

RM6203

High Performance Current Mode PWM Switching Power Supply Controller

### DESCRIPTION

The RM6203 is a kind of progressive overload and saturation current to prevent the function of switching power supply. It provides continuous output power up to 12W in the broad voltage range of 85V - 265V.Its optimized and highly reasonable circuit design has made it possible to minimize the total cost of the product. This power supply controller could be used in typical flyback circuit topology to constitute simple AC/DC converter. The internal initiating circuit of 6203 has been designed with a unique means of current sink to complete the startup using the amplifying function of the power switching tube. This will significantly reduce the power consumption of the start-up resistor; and when the output power becomes smaller, 6203 will automatically lower its operating frequency to enable very low standby power consumption.

When the power tube stops, the internal circuit will turn the power tube reverse bias to greatly raise the voltage resistant capacity of OC pin. This will ensure the safety of the power tube. The internal design of the 6203 is also provided with over-load and saturation preventive function capable of preventing disorders such as overload, transformer saturation and output short-circuit, so as to increase the reliability of the power supply. A voltage reference of 2.5V is also integrated in the 6203 to provide accurate power supply to the clock circuit, and the clock frequency may be set by external timing capacitance. Presently, standard DIP8 package and environmental friendly lead-free package in compliance with European standard can be supplied.

### **FEATURES**

Built-in 800V high voltage power switching tube with minimal external parts count

Latched PWM and pulse-by-pulse current limiting inspection

Reduced frequency at low output with standby power consumption below 0.25W

Built-in slope and feedback compensation function

Separate upper limit current inspection controller to handle timely the over-current and overload of the controller

Turn off periodic bias output of the emitter to improve the voltage resistance of the power tube

Built-in thermal protective circuit

Complete start-up using amplification of the switching power tube to reduce the power consumption of the start-up resistor more than ten times

Automatic VCC over-voltage limit

Broad voltage output power up to 12W and narrow voltage output power up to 18W

### Applications

- Power Adaptors(traveling chargers ,stand-alone power set)
- Internal power supply for Energy-Saving Appliances (such as electromagnetic oven, microwave oven and etc.)



## **TYPICAL APPLICATION**



### **PACKAGE INFORMATION**

#### TOP VIEW.



### **PIN FUNCTIONS**

Pin	Symbol	Function Description			
1	OB	Base Pin of the Power Tube.(Enabling current input and connect to initiating resistance)			
2	VCC	Power Supply Pin			
3	GND	Ground Pin			
4	CT	Oscillation Capacitance Pin. (Connect to timing capacitance)			
5	FB	Feedback Pin			
6	IS	Current Inspection Pin			
7 • 8	OC	Output Pin( Connect to switching transformer)			



# ABSOLUTE MAXIMUM RATINGS

Supply Voltage VCC	18V
OC Voltage0.3-8	VOC
Total Dissipation Power 1000r	nW
Storage Temperature Range40 - 15	0°C

Pin Input Voltage	VCC+0.3V
Switching Current	800mA
Operating Temperature Range	0-75℃
Welding Temperature	+260℃, 10S

## **ELECTRICAL CHARACTERISTICS**

The specifications are applied at T=25  $^{\circ}$ C , VCC=5.5-7.5V, Ct=680PF, RS=1  $_{\Omega}$ , unless otherwise noted.(Note 2)

Output Section  IOC=10mA  800  V    Max. Withstanding Voltage  VsArt  IoC=250mA  1  V    Saturation Voltage  VsArt  Ioc=250mA  1  V    Output Rise Time  TR  CL=1nF  75  ns    Output Pall Time  TF  CL=1nF  75  ns    Output Voltage  VREF  Io=1.0mA  2.4  2.5  2.6  V    Reference Section  Timo-100°C  250  270  290  mA    Reference Output Voltage  VREF  Io=1.0mA  2.4  2.5  2.6  V    Load Regulation  Io=2.1-1.2mA  3  %  mV  Coutput Noise Voltage  F=10Hz-10KHz  50  uV    Long Term Stability  1000 hours@85°C  5  mV  Socillator Section  mV    Oscillator Amplitude (Vp-p)  1000 hours@85°C  5  mV  Voltage Stability  Vcc=5.5-9V  1  %    Temperature Stability  Ta=0-85°C  0.6  70  dB  MA <th>Para</th> <th>ameter</th> <th>Symbol</th> <th>Conditions</th> <th>Min</th> <th>Тур</th> <th>Max</th> <th>Units</th>	Para	ameter	Symbol	Conditions	Min	Тур	Max	Units
Max. Withstanding Voltage of the Switching Tube  IOC=10mA  800  V    Saturation Voltage  VsAt  Ioc=250mA  1  V    Output Rise Time  TR  CL=1nF  75  ns    Output Fall Time  TF  CL=1nF  75  ns    Reference Section  Time  TC  200  mA    Reference Section  Vcc=5.5-9V  2  20  mV/T    Output Noise Voltage  F=10Hz-10KHz  50  uV  uV    Load Regulation  Io=0.1-1.2mA  0.2  mV/TC    Output Noise Voltage  F=10Hz-10KHz  50  uV  uV    Load Regulation  Io=0.627  5  mV  UV    Oscillating frequency  Fosc  C1=680PF  56  61  67  KHz    Voltage Stability <td></td> <td></td> <td>J</td> <td></td> <td></td> <td>JF</td> <td></td> <td></td>			J			JF		
Saturation Voltage  Vs.nt  loc=250mA  I  I  V    Output Rise Time  TR  CL=1nF	Max. Withstanding Voltage			IOC=10mA	800			V
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Reference Output Voltage  VREF  Io=1.0mA  2.4  2.5  2.6  V    Line Regulation  Vcc=5.5-9V  2  20  mV    Load Regulation  Io=0.1-1.2mA  3  %    Temperature Stability  0.2  mV/C    Output Noise Voltage  F=10Hz-10KHz  50  uV    Long Term Stability  1000 hours@85°C  5  mV    Oscillator Section   56  61  67  KHz    Voltage Stability  Voc=5.5-9V  1  %  0  0  V    Oscillator Amplitude (Vp-p)  FB=2.5V, IS=0V  0.55  0.6  0.65  mA    Impedance  Current Retio  FB=2.5V, IS=0V  0.55  0.60  0.65  MA    Oscillator Amplitude (Vp-p)  Vcc=5.5-9V  60  70  dB    Current Sampling Section  Vcc=5.5-9V  60  70  dB    Current Sampling Inreshold  Vcs  0.55  0.60  0.65  V    Anti-Upper Limit Current  <	Output Lim	niting Current		Tj=0-100℃	250	270	290	mA
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Temperature Stability  mV/C    Output Noise Voltage  F=10Hz-10KHz  50  uV    Long Term Stability  1000 hours@85°C  5  mV    Oscillator Section  50  uV    Oscillator Section  56  61  67  KHz    Voltage Stability  Fosc  Ct=680PF  56  61  67  KHz    Voltage Stability  Vac=5.5-9V  1  %  0scillator Amplitude (Vp-p)  1  %    Oscillator Amplitude (Vp-p)  Ta=0-85°C  0.55  0.6  0.65  mA    Input Impedance  Current  FB=2.5V, IS=0V  0.55  0.6  0.65  mA    Power Supply Suppression Resistor  Vcc=5.5-9V  60  70  dB  dB    Current Sampling Threshold  Vcs  0.55  0.60  0.65  V    Current Sampling Threshold  Vcs  0.55  0.60  70  dB    Ratio  Dmax  0.55  0.60  70  dB    Power Supply Suppression Ratio	Line Re	egulation		Vcc=5.5-9V		2	20	mV
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Oscillation Section  Fosc  Ct=680PF  56  61  67  KHz    Voltage Stability  Vcc=5.5-9V  1  %    Temperature Stability  Ta=0-85°C  1  %    Oscillator Amplitude (Vp-p)  2.2  V    Feedback Section  2.2  V    Input  Pull-up  2.2  V    Peedback Section  8  8.6  8.8  9.0    Imped Current  Pull-up Current  FB=2.5V, IS=0V  0.55  0.6  0.65  mA    Power Supply Suppression Ratio  Vcc=5.5-9V  60  70  dB  0.55  0.60  0.65  V    Current Sampling Section  Vcc=5.5-9V  60  70  dB  0.55  0.60  0.65  V    Anti-Upper Limit Current  IL  0.25  0.27  0.29  A    Power Supply Suppression Ratio  53  57  61  %    Maximum Duty Ratio  DmAx  53  57  61  %    Power Supply	Output No	oise Voltage		F=10Hz-10KHz			50	υV
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Feedback Section  FB=2.5V, IS=0V  0.55  0.6  0.65  mA    Impedance  Current  Pull-up  30  KΩ    Power Supply Suppression Ratio  Vcc=5.5-9V  60  70  dB    Current Sampling Section    Current Sampling Threshold  Vcs  0.55  0.60  70  dB    Power Supply Suppression Ratio  Vcs  0.55  0.60  70  dB    Current Sampling Threshold  Vcs  0.25  0.27  0.29  A    Power Supply Suppression Ratio  L  0.25  0.27  0.29  A    Power Supply Suppression Ratio  DMAX  53  57  61  %    Power Supply Current Section  DMAX  53  57  61  %    Minimum Duty Ratio  DMAX  53  57  61  %    Power Supply Current Section  1.6  2.4  3.2  mA    Initiating Reception Current  Ind  55  80  UA    Static Current	Temperat	ure Stability		Ta=0-85℃			1	%
$\begin{array}{ c c c c } \mbox{Impedance} & \begin{tabular}{ c c c c } \mbox{Impedance} \\ \end{tabular} \\ \begin{tabular}{ c c c c } \mbox{Impedance} \\ \end{tabular} \\ \begin{tabular}{ c c c c } \mbox{Impedance} \\ \end{tabular} \\ \begin{tabular}{ c c c c } \mbox{Impedance} \\ \end{tabular} \\ \end{tabular} \\ \end{tabular} \\ \begin{tabular}{ c c c c c } \mbox{Impedance} \\ \end{tabular} \\ tabular$	Oscillator Amplitude (Vp-p)					2.2		V
$\begin{array}{ c c c } Impedance & Current & \\ \hline Pull-Down & \\ \hline Resistor & \\ \hline Power Supply Suppression & \\ \hline Ratio & \\ \hline \\$	Feedback S	Section						
$\begin{array}{ c c c c } \hline Resistor &   &   &   &   &   &   &   &   \\ \hline Power Supply Suppression Ratio & Vcc=5.5-9V & 60 & 60 & 70 & dB \\ \hline Current Sampling Section & Vcc & 0.55 & 0.60 & 0.65 & V \\ \hline Current Sampling Threshold & Vcs & 0.55 & 0.60 & 0.65 & V \\ \hline Anti-Upper Limit Current & I_L & 0.25 & 0.27 & 0.29 & A \\ \hline Power Supply Suppression Ratio & 0 & 60 & 70 & dB \\ \hline Ratio & 0 & 0 & 0 & 0 & 0 & 0 \\ \hline PWM Section & V & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \hline PWM Section & V & Vcc & V & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0$				FB=2.5V, IS=0V	0.55	0.6	0.65	mA
Ratio  Image: constraint of the stand of the		Resistor				30		KΩ
Current Sampling Threshold  V <sub>CS</sub> 0.55  0.60  0.65  V    Anti-Upper Limit Current  IL  0.25  0.27  0.29  A    Power Supply Suppression Ratio  60  70  dB    PWM Section  60  70  dB    Maximum Duty Ratio  DMAX  53  57  61  %    Power Supply Current Section  DMIN  1.6  2.4  3.2  mA    Initiating Reception Current  1.6  2.4  3.2  mA    Static Current  IQ  Vcc=8V  2.8  3.0  3.2  mA    Static Current  IQ  Vcc=8V  2.8  8.6  8.8  9.0  V				Vcc=5.5-9V		60	70	dB
Anti-Upper Limit CurrentIL0.250.270.29APower Supply Suppression Ratio6070dBPWM Section535761%Maximum Duty RatioDMAX535761%Minimum Duty RatioDMIN13.5%Power Supply Current Section1.62.43.2mAInitiating Reception CurrentInitiating Static Current5580UAStatic CurrentIqVcc=8V2.83.03.2mAStatic UrrentIqVcc=8V2.88.68.89.0V								
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RatioImage: constraint of the systemPWM SectionMaximum Duty RatioD_MAX535761%Minimum Duty RatioD_MINImage: constraint of the system3.5%Power Supply Current SectionInitiating Reception Current1.62.43.2mAInitiating Static CurrentImage: constraint of the system5580UAStatic CurrentIqVcc=8V2.83.03.2mAStart-up voltageImage: constraint of the system8.68.89.0V	Anti-Upper	Limit Current	١L		0.25	0.27	0.29	А
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Initiating Reception Current1.62.43.2mAInitiating Static Current5580UAStatic CurrentIqVcc=8V2.83.03.2mAStart-up voltage8.68.89.0V					<u> </u>	<u> </u>	0.0	,°
Initiating Static Current5580UAStatic CurrentIqVcc=8V2.83.03.2mAStart-up voltage8.68.89.0V					1.6	2.4	3.2	mA
Static Current  IQ  Vcc=8V  2.8  3.0  3.2  mA    Start-up voltage  8.6  8.8  9.0  V								
Start-up voltage  8.6  8.8  9.0  V	•		0	Vcc=8V	2.8			
		9			4.4	4.6	4.8	V



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## ELECTRICAL CHARACTERISTIC.

The specifications are applied at T=25  $^{\circ}$ C, VCC=5.5-7.5V, Ct=680PF, RS=1  $\Omega$ , unless otherwise noted.(Note 2)(continued)

Re-enabling voltage		3.6	3.8	4.0	V
Over-Voltage Limiting Threshold		9.5	10	10.5	V

**Note1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime. Note2: The 6203 is guaranteed to meet performance

specifications from 0°C to 70°C. Specifications over the -40°C to  $85^{\circ}$ C operating temperature range are assured by design,

characterization and correlation with statistical process controls.



## **BLOCK DIAGRAM**

## **OPERATION** (Refer to Block Diagram)

When RM6203 is surpplied with the rectified AC power, it does not work at once but go to start-sup state. the start-up current of RM6203 depends on the start-up resistor whose unit is Mohm, then the capactor connected between the VCC pin and GND pin is charged by this start-up current. when the capacitor voltage rise to 8.8V and equal to the RM6203 start-up voltage, the RM6203 begin to work. In the next cycle, the VCC pin voltage or the capacitor voltage of

REACTOR

RM6203 is surpplied by the second-side feedback winding of transformer. the start-up time is decided by the value of resistor and capacitor.

As RM6203 work, low-point , sub-high-point and high-point current sampling circuit will respectively real-time sample the current of the power tansistor Q0,

when the current or VRS is lower than 0.55V, the output VL1 signal of the CP1 op-amplifier is low, which

can not enable the error-adjustment-limiter to wo For Evaluation Only. when the VRS rise to more than 0.55V, the op-amplifier will be enabled and with the VRS rise the output VL1 signal will be increased too, meanwhile, signal VL1 send to control VFB1 the is inverse-proportionaly by adjust-control-module, SO VFB1 becomes smaller and the duty cycle of modulated-wave is reduced. the signal VL2 from PFM controller has the same action as VL1. so the duty cycle of modulated-wave is Comprehensive regulated by VFB, VL1 and VL2.

When VRS is more than 0.58V, the output VL3 signal

#### Normal Stage Switching Cycle Oscillogram

-current-driver regulator and the base driver current of Q0 is reduced.

When VRS is morn than 0.6V, the output signal VL8 of CP3 op-amplifier will be high and the signal reset the RS flip-plop and at the same time switch the upper-limit-current-adjustment and driver controller, the high-driver is off and the low-driver is on. Q0 is turned off quickly.Whether to enter the PFM mode is decided by the The signal VL8 and VFB1, PFM will adjust the frequency of oscillator according to the different case.



## **Electric Parameter Definitions**

- Start-up receives current: The current of OC when there's a 0.5mA pull down current of OB in the start-up period.
- Start-up static current: The minimum current sourcing current which can enable VCC surging when VCC is connected to a filter capacitor and an adjustable current sourcing, CT is connected to a 680pF capacitor, and other pins with no connection.
- Start-up voltage: The maximum of VCC above.
- Re-start-up voltage: The minimum of VCC above.
- Oscillator shut-down voltage: The negative -edge of VCC above; the value of VCC which can stop the oscillator.
- Static current: The VCC power supply current in normal period when FB is connected to the ground by a 1.0KΩ resistance.

## **Power Supply Design Points (Refer to Application Example)**

- Current control switching power supply with flyback design, discontinuous current operation mode.
- The power supply start-up current is 0.5-2mA which is alternative. The magnification of power transistor Q1 can be supposed as 10. Then the alternation of the start-up resistance must assure the current of the power transistor's base is between 0.05mA to 0.2mA. Therefore, the power of the output resistance can reduce to 1/10, which reduces the power in idle state.
- In diagram 3, C3=680pF, the maximum operation frequency is about 67KHz.
- The reference winding rectifier output is 4.8~9.0V (6V is recommended) of the Switching transformer (T1 in diagram 3), which provide operation power for RM6203.
- The maximum primary peak current of the

- Oscillator pull up/pull down current: The pull up/pull down current of CT when FB=2.5V and CT=1.25V in normal period.
- FB pull up current: which occurs in normal period, when FB=2.5V, and IS=0A.
- FB upper current protection: The pull down current of FB when FB=6V and IS=0.6A in normal period.
- Inside feedback power supply: The value of VCC when there is no feedback circuit of RM6203 in normal period.
- OC upper limit current: If FB=6V, the minimum OC current when there is pull down current in FB.
- Oscillator cycle: Which is the function of the capacitor connected to CT, about CT\*25400 seconds.

switching transformer is 0.6A. When at wide voltage or 110V Vac, or 85V magnetism dissipation voltage, the maximum output power can achieve more than 12W.

- The OC (Pin 7, 8) of RM6203 is in high voltage, and IS (Pin 6, for current sense resister) is connected. Therefore, it is easy to open a divider between pin 6 and 7 to meet the requirement of the safe regulation.
- Although there is over-temperature protection, when high-power output is needed without considering PCB heat dissipation, the output power and voltage may fall.



## **PACKAGE INFORMATION**

DIP-8







#### Dimensions

Symbol		Millimeter		Inch			
	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α			5.334			0.210	
A1	0.381			0.015			
A2	3.175	3.302	3.429	0.125	0.130	0.135	
b		1.524			0.060		
b1		0.457			0.018		
D	9.017	9.271	10.160	0.355	0.365	0.400	
E		7.620			0.300		
E1	6.223	6.350	6.477	0.245	0.250	0.255	
E		2.540			0.100		
Ĺ	2.921	3.302	3.810	0.115	0.130	0.150	
e <sub>B</sub>	8.509	9.017	9.525	0.335	0.355	0.375	
θ°	0°	7°	15°	0°	7°	15°	

# **Thermal Impedence**

DIP-8 Package Thermal Rsistance(Reference)
$ heta_{JC}^{notel}$ Junction to case
$ heta_{J\!A}^{note2}$ Junction to Ambient
Note:1.all items are tested with the standards JESD 51-2.
2.Free-standing, with no heat-sink, under natural convection.
3. Pin 7 & 8 connected to $200  mm^2$ PCB copper clad.

