUh]cbg'Zcf' :G8 A\$) *) F9' flHcd' J]Ykl'



:][i fY' & (" @Umc ih '7 cbg]XYfUh]cbg'Zcf' :G8 A\$) *) F9' fl6chhc a' J]Ykl'

:G8 A\$ (*) F9':G8 A\$) *) F9':G8 A\$+*) &F9' i' ;fYyb'AcXy'DcKyf'Gk]hw\

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