



3521

CMOS IC

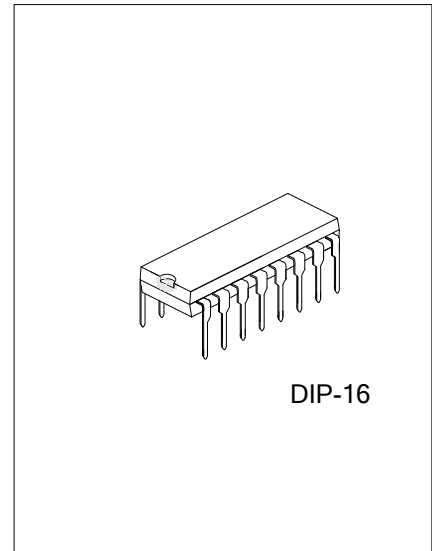
## PWM CONTROLLER WITH SUPERVISORY CIRCUIT FOR SWITCHING POWER SUPPLY

### ■ DESCRIPTION

UTC **3521** PWM controller is designed for switching mode power supply for PCs. It provides all the functions necessary to monitor and control the output of the power supply. Remote ON/OFF control, power good circuitry, some protection features against over-voltage and over-power are implements.

### ■ FEATURES

- \* Over-Voltage Protection for 3.3V, 5V and 12V
- \* Under-Voltage Detection for 3.3V, 5V and 12V
- \* Over-Power Protection
- \* Remote ON/OFF Function
- \* Power Good Circuitry
- \* Delay Time for PG Signal
- \* Delay Time for Over-Voltage and Under-Voltage Protection
- \* On-Chip Oscillator and Error Amplifier

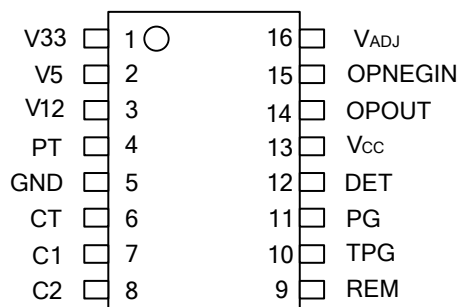


### ■ ORDERING INFORMATION

| Ordering Number   |              | Package | Packing |
|-------------------|--------------|---------|---------|
| Lead Free Plating | Halogen Free |         |         |
| 3521L-D16-T       | 3521G-D16-T  | DIP-16  | Tube    |

|                                                                                                                                    |                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <p>3521L-D16-T</p> <ul style="list-style-type: none"><li>(1) Packing Type</li><li>(2) Package Type</li><li>(3) Lead Free</li></ul> | <ul style="list-style-type: none"><li>(1) T: Tube</li><li>(2) D16: DIP-16</li><li>(3) L: Lead Free, G: Halogen Free</li></ul> |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|

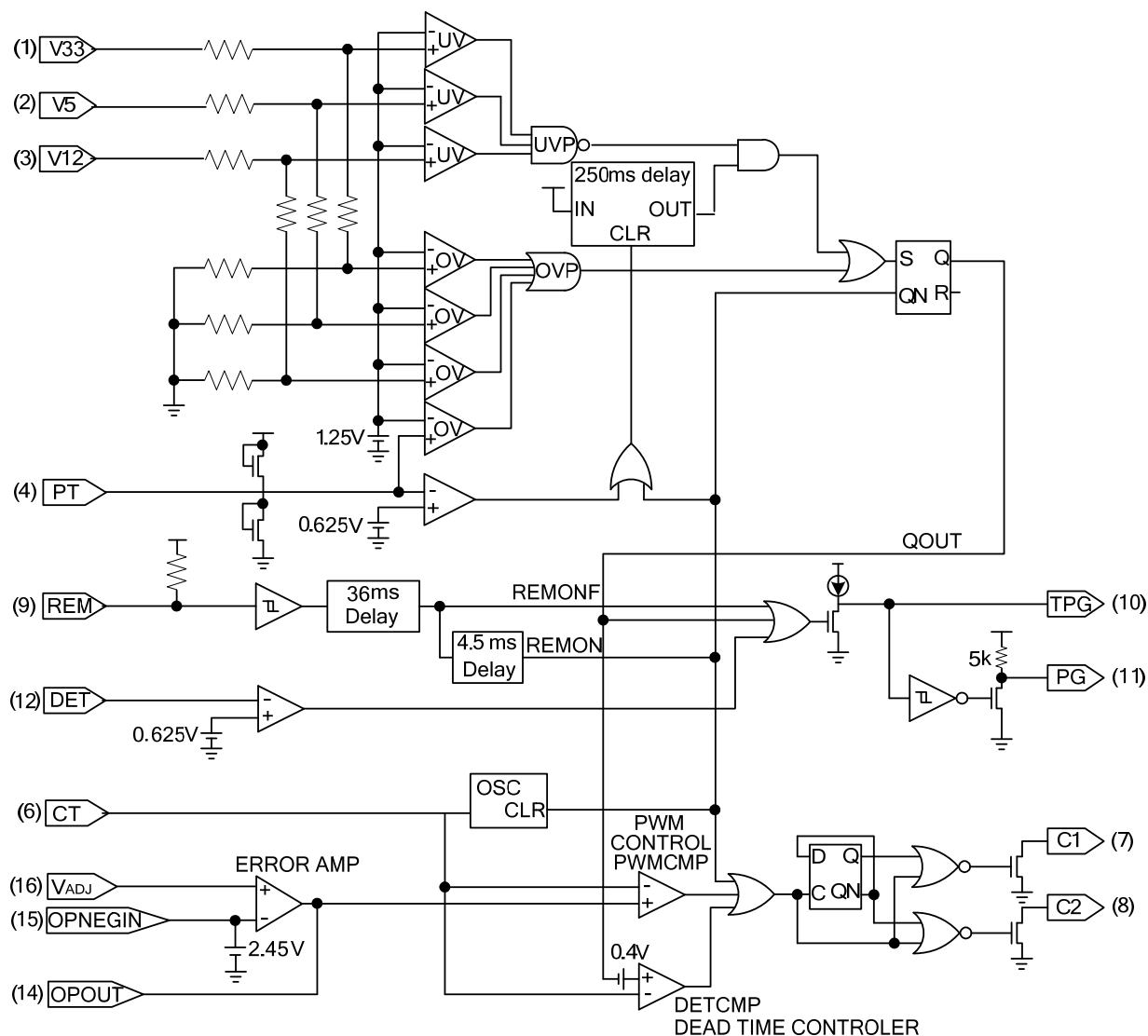
## ■ PIN CONFIGURATION



## ■ PIN DESCRIPTION

| PIN NO. | PIN NAME         | TYPE | FUNCTIONS                         |
|---------|------------------|------|-----------------------------------|
| 1       | V33              | I    | OVP/UVI Input For 3.3V            |
| 2       | V5               | I    | OVP/UVI Input For 5V              |
| 3       | V12              | I    | OVP/UVI Input For 12V             |
| 4       | PT               | I    | Additional OVP Protection         |
| 5       | GND              | P    | Ground                            |
| 6       | CT               |      | Cap FOR Oscillation Frequency     |
| 7       | C1               | O    | Output 1                          |
| 8       | C2               | O    | Output 2                          |
| 9       | REM              | I    | Remote ON/OFF Pin.                |
| 10      | TPG              |      | Power Good Delay Time Setting     |
| 11      | PG               | O    | Power Good Signal Out.            |
| 12      | DET              | I    | Power Good Signal Detection Input |
| 13      | V <sub>CC</sub>  | P    | Supply Voltage For IC             |
| 14      | OPOUT            | O    | OP AMP Output                     |
| 15      | OPNEGIN          | I    | OP AMP Negative Input             |
| 16      | V <sub>ADJ</sub> | I    | Voltage Adjust Pin                |

# ■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATINGS ( $V_{CC}=5.5V$ , unless otherwise specified)

| PARAMETER             | SYMBOL             | RATINGS    | UNIT |
|-----------------------|--------------------|------------|------|
| Supply Voltage        | $V_{CC}$           | 5.5        | V    |
| Drain Output Voltage  | $V_{CC1}, V_{CC2}$ | 5.5        | V    |
| Drain Output Current  | $I_{CC1}, I_{CC2}$ | 200        | mA   |
| Power Dissipation     | $P_D$              | 200        | mW   |
| Operating Temperature | $T_{OPR}$          | -10 ~ +70  | °C   |
| Storage Temperature   | $T_{STG}$          | -65 ~ +150 | °C   |

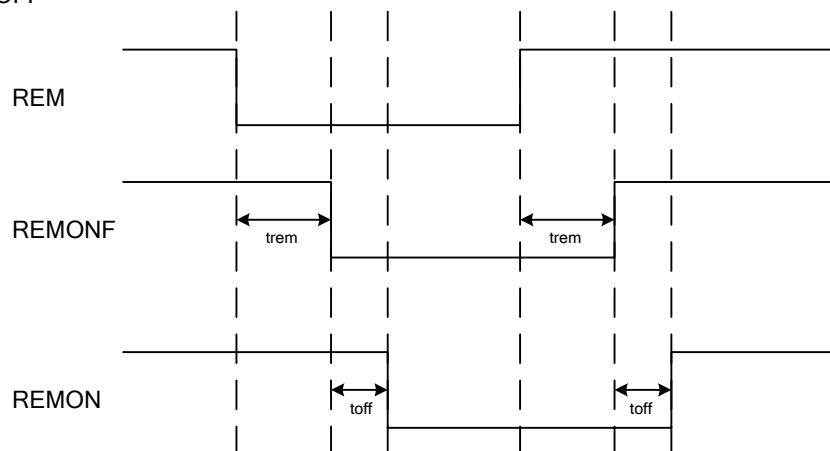
Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ ELECTRICAL CHARACTERISTICS ( $T_a=25^{\circ}C$ , $V_{CC}=5V$ , unless otherwise specified)

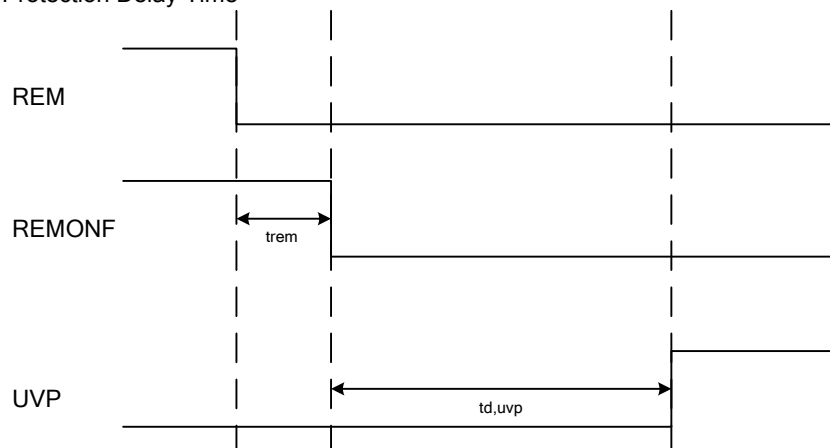
| PARAMETER                      | SYMBOL                  | TEST CONDITIONS                                     | MIN  | TYP  | MAX  | UNIT |
|--------------------------------|-------------------------|-----------------------------------------------------|------|------|------|------|
| DEAD TIME CONTROL SECTION      |                         |                                                     |      |      |      |      |
| Input Threshold Voltage        | V <sub>I(THR)</sub>     | ZERO DUTY CYCLE                                     |      | 3.0  | 3.5  | V    |
|                                |                         | MAX. DUTY CYCLE                                     |      | 0.1  |      |      |
| ERROR AMP SECTION              |                         |                                                     |      |      |      |      |
| Opneg Bias Voltage             |                         | OPNEG OPEN                                          | 2.35 | 2.45 | 2.55 | V    |
| Close Loop Voltage Gain        | G <sub>VC</sub>         | 0.5V ~ 3.5V                                         |      | 65   |      | dB   |
| Cross Over Point               |                         | 0dB                                                 |      | 320  |      | KHz  |
| OUTPUT SECTION                 |                         |                                                     |      |      |      |      |
| Output Saturation Voltage      | V <sub>DSSAT</sub>      | I <sub>D</sub> =200mA                               |      | 1.1  | 1.3  | V    |
| Drain Off-State Current        | I <sub>D(OFF)</sub>     | V <sub>CC</sub> =V <sub>D</sub> =V <sub>S</sub> =0V |      | 2    | 10   | μA   |
| Rising Time                    | t <sub>R</sub>          | R <sub>PULL-UP</sub> =1 KΩ                          |      | 100  | 200  | ns   |
| Falling Time                   | t <sub>F</sub>          | R <sub>PULL-UP</sub> =1 KΩ                          |      | 50   | 200  | ns   |
| PROTECTION SECTION             |                         |                                                     |      |      |      |      |
| Over Voltage Protection (OVP)  | V33                     |                                                     | 3.8  | 4.1  | 4.4  | V    |
|                                | V5                      |                                                     | 5.8  | 6.2  | 6.6  |      |
|                                | V12                     |                                                     | 4.38 | 4.64 | 4.90 |      |
|                                | P <sub>T</sub>          |                                                     | 1.2  | 1.25 | 1.3  |      |
| Under Voltage Protection (UVP) | V33                     |                                                     | 1.78 | 1.98 | 2.18 | V    |
|                                | V5                      |                                                     | 2.70 | 3.00 | 3.30 |      |
|                                | V12                     |                                                     | 2.11 | 2.37 | 2.63 |      |
| UVP Disable Voltage            | P <sub>T</sub>          |                                                     | 0.54 | 0.62 | 0.70 | V    |
| UVP Delay Time                 | t <sub>DLY</sub>        |                                                     | 100  | 250  | 500  | ms   |
| REMOTE ON/OFF SECTION          |                         |                                                     |      |      |      |      |
| REM High Input Voltage         | V <sub>IH</sub>         |                                                     | 2.0  |      |      | V    |
| REM Low Input Voltage          | V <sub>IL</sub>         |                                                     |      |      | 0.8  | V    |
| REM Pull High Voltage          | V <sub>H(PULL)</sub>    |                                                     | 2.0  |      | 5.25 | V    |
| REM Delay Time                 | t <sub>DLY</sub>        |                                                     | 30   | 36   | 42   | ms   |
| REM Off Delay Time             | t <sub>DLY (OFF)</sub>  |                                                     | 3.5  | 4.5  | 5.5  | ms   |
| POWER GOOD SECTION             |                         |                                                     |      |      |      |      |
| Detecting Input Voltage        | V <sub>I(DET)</sub>     |                                                     | 0.54 | 0.62 | 0.70 | V    |
| Output Saturation Voltage      | V <sub>O(SAT)</sub>     | I <sub>PG</sub> =10mA                               |      | 0.2  | 0.4  | V    |
| Charging Current For TPG       | I <sub>CHAR</sub>       |                                                     |      | 30   |      | μA   |
| PG Output Pull-up Resistor     | R <sub>O(PULL-UP)</sub> |                                                     |      | 5    |      | KΩ   |
| PG Output Load Resistor        | R <sub>O(LOAD)</sub>    |                                                     | 0.5  | 1    | 2    | KΩ   |
| PG Delay Time                  | t <sub>DLY</sub>        | C=2.2μF                                             | 100  | 250  | 500  | ms   |
| TOTAL DEVICE                   |                         |                                                     |      |      |      |      |
| Standby Supply Current         | I <sub>CC</sub>         |                                                     |      | 10   | 20   | mA   |
| OSCILLATION SECTION            |                         |                                                     |      |      |      |      |
| Oscillation Frequency          | F <sub>osc</sub>        | C <sub>T</sub> =2200P                               | 50   |      | 70   | KHz  |
| Frequency Change With TEMP.    | F <sub>osc/T</sub>      | C <sub>T</sub> =2200P                               |      | 2    |      | %    |

## ■ FUNCTION DESCRIPTION

### (1) REMOTE ON/OFF



### (2) Under Voltage Protection Delay Time



### (3) Pulse Width Modulation

The output pulse width modulation is generated by comparison of the saw-tooth waveform from the capacitor  $C_T$  to the feedback of the voltage.

Therefore, an increase in feedback control signal amplitude causes a linear decrease of the output pulse width.

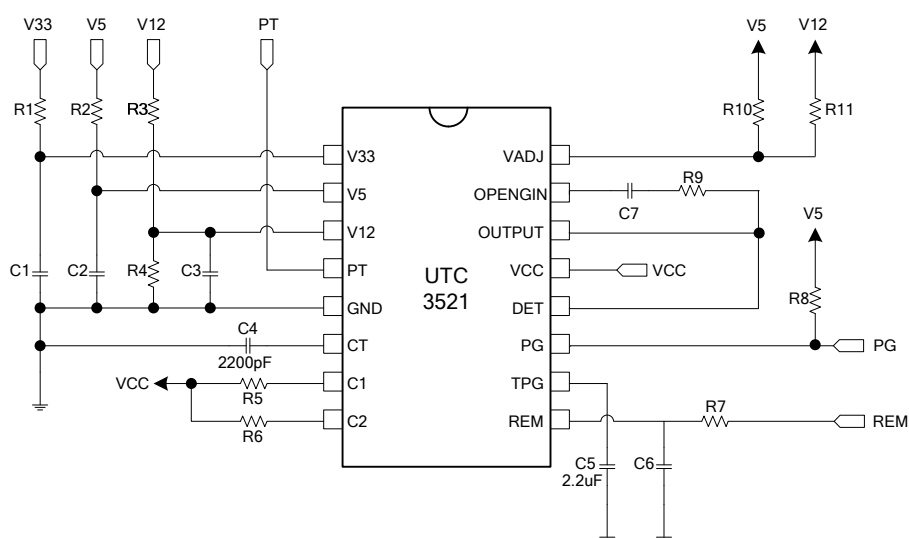
### (4) Protection Control of the Soft-Start

The soft-start function is to reduce the large current surge during power-up or preventing the output voltages ( $V_{33}/V_5/V_{12}$ ) reaches the Over Voltage Protection level.

### (5) The function of PT

This signal is prepared for extra Over Voltage Protection Input ( $V_{PT} > 1.25V$ ) or another Disable Under Voltage Protection function ( $V_{PT} < 0.62V$ ).

## ■ APPLICATION CIRCUIT



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