



# RM6401 Application Information

## --12V\_3A

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## OUTLINE

- RM6401 Introduction
- Electrical Characteristic Description
- Application Circuit
- BOM List
- Transformer Parameter
- Test Report



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## 一、RM6401 Description

RM6401 is a high performance flyback quasi-resonant controller optimized to achieve high efficiency in the universal input range and full full loading range with effective system cost.

At full loading,the IC operates in fix frequency CCM mode in the low line input range and operates in quasi-resonant mode in high line input range.in this way,high efficiency in the universal input range at full loading can be achieved

At normal load condition,it operates in QR mode.To minimize switching loss, the max switching frequency in QR mode is internally limited to 90Khz.When the loading goes low,it operates in PFM mode for high power conversion efficiency. When the load is very small,the IC operates in “Extended Burst Mode”to minimize the standby power loss.As a result,high conversion efficiency can be achieved in the whole loading range.



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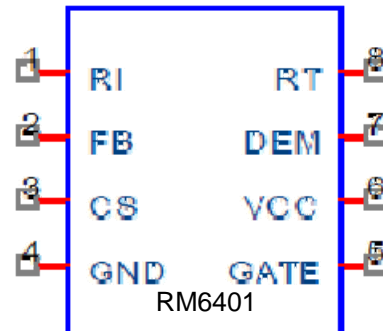
## Features

- Multi-Mode Operation:
  - At full loading, Fix frequency CCM operation & Low Line and QR Mode operation & High Line input.
  - Quasi-resonant operation at normal load .
  - Pulse frequency modulation operation at light load .
  - Burst Mode at no load .
- Adaptive frequency shuffling and slope compensation & fix frequency In CCM.
- Programmable OTP with latch shutdown.
- Fixed 4ms Soft-start .
- 2.5us minimum off time .
- 12.5us maximum on time limit.
- 55us maximum off time limit .
- 90khz maximum frequency limit .
- Internal LEB .
- OVP.
- 800mA peak current sink/source capability .

# PIN configuration (top view)



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| Pin Num | Pin Name | I/O | Description  |
|---------|----------|-----|--|
| 1       | RI       | I   | A resistor connected between RI and GND sets the internal frequency and timer,the resistor is recommended to be set in the vicinity of 20Kohm; |
| 2       | FB       | I   | Feedback input pin,PWM duty cycle is determined by voltage level into this pin and current-sense signal level at pin3;                         |
| 3       | CS       | I   | Current sense pin  |
| 4       | GND      | P   | Ground   |
| 5       | GATE     | O   | Totem-pole gate drive output for power MOSFET  |
| 6       | VCC      | P   | Chip DC power supply pin   |
| 7       | DEM      | I   | Transformer core demagnetization detection pin,this pin is also used for output over voltage protection;                                       |
| 8       | RT       | I   | Over temperature protection pin,connected through a NTC resistor to GND for over temperature latch shutdown.                                   |



## 二、Electronical Characteristics

(TA=25°C,VCC=16V,RI=20Kohm,if not otherwise noted)

| Symbol          | Parameter                                  | Conditions   | Min  | Typ  | Max  | Units |
|-----------------|--|--|------|------|------|-------|
| I_VCC_Startup   | VCC Start up Current                       | VCC=UVLO(OFF)<br>-1.5V,Measure<br>current into VCC |      | 5    | 15   | uA    |
| I_VCC_quiet     | Operation Current without<br>switching     | FB=3V  |      | 2.0  | 4.0  | mA    |
| I_VCC_operation | Operation Current with<br>switching        | FB=13,1nf load at<br>GATE                          |      | 3.0  | 5.0  | mA    |
| UVLO(ON)        | VCC Under Voltage Lockout<br>Enter         |  | 8.0  | 9.0  | 10.0 | V     |
| UVLO(OFF)       | VCC Under Voltage Lockout<br>Exit(startup) |  | 15.0 | 16.0 | 17.0 | V     |
| VCC_clamp       | VCC Zener Clamp Volatge                    | I_VCC=5mA  |      | 29   |      | V     |
| OVP(ON)         | VCC Over voltage protection<br>Enter       |  |      | 28   |      | V     |

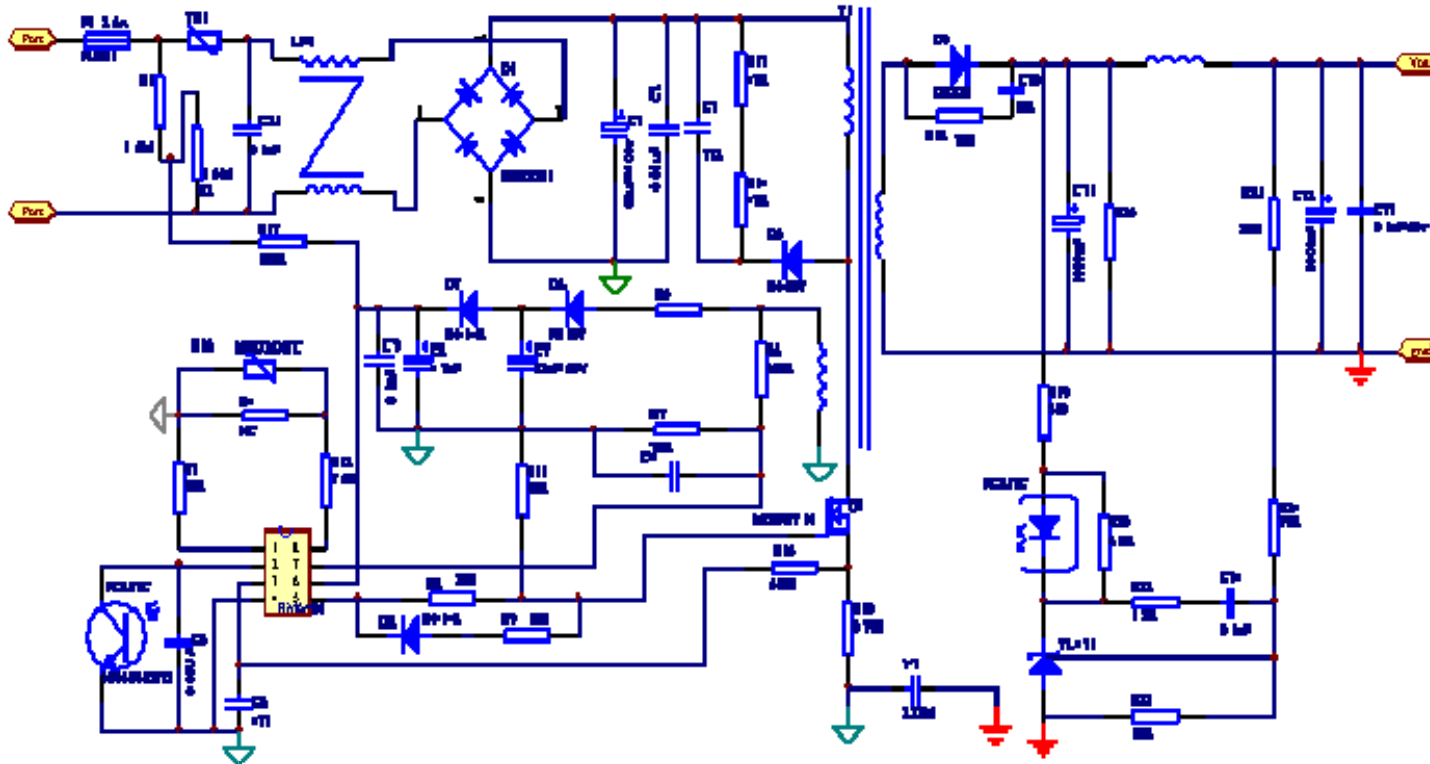


| <b>Symbol</b>        | <b>Parameter</b>                    | <b>Conditions</b>                    | <b>Min</b> | <b>Typ</b> | <b>Max</b> | <b>Units</b> |
|----------------------|-------------------------------------|--------------------------------------|------------|------------|------------|--------------|
| Vfb_Open             | FB Open Voltage                     |                                      |            | 5.3        |            | V            |
| Ifb_Short            | FB pin short circuit current        | Short FB pin to GND, measure current |            | 1.5        |            | mA           |
| Vth_BM_ON            | Burst Mode on threshold             |                                      |            | 0.8        |            | V            |
| Vth_BM_OFF           | Burst Mode off threshold            |                                      |            | 0.7        |            | V            |
| Vth_PL               | Power limiting FB Threshold Voltage |                                      |            | 4.4        |            | V            |
| Vth_OCP_zero_on time | Internal current limiting threshold | Zero duty cycle                      | 0.415      | 0.45       | 0.485      | V            |
| Vth_OCP_max          | Internal current limiting threshold | Maximum duty cycle                   |            | 0.80       |            | V            |
| Vth_OVP              | Output OVP trigger point            |                                      |            | 3.75       |            | V            |

### 三、Application circuit



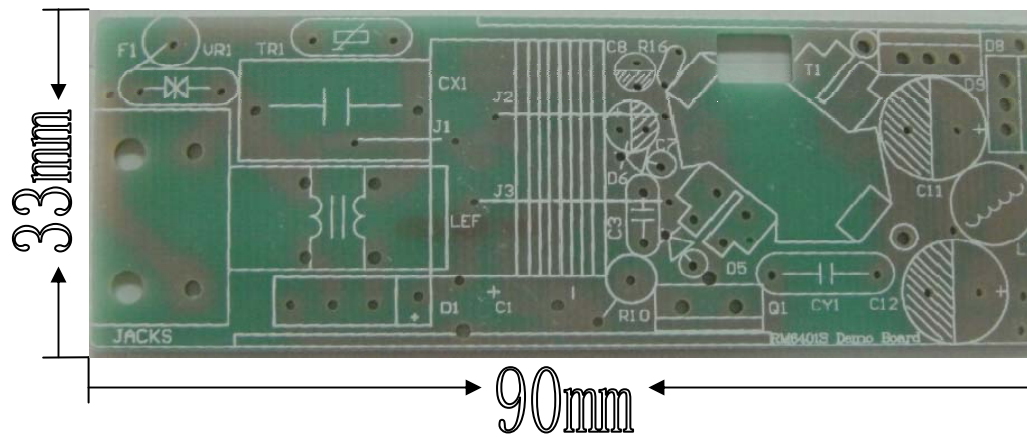
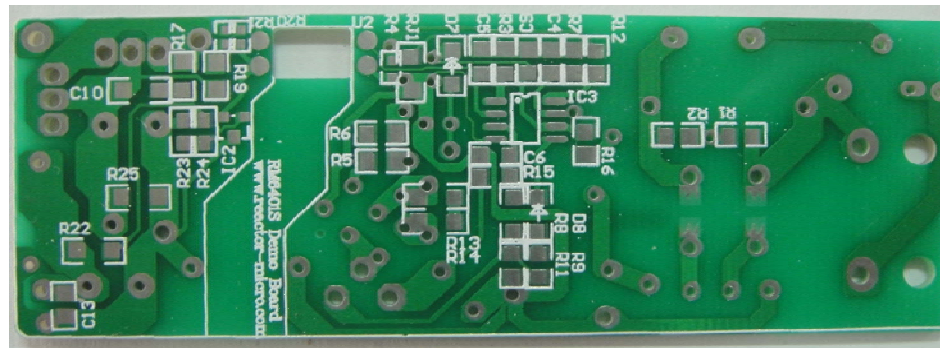
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# PCB



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## 四、BOM LIST

| 名称型号                               | 用量 | 位置    | 尺寸要求     |
|------------------------------------|----|-------|----------|
| KBP206,2A/600V                     | 1  | D1    |          |
| FR107 1A/400V,DO-41                | 1  | D6    |          |
| IN4007,1A/1000V,DO-401             | 1  | D5    |          |
| IN4148,0.1A/100V,SMD1206           | 2  | D7 D8 |          |
| MBR15100 TO-220                    | 1  | D9    |          |
| 90*33MM 94V0 1.6MM                 | 1  | PCB   |          |
| Core18*10*7mm(24mH)Φ0.5mm*45t*2    | 1  | LF1   |          |
| RM-8 TDK PC40 10KHZ/0.3V 900UH     | 1  | T1    |          |
| 散热片RM40-A 铜                        | 1  |       |          |
| 散热片RM40W-B 铜                       | 1  |       |          |
| AC 插头 “8”头                         | 1  | JACKS |          |
| 金属膜3.3nF/630V,-40/105℃, ±20%       | 1  | C3    | 盒型8*5mm  |
| 4.7uF/50V,-40/105℃, ±20%           | 1  | C8    | Φ4*6MM   |
| 22UF/50V,-40/105℃, ±20%            | 1  | C7    | Φ5*8MM   |
| 1000UF/25V,-40/105℃, ±20%          | 1  | C11   | Φ10*20MM |
| 1000UF/16V,-40/105℃, ±20%          | 1  | C12   | Φ10*20MM |
| 68UF/400V,-40/105℃, ±20%           | 1  | C1    | Φ16*28MM |
| MOSEFT,MOS POWER.N-CHANNAL,FQP5N60 | 1  | Q1    | TO-220   |



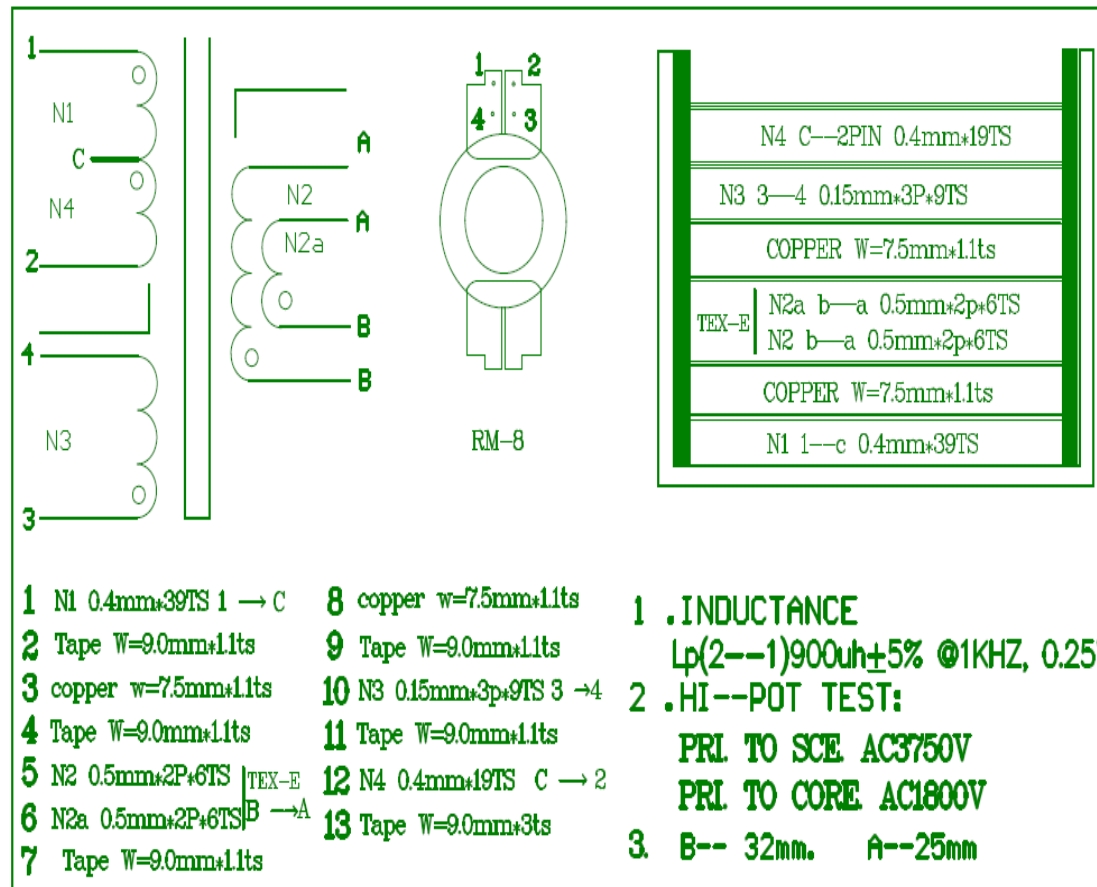
| 名称型号                                  | 用量 | 位置      | 尺寸要求    |
|---------------------------------------|----|---------|---------|
| X2,0.33UF/275AC,-40/105℃, ±20%        | 1  | CX1     | 10*18mm |
| NTC thermistor 150k/20℃ Φ3mm          | 1  | R16     |         |
| 7D471,300Vac rms max,385Vdc rms       | 1  | VR1     |         |
| 金膜电阻0.39R 2WS                         | 1  | R10     |         |
| RM6201S QR CONTROLLER SOT-8           | 1  | IC3     |         |
| PC817C DIP-4                          | 1  | IC2     |         |
| TL431 ±1% SOT-23                      | 1  | IC1     |         |
| Capctar,Y1 disk 2.2nf/250ac -40℃+150℃ | 1  | CY1     |         |
| T2.5A 3*10MM                          | 1  | F1      |         |
| Resistor chip1.5MΩ,0.25W,±5%,SMD0805  | 2  | R1 R2   |         |
| Resistor chip 47K,0.5W,±5%,SMD1206    | 2  | R13 R14 |         |
| Resistor chip160K,0.24W,±1%,SMD0805   | 1  | R6      |         |
| Resistor chip 30K,0.24W,±1%,SMD0805   | 1  | R7      |         |
| Resistor chip 20R,0.25W,±5%,SMD0805   | 1  | R8      |         |
| Resistor chip 10R,0.25W,±5%,SMD0805   | 1  | R9      |         |
| Resistor chip 10K,0.25W,±5%,SMD0805   | 1  | R11     |         |
| Resistor chip 510R,0.25W,±5%,SMD0805  | 1  | R15     |         |



| 名称型号                                     | 用量 | 位置         | 尺寸要求 |
|--|----|------------|------|
| Resistor chip 7.5K,0.25W,±5%,SMD0805     | 1  | R12        |      |
| Resistor chip 18K,0.25W,±5%,SMD0805      | 1  | R3         |      |
| Resistor chip 100K,0.25W,±5%,SMD0805     | 1  | R17        |      |
| Resistor chip 0R,0.25W,±5%,SMD0805       | 1  | R5         |      |
| capacitor 100nF/50V,X7R,±10%,SMD0805     | 3  | C9 C13 C14 |      |
| capacitor 10NF/1000V,-40/105℃, ±20%,1206 | 1  | C2         |      |
| capacitor 471/100V,X7R,±5%,SMD0805       | 1  | C6         |      |
| capacitor 1NF/100V,X7R,±10%,SMD1206      | 1  | C10        |      |
| capacitor 10nF/25V,X7R,±10%,SMD0805      | 1  | C5         |      |
| Resistor chip 20R,0.5W,±5%,SMD1206       | 1  | R18        |      |
| Resistor chip 510R,0.25W,±5%,SMD0805     | 1  | R19        |      |
| Resistor chip 6.8K,0.25W,±5%,SMD0805     | 1  | R20        |      |
| Resistor chip 1K,0.25W,±5%,SMD0805       | 1  | R22        |      |
| Resistor chip 39K,0.25W,±1%,SMD0805      | 1  | R24        |      |
| Resistor chip 10K,0.25W,±1%,SMD0805      | 1  | R23        |      |
| Resistor chip 20R,0.5W,±5%,SMD1206       | 1  | R21        |      |
| Resistor chip 20KR,0.5W,±5%,SMD1206      | 1  | R25        |      |



## 五、Transformer



## 六、 Test Report-Test Condition and Test SPEC.



| Description          | MIN         | TPY | MAX          | Test Data      | Result |
|----------------------|-------------|-----|--------------|----------------|--------|
| <b>Input</b>         |             |     |              |                |        |
| Voltage<br>Frequency | 90V<br>50hz |     | 265V<br>60hz | 85V-265V       | PASS   |
| <b>Output</b>        |             |     |              |                |        |
| Voltage              | 11.4V       | 12V | 12.6V        | 12.18V         | PASS   |
| Current              |             |     | 3A           |                | PASS   |
| Load regulation      | -5%         |     | 5%           | 1.6%           | PASS   |
| Power                |             | 36W |              | 36.57 W (avg.) | PASS   |
| <b>Efficiency</b>    |             |     |              |                |        |
| Energy Star(5)       |             |     |              | 87%(avg.)      | PASS   |

# Test Data



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## Line Regulation

Test Condition: Iload=1.5A

|         |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|
| Vin(V)  | 90   | 115  | 185  | 220  | 235  | 265  |
| F (Khz) | 51.6 | 58.1 | 44.6 | 41.5 | 42.3 | 42.8 |

F (MAX) : 90KHz F (MIN) : 40KHz ; Result: **PASS** ;

Test Condition: Iload=3.0A

|         |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|
| Vin(V)  | 90   | 115  | 185  | 220  | 235  | 265  |
| F (Khz) | 59.5 | 58.1 | 76.9 | 83.3 | 84.2 | 73.1 |

F (MAX) : 90KHz F (MIN) : 40KHz ; Result: **PASS** ;

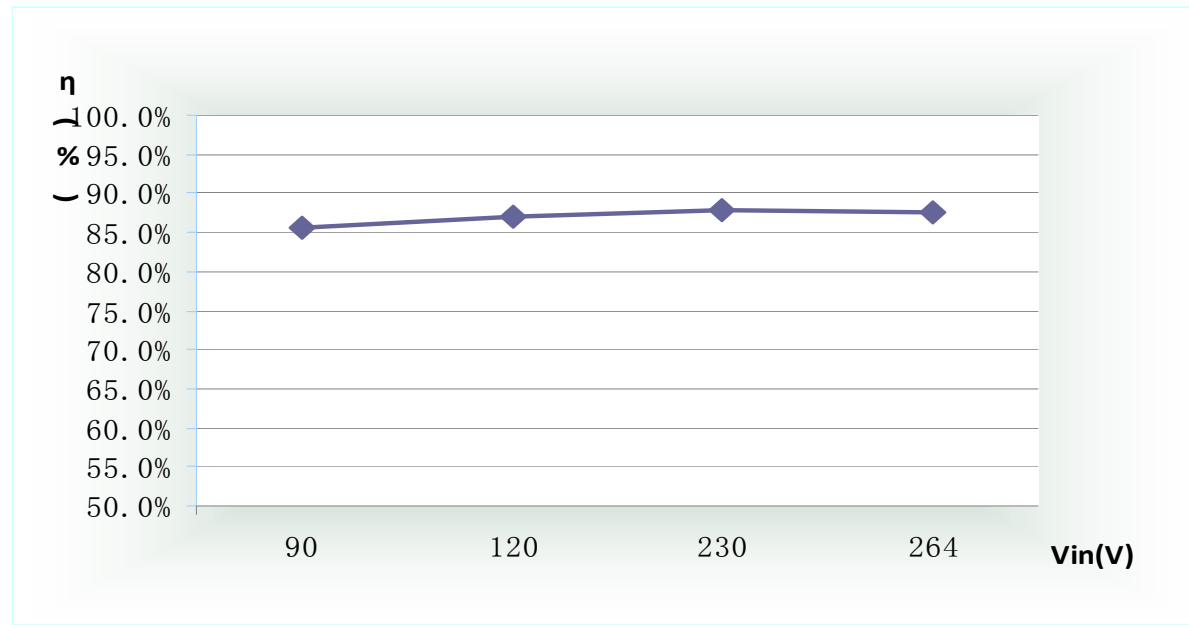
## OCP

|         |             |             |             |             |             |
|---------|-------------|-------------|-------------|-------------|-------------|
| Vin(V)  | 90          | 115         | 185         | 220         | 265         |
| OCP (A) | 4.02        | 4.02        | 4.02        | 4.02        | 4.02        |
| Result  | <b>PASS</b> | <b>PASS</b> | <b>PASS</b> | <b>PASS</b> | <b>PASS</b> |

Note: I<sub>oCP</sub>=(1.3-1.8) I<sub>out (max)</sub> ;

# Test Data

## Efficiency





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THE END