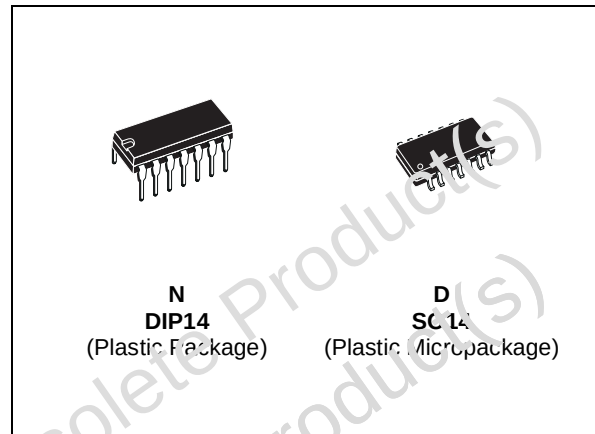


## 3.3V 5V 12V HOUSEKEEPING IC

- Over voltage protection for 3.3V 5V and 12V without external components
- Under voltage protection for 3.3V 5V and 12V without external components
- Over voltage protection for -12V or -5V with external components
- Externally adjustable under voltage blanking during power up
- Power good input/output
- Externally adjustable pg delay
- Fault output
- Remote output
- Externally adjustable remote delay
- Precision voltage reference
- 2kV ESD protection



### DESCRIPTION

The TSM1121 integrated circuit incorporates all sensing circuitry to regulate and protect from over voltage and under voltage a multiple output power supply (3.3V, 5V and 12V).

TSM1121 incorporates all the necessary functions for Housekeeping features which allow safe operation in all conditions, and very high system integration

TSM1121 integrates a precise voltage reference.

### APPLICATION

- PC SMP3 triple power line housekeeping ic (3.3 / 5V 12V)

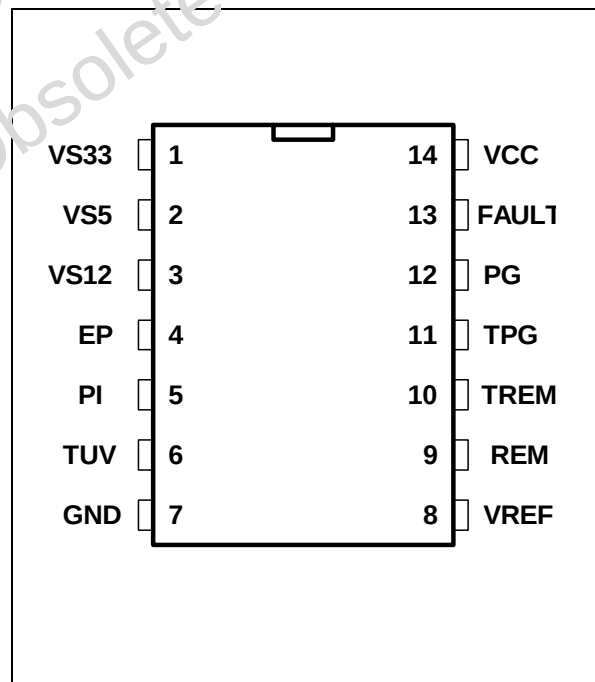
### ORDER CODE

| Part Number | Temperature Range | Package |   | Marking  |
|-------------|-------------------|---------|---|----------|
|             |                   | N       | D |          |
| TSM1121CN   | 0 to 85°C         | •       |   | TSM1121C |
| TSM1121CD   | 0 to 85°C         |         | • | M1121    |

Note: **N** = Dual in Line Package (DIP)

**D** = Small Outline Package (SO) - also available in Tape & Reel (DT)

### PIN CONNECTIONS (top view)



## 1 PIN DESCRIPTION

| Name  | Pin # | Type              | Function                                                                                                                                                                                       |
|-------|-------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vcc   | 14    | Power Supply      | Positive Power Supply Line                                                                                                                                                                     |
| Gnd   | 7     | Power Supply      | Ground Line. 0V Reference For All Voltages                                                                                                                                                     |
| Vs12  | 3     | Analog Input      | Over and Under voltage Sense Input Dedicated to the 12V Line <sup>1</sup>                                                                                                                      |
| Vs5   | 2     | Analog Input      | Over and Under voltage Sense Input Dedicated to the 5V Line <sup>1</sup>                                                                                                                       |
| Vs33  | 1     | Analog Input      | Over and Under voltage Sense Input Dedicated to the 3.3V Line <sup>1</sup>                                                                                                                     |
| Tuv   | 6     | Timing Capacitor  | Adjustable Under voltage Blanking Delay at Power Up (Setting Capacitor)                                                                                                                        |
| Fault | 13    | Open Collector    | Fault Output. Fault is high when Over or Under Voltage has been Detected                                                                                                                       |
| PI    | 5     | Analog Input      | Power Good Input. Detection of the Power Conditions                                                                                                                                            |
| PG    | 12    | Open Collector    | Power Good Output. PG output is High when the Power Conditions are OK                                                                                                                          |
| Tpg   | 11    | Timing Capacitor  | Adjustable Power Good Delay (Setting Capacitor)                                                                                                                                                |
| REM   | 9     | Logic Input       | Input Remote Control of the Complete System by the Motherboard (μController). Remote is active high. Switch OFF/ON of the Power Supply. Reset of the Complete System after a FAULT Activation. |
| Trem  | 10    | Timing Capacitor  | Adjustable Remote Delay (Setting Capacitor).                                                                                                                                                   |
| Vref  | 8     | Voltage Reference | 2.5V Reference for all Voltages                                                                                                                                                                |
| EP    | 4     | Analog Input      | Extra Protection Circuit. Can be used for -12V or -5V Over Voltage Protection.                                                                                                                 |

1) Over and Under Voltage Inputs can go higher than Vcc within the allowed Max Rating range

## ABSOLUTE MAXIMUM RATINGS

| Symbol | DC Supply Voltage                             | Value      | Unit |
|--------|-----------------------------------------------|------------|------|
| Vcc    | DC Supply Voltage <sup>1</sup>                | 25         | V    |
| Iout   | Output Current Power Good                     | 30         | mA   |
| Io     | Output current for the voltage reference      | 20         | mA   |
| VFault | Fault Output                                  | 5          | V    |
| Pd     | Power Dissipation                             | 0.7        | W    |
| Tstg   | Storage Temperature                           | -55 to 150 | °C   |
| ESD    | Electrostatic Discharge                       | 2          | kV   |
| Tuv    | Adjustable Under voltage Blanking At Power UP | 5          | V    |
| EP     | Extra Protection                              | 5          | V    |
| PI     | Power Good Input                              | 5          | V    |
| PG     | Power Good Output                             | 5          | V    |
| Tpg    | Adjustable Power Good Delay                   | 5          | V    |
| REM    | Remote Control                                | 5          | V    |
| Trem   | Adjustable Remote Delay                       | 5          | V    |

1) All voltage values, except differential voltage are with respect to network ground terminal.

## OPERATING CONDITIONS

| Symbol | Parameter                            | Value     | Unit |
|--------|--------------------------------------|-----------|------|
| Vcc    | DC Supply Conditions                 | 4.5 to 24 | V    |
| Toper  | Operating Free Air Temperature Range | 0 to 85   | °C   |

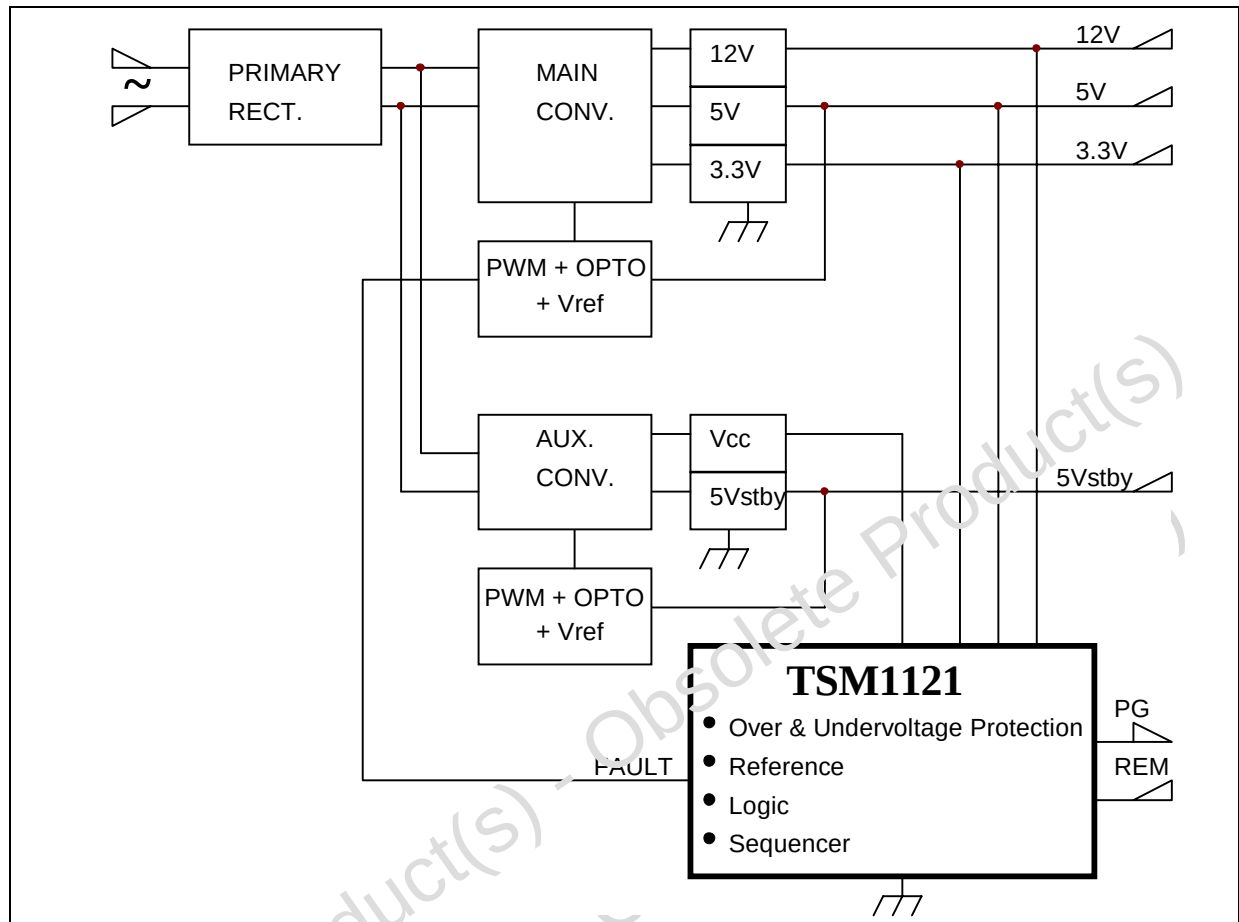
## 2 ELECTRICAL CHARACTERISTICS

Tamb = 25°C and Vcc = 17V (unless otherwise specified)

| Symbol                                           | Parameter                                           | Test Condition                     | Min  | Typ  | Max  | Unit |
|--------------------------------------------------|-----------------------------------------------------|------------------------------------|------|------|------|------|
| <b>Total Current Consumption</b>                 |                                                     |                                    |      |      |      |      |
| Icc                                              | Total Supply Current                                |                                    |      | 3    | 5    | mA   |
| <b>Over Voltage and Under Voltage Protection</b> |                                                     |                                    |      |      |      |      |
| Vov33                                            | Over Voltage Sense 3.3V                             | Input can go higher than Vcc       | 3.8  | 4    | 4.2  | V    |
| Vov5                                             | Over Voltage Sense 5V                               | Input can go higher than Vcc       | 5.8  | 6.1  | 6.4  | V    |
| Vov12                                            | Over Voltage Sense 12V                              | Input can go higher than Vcc       | 13.4 | 14.2 | 15   | V    |
| Vuv33                                            | Under Voltage Sense 3.3V                            |                                    | 2.1  | 2.3  | 2.5  | V    |
| Vuv5                                             | Under Voltage Sense 5V                              |                                    | 3.7  | 4    | 4.3  | V    |
| Vuv12                                            | Under Voltage Sense 12V                             |                                    | 9.2  | 10   | 10.3 | V    |
| Vep                                              | Extra Over voltage Protection Threshold             |                                    |      | 1.28 |      | V    |
| Tfault                                           | Fault Delay Before Latching                         | Internally Fixed Delay             |      | 100  |      | μs   |
| <b>Under Voltage Blanking During Power Up</b>    |                                                     |                                    |      |      |      |      |
| Tuv                                              | Under Voltage Blanking During Power Up (Vcc rising) | Cuv = 2.2μF<br>Adjustable Blanking | 100  | 300  | 500  | ms   |
| Thuv                                             | Blanking Threshold                                  |                                    |      | 1.28 |      | V    |
| <b>Power Good (PG)</b>                           |                                                     |                                    |      |      |      |      |
| Vpgth                                            | Power Good Voltage Threshold                        |                                    |      | 1.28 |      | V    |
| Vpghyst                                          | Power Good Voltage Threshold Hysteresis             |                                    |      | 70   |      | mV   |
| Vpgol                                            | Low Output Open Collector Saturation Voltage        | Collector Current = 15mA           |      |      | 0.4  | V    |
| Ipgoh                                            | High Output Open Collector Leakage Current          | PG Output = 5V                     |      |      | 1    | μA   |
| Tpgr                                             | Power Good Output Rise Time                         | Load Capacitor = 100pF             |      | 1    |      | μs   |
| Tpgf                                             | Power Good Output Fall Time                         | Load Capacitor = 100pF             |      | 1    |      | μs   |
| Tpg                                              | Power Good Adjustable Delay                         | Load Capacitor Cpg=2.2μF           | 100  | 300  | 500  | ms   |
| Plth                                             | Power Input Detection Threshold                     |                                    |      | 1.28 |      | V    |
| <b>Fault</b>                                     |                                                     |                                    |      |      |      |      |
| Vfaultol                                         | Fault Output Saturation Voltage Level               | IFault = 1mA                       |      | 1    |      | V    |
| Ifaultoh                                         | Fault Output Leakage Current Level                  | Vfault = 5V                        |      | 1    |      | μA   |
| <b>Remote Control (REM)</b>                      |                                                     |                                    |      |      |      |      |
| Vremth                                           | Remote ON/OFF Input Voltage Threshold               |                                    | 0.7  | 0.8  | 1    | V    |
| Vremih                                           | High Input Remote Voltage                           |                                    | 3.3  | 3.4  |      | V    |
| Iremil                                           | Low Input Remote Saturation Current                 |                                    |      |      | 0.5  | mA   |
| Trem1                                            | Remote Adjustable Delay ON to OFF                   | Load Capacitor Crem=0.1μF          | 40   | 50   | 60   | ms   |
| Trem2                                            | Remote Adjustable Delay OFF to ON                   | Load Capacitor Crem=0.1μF          | 40   | 50   | 60   | ms   |
| <b>Voltage Reference</b>                         |                                                     |                                    |      |      |      |      |
| Vref                                             | Internal Voltage Reference                          | Io = 0mA                           | 2.46 | 2.5  | 2.54 | V    |
| Regline                                          | Line regulation                                     | Io = 0mA<br>4.5V<Vcc<24V           |      | 4    | 10   | mV   |
| Regline                                          | Line regulation                                     | Io = 10mA<br>4.5V<Vcc<24V          |      | 15   |      | mV   |
| Regload                                          | Load regulation <sup>1</sup>                        | 0<Io<10mA                          |      | 25   |      | mV   |

1) Do not short circuit the Vref Pin

**Fig. 1: Application Schematic**



**Fig. 2: Internal Schematic**

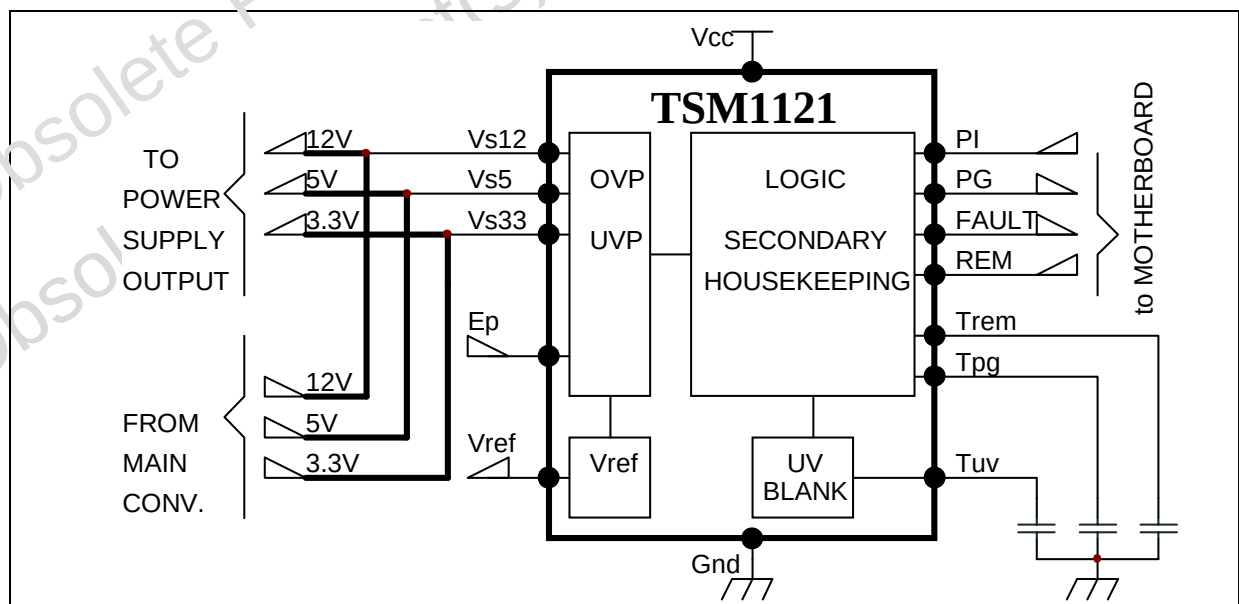
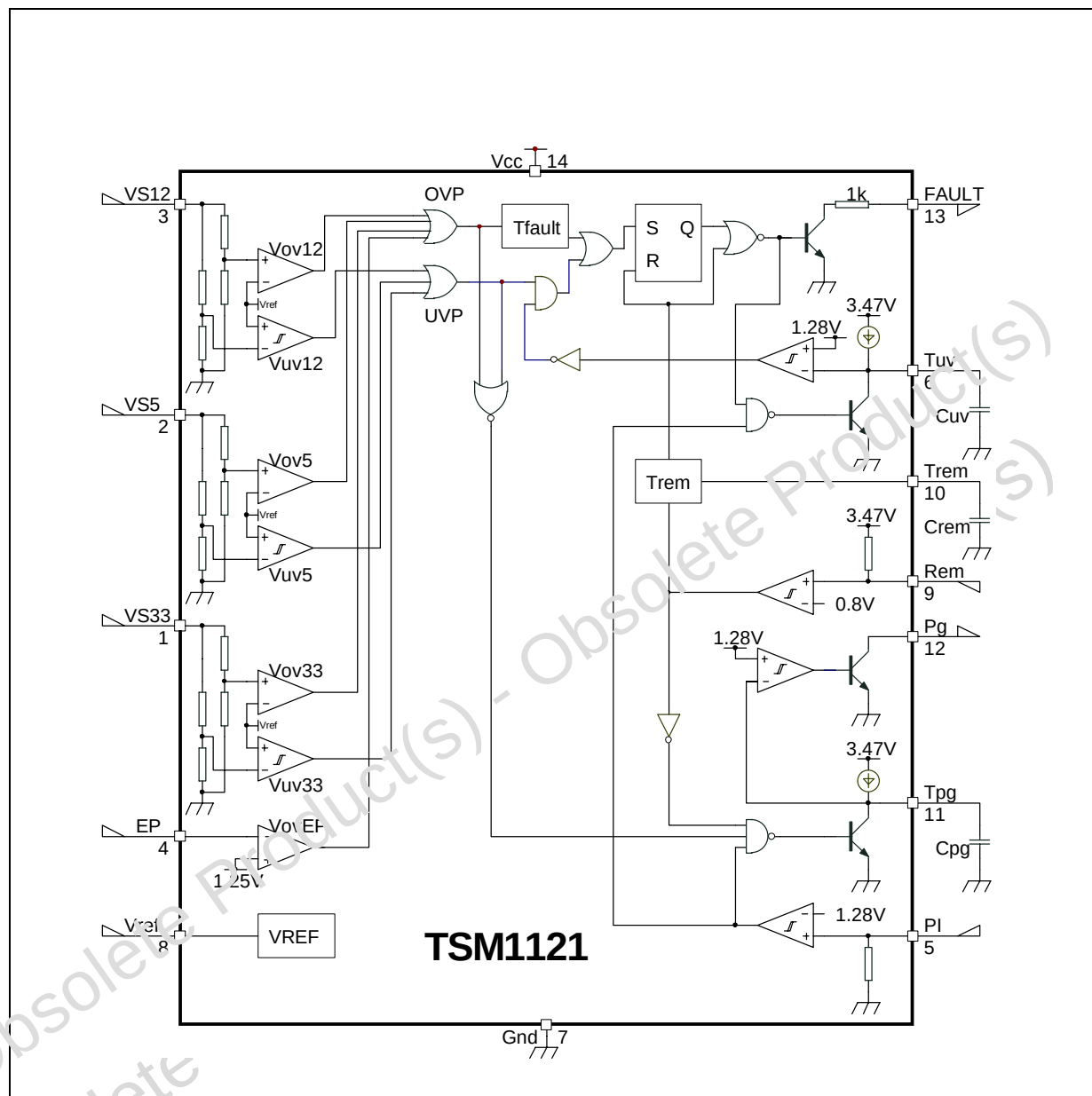


Fig. 3: Detailed Internal Schematic



## Principle of Operation and Application Hints

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### TSM1121: Housekeeping IC.

TSM1121 is a one chip solution for all PC SMPS: it integrates on one chip the Housekeeping Circuitry (Over Voltage and Under Voltage protections, with adequate sequencing).

### Triple Power Line Protection

The TSM1121 Housekeeping Circuit is dedicated to 3.3V, 5V and 12V power lines protection. It integrates a Precision Voltage Reference, a Triple Over Voltage Protection Circuit and a Triple Under Voltage Protection Circuit as well as all the necessary logic and transient timing management circuits for optimal and secure communication with the motherboard, during start up, switch off and stabilized conditions.

### Over Voltage Protection

The Over Voltage Protection Circuit is made of three comparators with internal voltage thresholds (Vov33, Vov5, Vov12) which do not require any external components for proper operation. The outputs of these three comparators are ORed.

### Under Voltage Protection

The Under Voltage Protection Circuit is made of three comparators with internal voltage thresholds (Vuv33, Vuv5, Vuv12) which do not require any external components for proper operation. The outputs of these three comparators are ORed, and blanked by an internal delay circuitry (Power Up Blanking - Tuv) which can be adjusted with an external capacitor (Cuv). This allows that during power up, the under voltage protection circuit is inhibited.

### Latch OFF

The Over Voltage and Under Voltage Circuits outputs are again ORed before activating a latch. When activated, this latch commands the full switch OFF of the three main power lines (3.3V, 5V, 12V) by an external link between the housekeeping and the primary PWM circuits via the main optocoupler or any other device. Note that the Under Voltage Circuit, after Power Up UV blanking, bears no other delay to the latch setting input whereas the Over Voltage circuit bears an additional Tfault delay time. This allows an efficient protection against Output Short Circuit conditions.

### Power Good

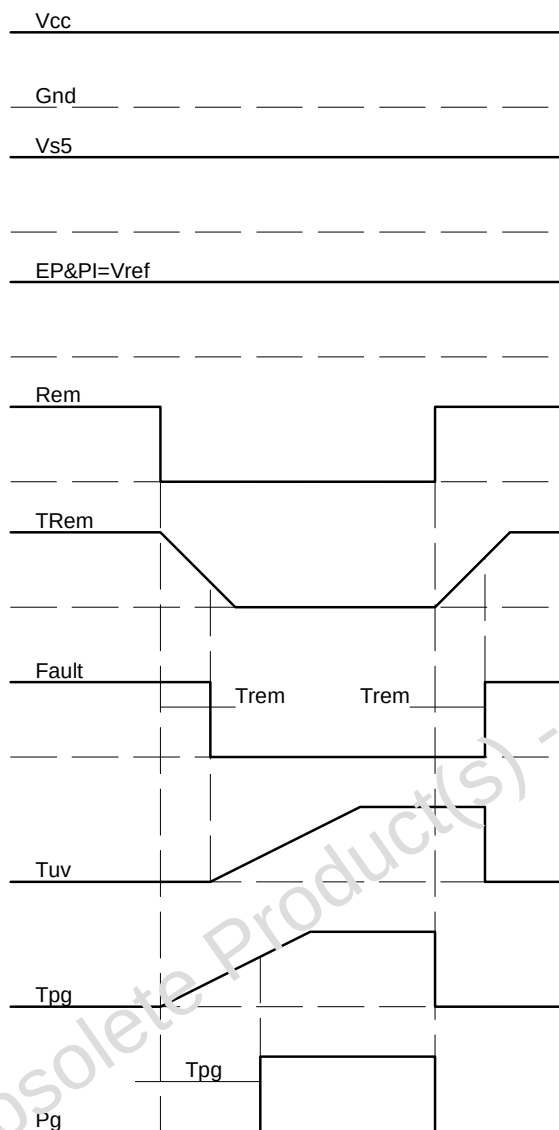
The Over Voltage and Under Voltage Circuits are ORed to switch the Power Good output active (PG) to warn the motherboard that the voltage of at least one of the three power lines is out of range. The PG activation bears an internal Tpg delay circuitry which can be adjusted with an external capacitor (Cpg).

### Remote Control

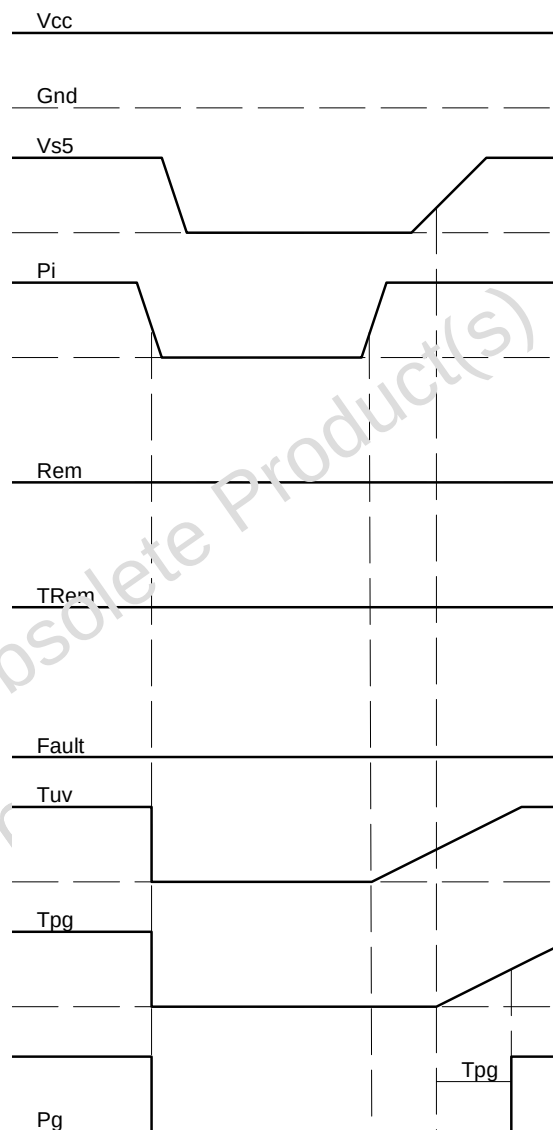
Thanks to this information link to the motherboard, a resetting signal to the latch is achievable with the Remote pin (REM). When the Remote pin is active, the external Fault link between Housekeeping circuit and the PWM generator is active (high = PWM OFF) and the PG pin is active (high). Note that to reset effectively the latch, a minimum width Remote pulse should be applied thanks to an internal delay circuitry (Trem) which can be adjusted with an external capacitor (Crem).

### 3 APPLICATION INFORMATION

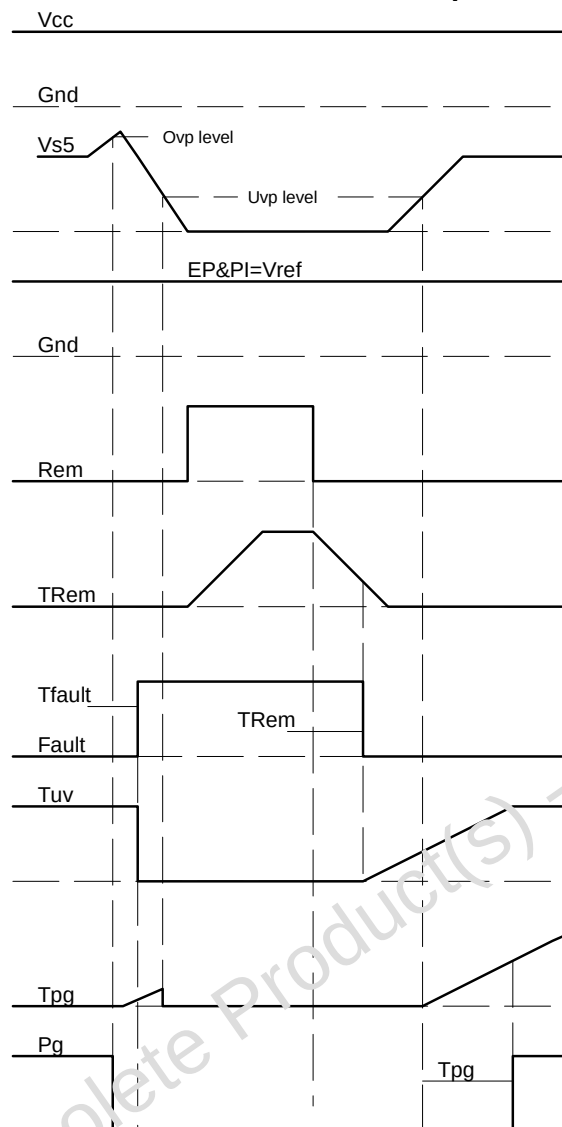
#### 1 - Rem On/Off



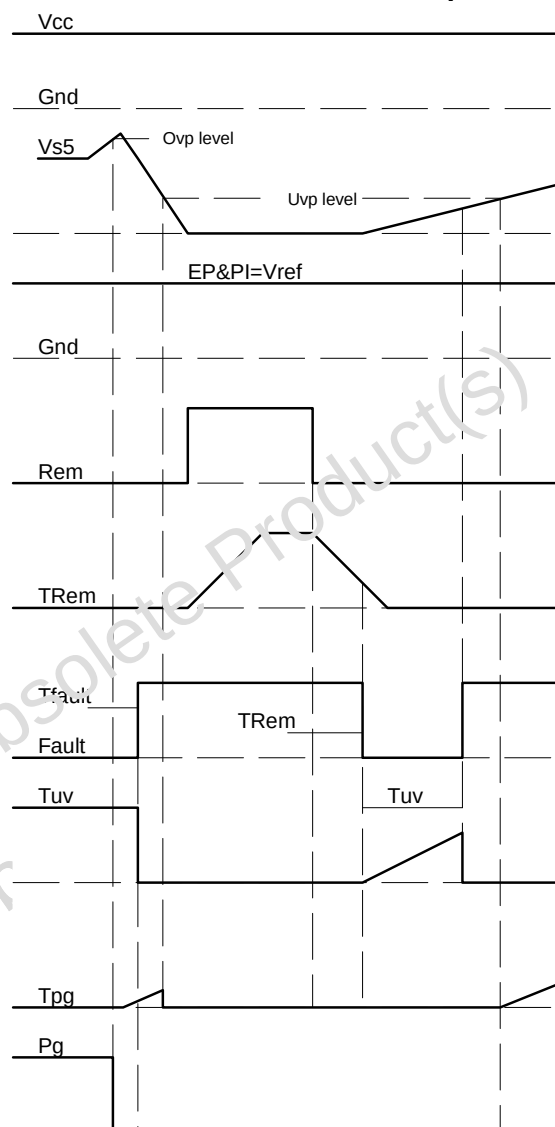
#### 2 - Pi & Vs5 On/Off



## 3 - OVP Rem On/Off, Tuv start up OK



## 4 - OVP Rem On/Off, Tuv start up NOK





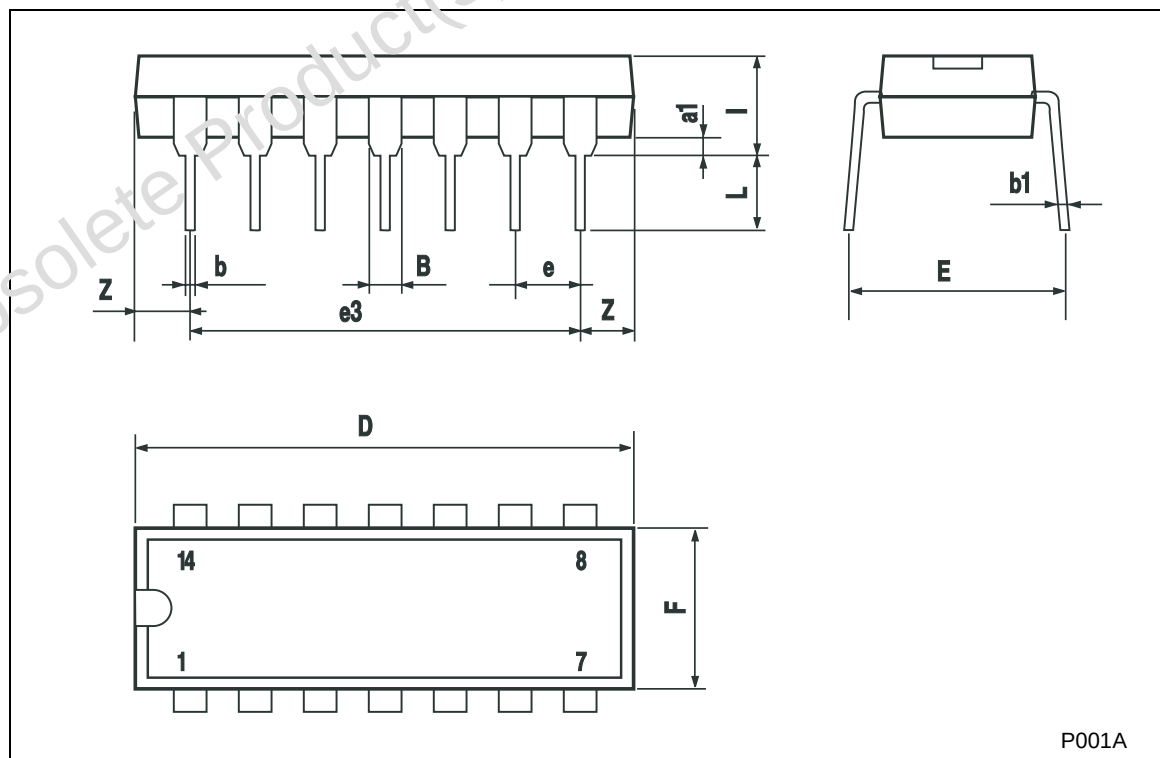
Truth Table for OVP and UVP detection

| EP     | PI     | Vsxx        | Rem | Fault | PG | Power supply state |
|--------|--------|-------------|-----|-------|----|--------------------|
| Vref   | Vref   | OK          | 1   | 1     | 0  | Remote             |
| Vref   | Vref   | OK          | 0   | 0     | 1  | OK                 |
| Vref   | Vref   | OVP on Vsxx | 0   | 1     | 0  | OVP detected       |
| Vref   | Vref   | OK          | 0   | 1     | 1  | Fault latched      |
| Vref   | Vref   | OK          | 1   | 1     | 0  | Remote             |
| Vref   | Vref   | OK          | 0   | 0     | 1  | OK                 |
| Vref   | <1.28V | OK          | 0   | 0     | 0  | UVP detected on PI |
| Vref   | Vref   | OK          | 0   | 0     | 1  | OK                 |
| <1.28V | Vref   | OK          | 0   | 1     | 0  | UVP detected on EP |
| Vref   | Vref   | OK          | 0   | 1     | 0  | Fault latched      |
| Vref   | Vref   | OK          | 1   | 1     | 0  | Remote             |
| Vref   | Vref   | OK          | 0   | 0     | 1  | OK                 |

## 4 PACKAGE MECHANICAL DATA

## Plastic DIP-14 MECHANICAL DATA

| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |



P001A

## 5 PACKAGE MECHANICAL DATA

| SO-14 MECHANICAL DATA |            |      |      |       |       |       |
|-----------------------|------------|------|------|-------|-------|-------|
| DIM.                  | mm.        |      |      | inch  |       |       |
|                       | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A                     |            |      | 1.75 |       |       | 0.068 |
| a1                    | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2                    |            |      | 1.65 |       |       | 0.064 |
| b                     | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1                    | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C                     |            | 0.5  |      |       | 0.019 |       |
| c1                    | 45° (typ.) |      |      |       |       |       |
| D                     | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E                     | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e                     |            | 1.27 |      |       | 0.050 |       |
| e3                    |            | 7.62 |      |       | 0.300 |       |
| F                     | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G                     | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L                     | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M                     |            |      | 0.68 |       |       | 0.026 |
| S                     | 8° (max.)  |      |      |       |       |       |

The diagram illustrates the mechanical specifications of the SO-14 package. It includes three views: a top view showing the package outline with dimensions D (width), F (height), and pin locations (1, 7, 8, 14); a side view showing the profile with dimensions A (total height), a1 (lead height), a2 (lead length), b (lead width), b1 (lead thickness), C (body height), c1 (lead angle), E (body width), G (body length), L (lead length), M (lead thickness), and S (lead angle); and a bottom view showing the pin layout with dimensions e (pitch) and e3 (total pin length).

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