

# KA3505

## PC SMPS Supervisory IC

### Features

- PC Power Supply Output Monitor Circuitry
- Few External Components
- Over Voltage Protection for 3.3V/5V/12V Output
- Under Voltage Protection for 3.3V/5V/12V Output With Delay Time
- Over Current Protection for 3.3V/5V/12V Output With Delay Time
- Fault Protection Output With Open Collector Output
- Power Supply on/off Delay Time Control (PSON)
- Power Good Signal Generator With Hysteresis
- Open Collector PG Output
- 300ms Power Good Delay
- Current Sense Setting Function With RI
- Latch Function Controlled by PSON and Protection Input
- 16-Pin Dual In-line Package

### FPO (Fault Protection Output)

Fault Protection Output indicates the fault condition as protection signal. When fault state occurs, the main power is to be turned-off and the PGO signal goes LOW.

NORMAL = "LOW", FAULT = "HIGH"

### PGO (Power Good Output)

Power Good Signal Generator is to monitor the voltage level of power supply for safe operation of a microprocessor having some delay time at turn-on. The delay time is programmed by a timing capacitor connected to TPG pin of KA3505. The power good output should be low state before the output voltage is out of regulation at turn-off.

NORMAL = "HIGH", FAULT = "LOW"

### Description

The KA3505 is complete output supervisory circuitry intended for use in the secondary side of the switched mode power supply. It provides all the functions necessary to monitor and control the output of the power supply system. Power good signal generator, Remote on and off control, some precision protection features against over-voltage, under-voltage and over-current are implemented. It directly senses all the output rails for OVP and UVP without any external dividers. As for output control, Power Good Output (PGO) and Fault Protection Output (FPO) are also included. Utilizing a minimum number of external components, the KA3505 offers a simple and cost effective solution, greatly reducing PCB board space for power supply system.

### OCP (Over Current Protection)

It has precision OCP functions for +3.3V, +5V, +12V outputs. The block is made up of three comparators with current source setting function. Two inputs of each OCP comparator are connected to both sides of output inductor that is located in the secondary output of SMPS.

### OVP (Over Voltage Protection)

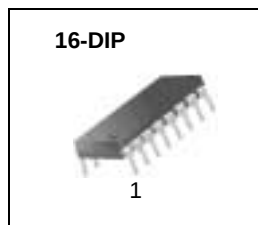
It has OVP functions for +3.3V, +5V, +12V outputs. The circuit is made up of a comparator with three detecting inputs.

### UVP (Under Voltage Protection)

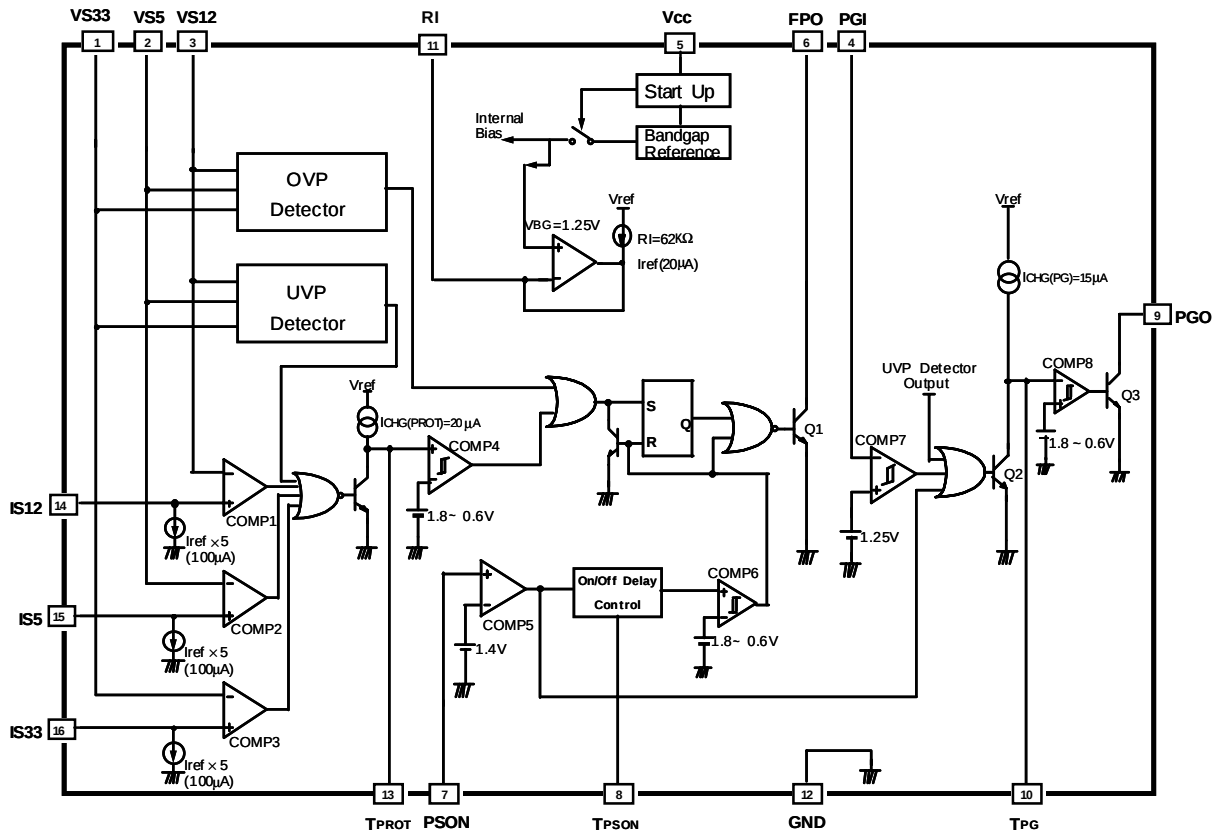
It also has UVP functions for +3.3V, +5V, +12V outputs. The block is made up of a comparator with three detecting inputs.

### Remote ON/OFF

Remote on/off section is used to control SMPS externally. If a high signal is supplied to the remote on/off input, FPO signal becomes a high state and all secondary outputs are grounded. The remote on/off signal is transferred with some on-delay and off-delay time of 8ms, 24ms respectively with 0.1μF external capacitor.



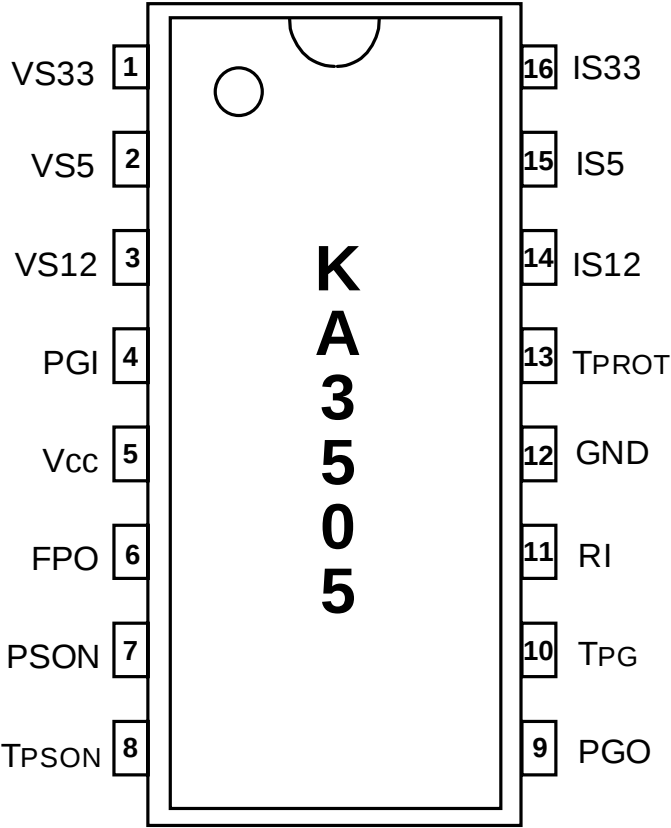
## Internal Block Diagram



## Absolute Maximum Ratings

| Parameter                 | Symbol | Value      | Unit |
|---------------------------|--------|------------|------|
| Supply Voltage            | VCC    | 15 ~ 30    | V    |
| Input Voltage             | Vinput | 30         | V    |
| FPO Voltage               | VFPO   | 30         | V    |
| FPO Maximum Current       | IFPO   | 20         | mA   |
| Operating Temperature     | Topr   | -25 ~ +85  | °C   |
| Storage Temperature Range | Tstg   | -65 ~ +150 | °C   |
| Power Dissipation         | PD     | 1          | W    |

Pin Assignments : KA3505



## Pin Definitions

| Pin No. | Name  | Pin Function Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | V33   | Over and Under Voltage Protection Input for the 3.3V. It directly senses the 3.3V rail without any external divider.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2       | V5    | Over and Under Voltage Protection Input for the 5V. It directly senses the 5V rail without any external divider.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 3       | V12   | Over and Under Voltage Protection Input for the 12V. It directly senses the 12V rail without any external divider.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 4       | PGI   | Power Good Signal Generator Input. It should be supplied from a bulk dependent voltage in order to detect power on and off state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5       | VCC   | Supply voltage. Its recommended operating voltage is ranged from 15V to 30V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6       | FPO   | Fault Protection Output (Open Collector Output). This pin indicates the fault condition. When fault state occurs, the PGO signal goes Low. Normal = 'Low', Fault = "High".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 7       | PSON  | Remote on/off input. It does TTL operation and its threshold voltage is 1.4V. In case of open circuit, the voltage at this pin is High (5.0V). If PSON = "Low", then FPO = "Low". It means the main SMPS is working. When PSON = "High or Open", then FPO = "High" and the main SMPS stops to work.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 8       | TPSON | Timing pin for PSON delay. Ton/Toff=8ms/24ms (Typ.) with Cpson=0.1μF externally. PSON On Delay Time (Ton) is measured as PSON input goes Low to High. PSON Off Delay Time (Toff) can be measured reversely.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 9       | PGO   | Power Good Output Signal (Open Collector). PGO = "High" means "Power Good" for operation and PGO = "Low" means "Power Fail".                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 10      | TPG   | Timing pin for PGO delay. TPG = 270ms (Typ.) with CPG = 2.2μF externally. The high/low threshold voltages are 1.8V/0.6V and the voltage of pin10 would be charged up to 2.9V for noise margin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 11      | RI    | OCP current sense setting pin. The reference voltage at this pin is set to 1.25V internally. You can fix the OCP reference current by using RI resistor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 12      | GND   | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 13      | TPROT | Timing pin for under voltage protection and over current protection blank-out time. Its threshold voltage is 1.8V and clamped at 2.9V after full charging. Target of delay time is 38ms and it is realized through external capacitor (C=0.47μF).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 14      | IS12  | Current sense input for +12V. This pin is connected to the current sensing resistor or inductor. You can define OCP offset voltage for +12V by using RI resistor externally. If you connected RI resistor of 62kΩ at Pin11 to ground, the reference current(Iref) should be 20μA. After that, you can make a constant OCP offset voltage ( $V_{OFFSET} = R_O \times 5 \times I_{ref}$ ).<br>In case the voltage drop ( $=I_{O.12} \times R_S$ ) of the sense resistor or inductor is larger than offset voltage, FPO becomes "High" after some delay time and the main SMPS is turned-off. So the over current level is determined by following equation. ( $I_{O.12} = V_{OFFSET} / R_S$ )<br>* See application note for details. |
| 15      | IS5   | Current sense input for +5V. You can make the +5V OCP function as previous method in IS12 (Pin14).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 16      | IS33  | Current sense input for +3.3V. You can also make the +3.3V OCP function as previous method in IS12 (Pin14).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Electrical Characteristics

(V<sub>CC</sub> = 20V, -25°C ≤ T<sub>a</sub> ≤ 85°C, unless otherwise specified)

| Characteristic                                            | Symbol                   | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------------------------------|--------------------------|-----------------|------|------|------|------|
| <b>PROTECTION SECTION</b>                                 |                          |                 |      |      |      |      |
| Over Voltage Protection for 3.3V                          | VOVP33                   | VPSON = 0V      | 3.9  | 4.1  | 4.3  | V    |
| Over Voltage Protection for 5V                            | VOVP5                    | VPSON = 0V      | 5.7  | 6.1  | 6.5  | V    |
| Over Voltage Protection for 12V                           | VOVP12                   | VPSON = 0V      | 13.6 | 14.3 | 15.0 | V    |
| Under Voltage Protection for 3.3V                         | VUVP33                   | VPSON = 0V      | 2.69 | 2.83 | 2.97 | V    |
| Under Voltage Protection for 5V                           | VUVP5                    | VPSON = 0V      | 4.1  | 4.3  | 4.5  | V    |
| Under Voltage Protection for 12V                          | VUVP12                   | VPSON = 0V      | 9.8  | 10.3 | 10.8 | V    |
| Offset Voltage of OCP Comparator                          | V <sub>offset</sub>      | VPSON = 0V      | -3   | -    | 3    | mV   |
| Charging Current for OCP, UVP Delay                       | ICHG(PROT)               | -               | -15  | -21  | -30  | μA   |
| 3.3, 5, 12V Over Current Delay Time                       | T <sub>D</sub> (OCP)     | C = 0.47μF      | 24   | 38   | 57   | msec |
| 3.3, 5, 12V Under Voltage Delay Time                      | T <sub>D</sub> (UVP)     | C = 0.47μF      | 24   | 38   | 57   | msec |
| <b>POWER SUPPLY ON/OFF SECTION (PSON) <sup>Note</sup></b> |                          |                 |      |      |      |      |
| PSON Input Threshold Voltage                              | V <sub>TH</sub> (PSON)   | PSON: "H" → "L" | 1    | 1.4  | 1.8  | V    |
| PSON Open Voltage                                         | V <sub>OPEN</sub> (PSON) | PSON: Open      | 4    | -    | 5.25 | V    |
| PSON Input Low Current                                    | I <sub>LOW</sub> (PSON)  | VPSON = 0V      | -    | -    | -1.6 | mA   |
| ON Delay Time                                             | T <sub>ON</sub> (PSON)   | C = 0.1μF       | 4    | 8    | 14   | msec |
| OFF Delay Time                                            | T <sub>OFF</sub> (PSON)  | C = 0.1μF       | 16   | 24   | 34   | msec |
| <b>FPO SECTION</b>                                        |                          |                 |      |      |      |      |
| FPO Saturation Voltage                                    | V <sub>SAT</sub> (FPO)   | IFPO = 10mA     | -    | 0.2  | 0.4  | V    |
| FPO Leakage Current                                       | V <sub>LKG</sub> (FPO)   | VFPO = 20V      | -    | 0.01 | 1    | μA   |

## Electrical Characteristics (Continued)

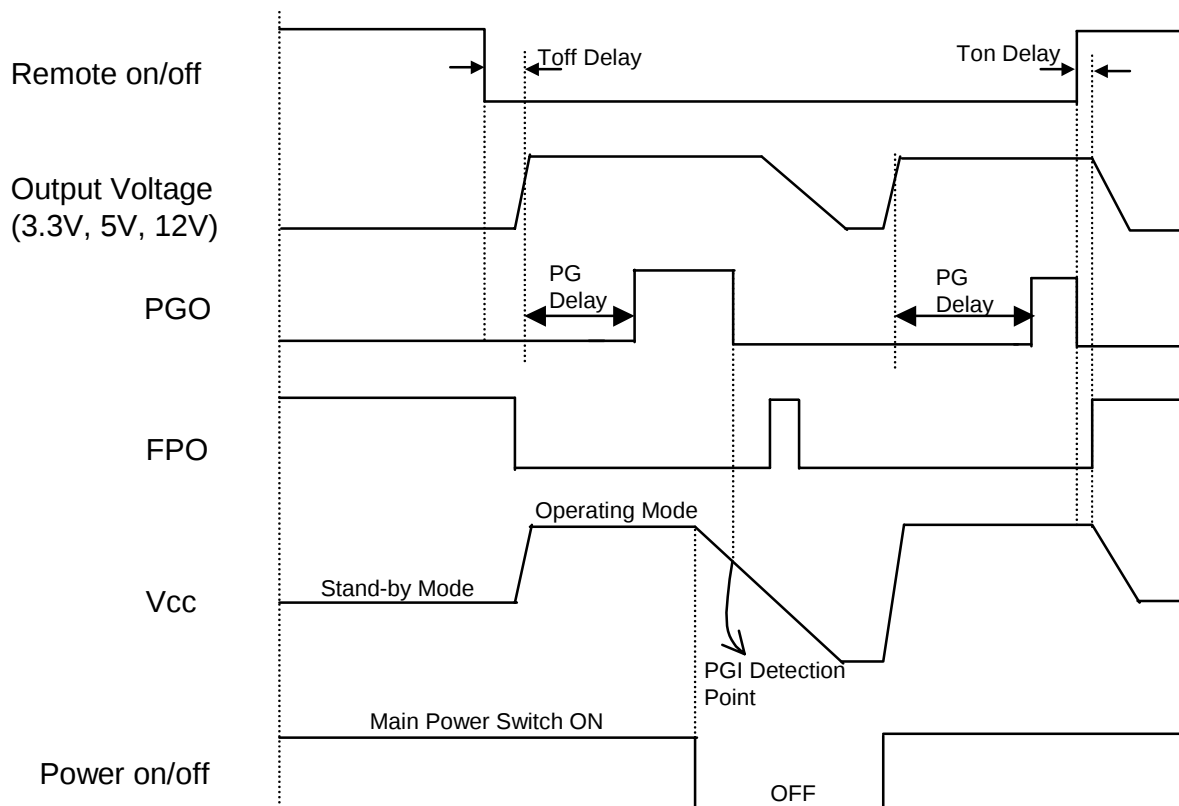
(V<sub>CC</sub> = 20V, -25°C ≤ T<sub>a</sub> ≤ 85°C, unless otherwise specified)

| Characteristic                | Symbol                | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|-----------------------|-----------------|------|------|------|------|
| <b>POWER GOOD SECTION</b>     |                       |                 |      |      |      |      |
| PG Input Threshold Voltage    | V <sub>IN</sub> (PG1) | PG: "H" → "L"   | 1.20 | 1.25 | 1.30 | V    |
| Hysteresis Voltage 1          | HY1                   | COMP7           | 10   | 40   | 80   | mV   |
| Hysteresis Voltage 2          | HY2                   | COMP4, 6, 8     | 0.6  | 1.2  | -    | V    |
| Charging Current for PG Delay | ICHG(PG)              | -               | -9   | -14  | -22  | μA   |
| PG Delay Time                 | T <sub>D</sub> (PG)   | C = 2.2μF       | 150  | 270  | 450  | msec |
| PG Output Saturation Voltage  | V <sub>SAT</sub> (PG) | IPG = 10mA      | -    | 0.2  | 0.4  | V    |
| <b>TOTAL DEVICE</b>           |                       |                 |      |      |      |      |
| Stand-by Supply Current       | I <sub>CC</sub>       | -               | -    | 5    | 10   | mA   |

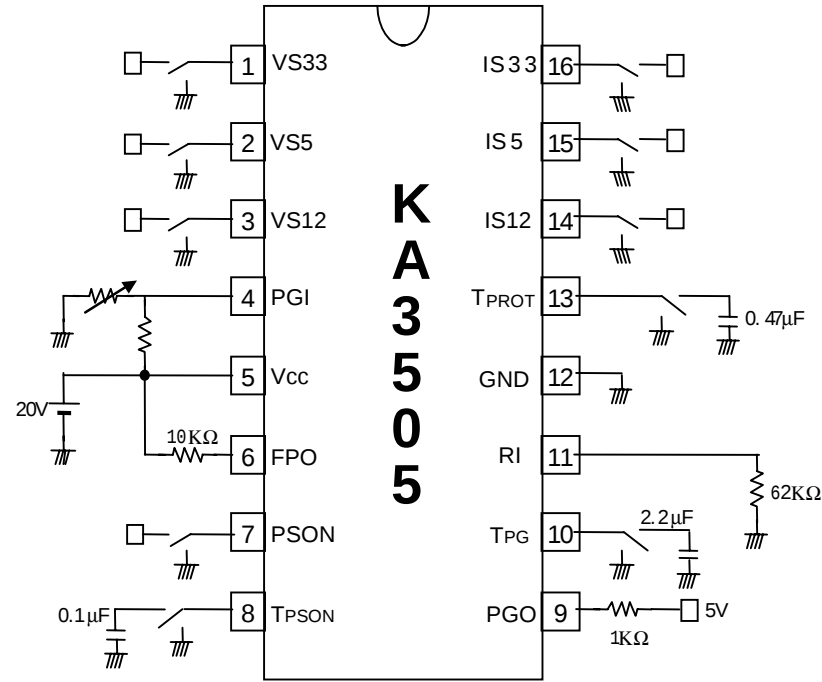
### Note:

1. It does TTL operation and its threshold voltage is 1.4V.
2. Power Supply ON Delay Time (T<sub>on</sub>) is measured as PSON input goes "Low" to "High".
3. Power Supply OFF Delay Time (T<sub>off</sub>) is measured as PSON input goes "High" to "Low".

## Timing / Housekeeping / Control



# Test Circuit



## Typical Characteristics

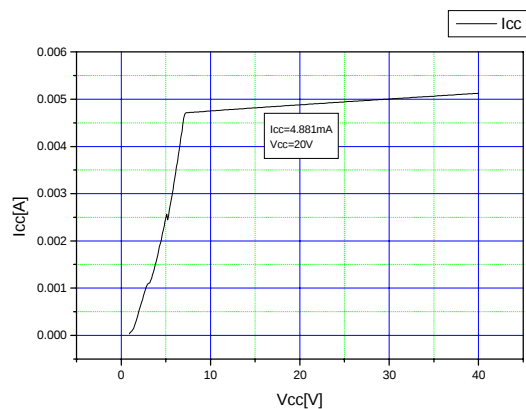


Figure 1.  $V_{CC}$  -  $I_{CC}$

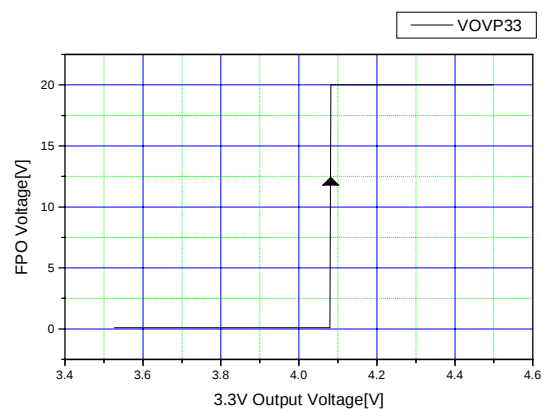


Figure 2. Over Voltage Protection for 3.3V

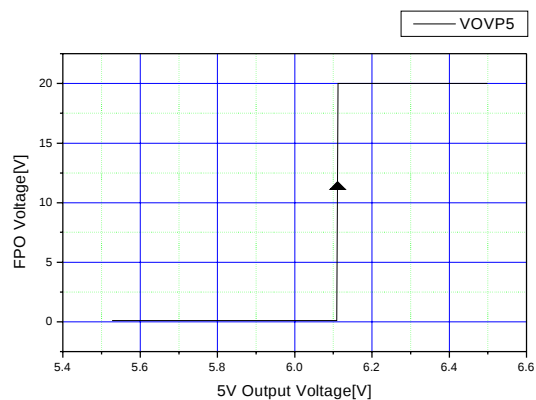


Figure 3. Over Voltage Protection for +5V

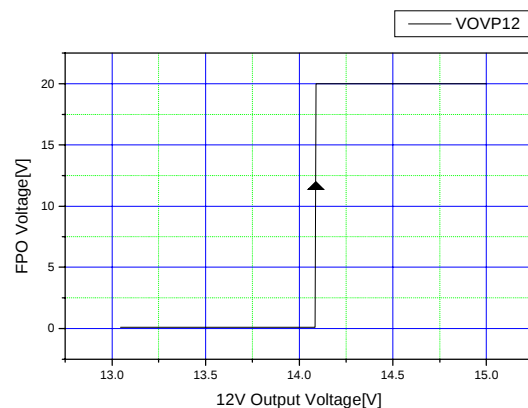


Figure 4. Over Voltage Protection for +12V

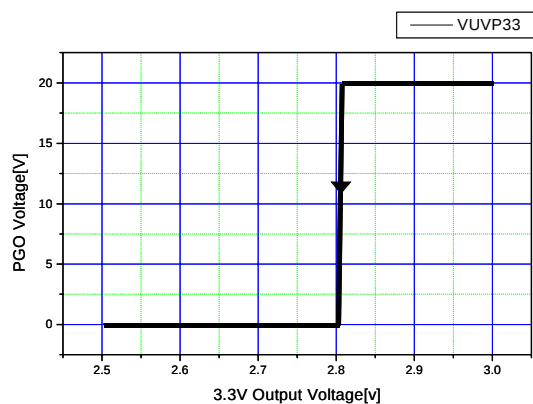


Figure 5. Under Voltage Protection for +3.3V

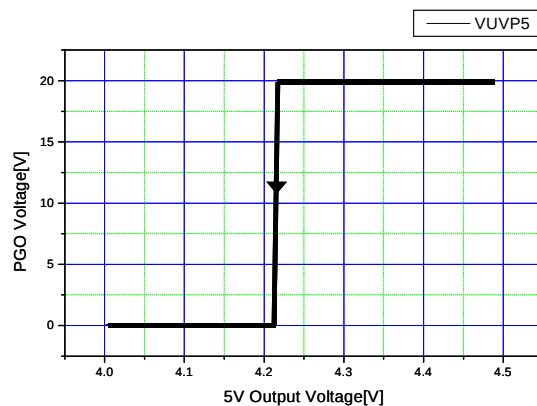


Figure 6. Under Voltage Protection for +5V

# Typical Characteristics (Continued)

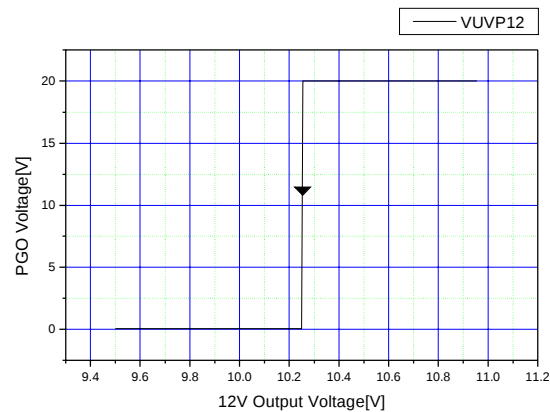


Figure 7. Under Voltage Protection for +12V

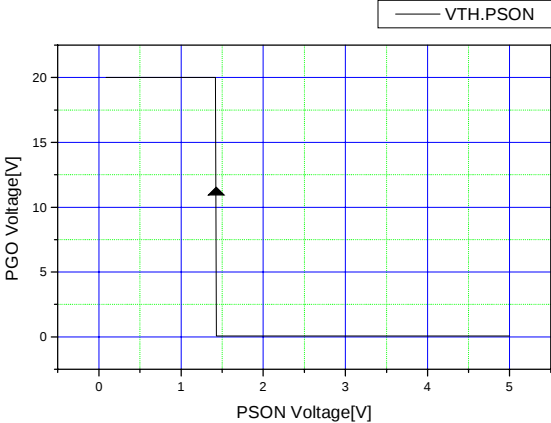


Figure 8. PSN Input Threshold Voltage

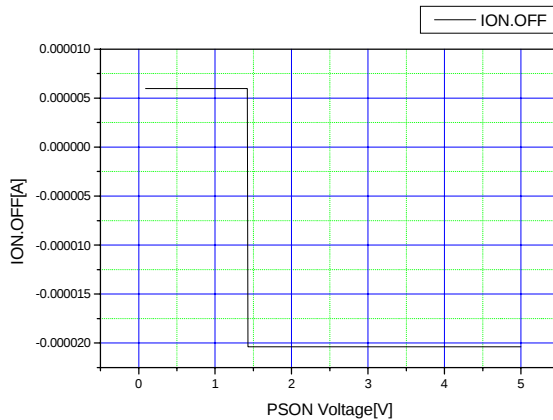


Figure 9. PS On/Off Delay Current

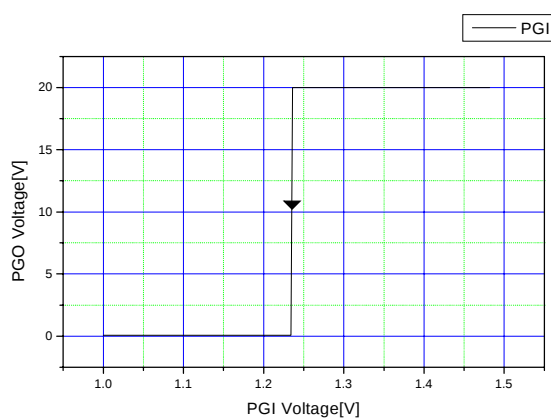


Figure 10. PG Input Threshold Voltage

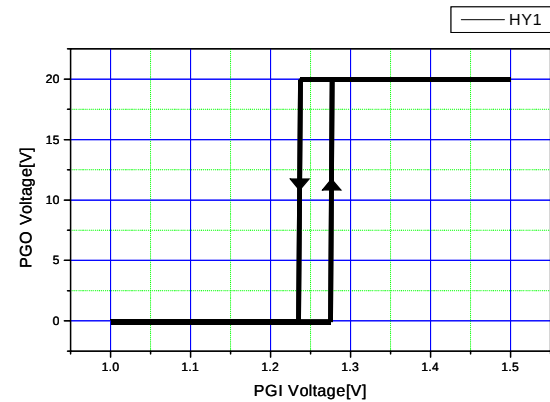


Figure 11. Hysteresis Voltage 1

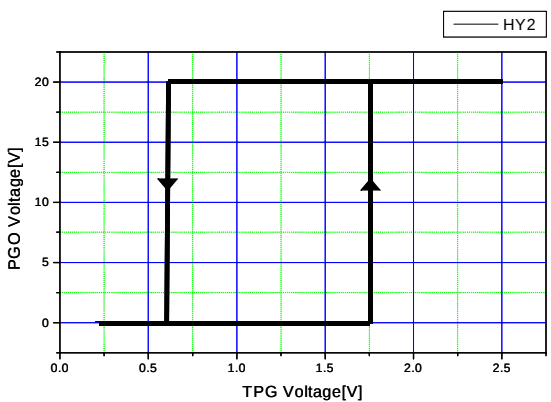
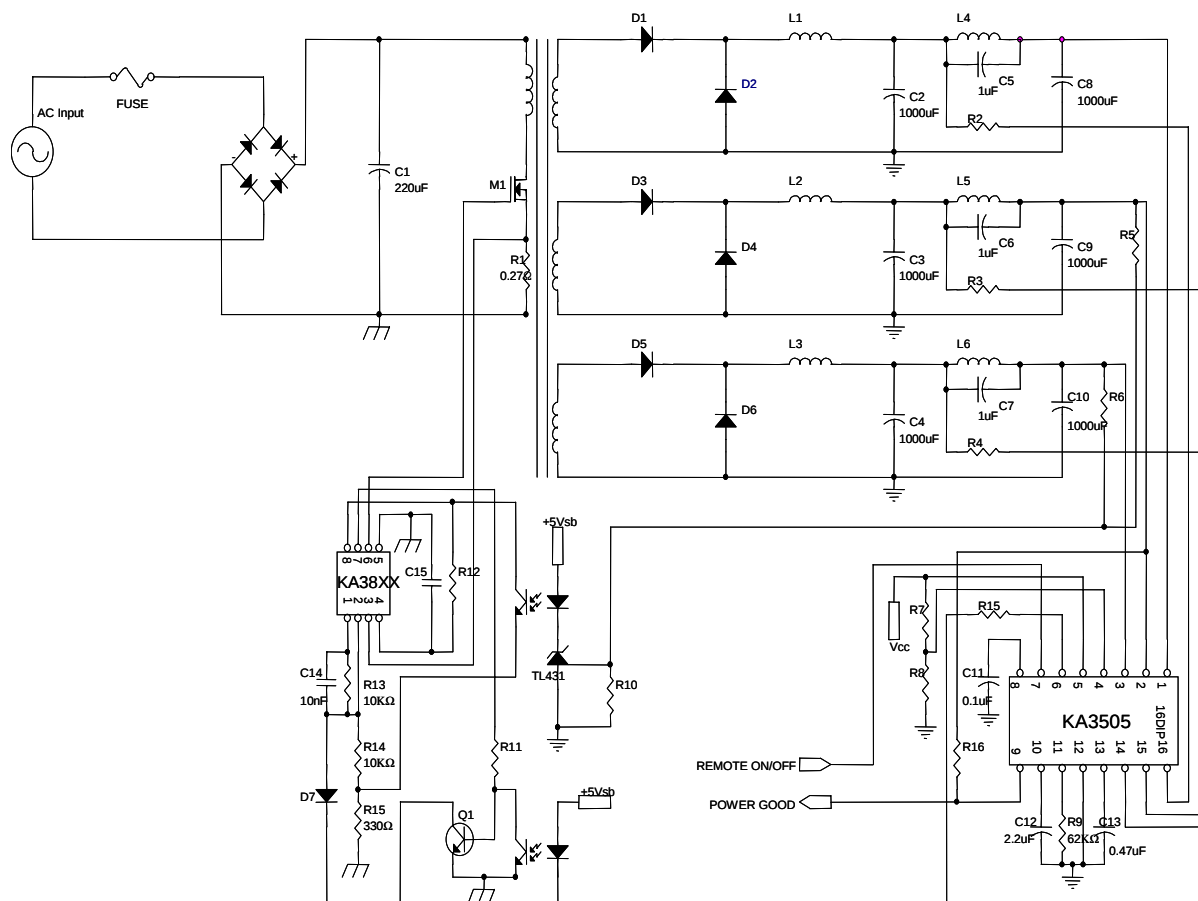
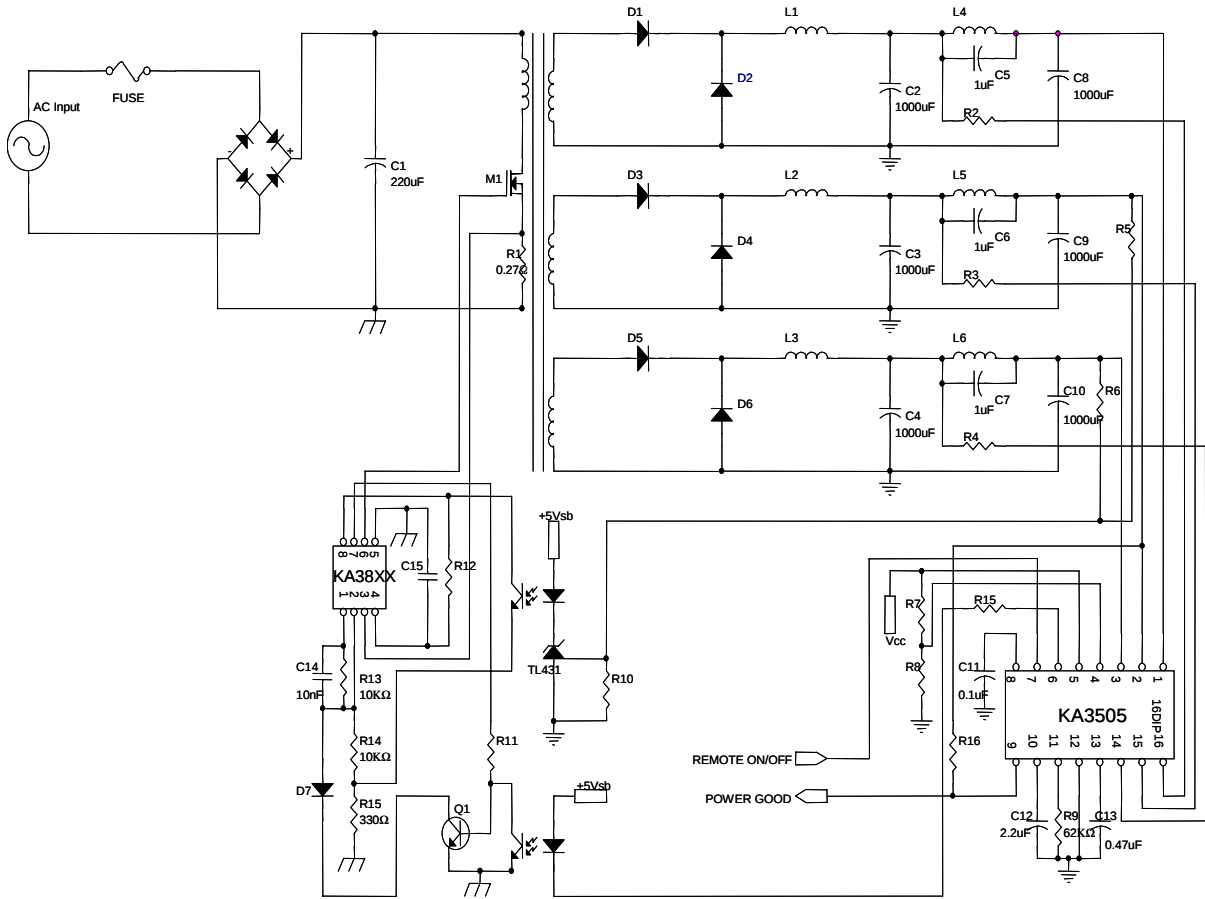


Figure 12. Hysteresis Voltage 2

## Voltage Mode Application Schemata



# Current Mode Application Schematic

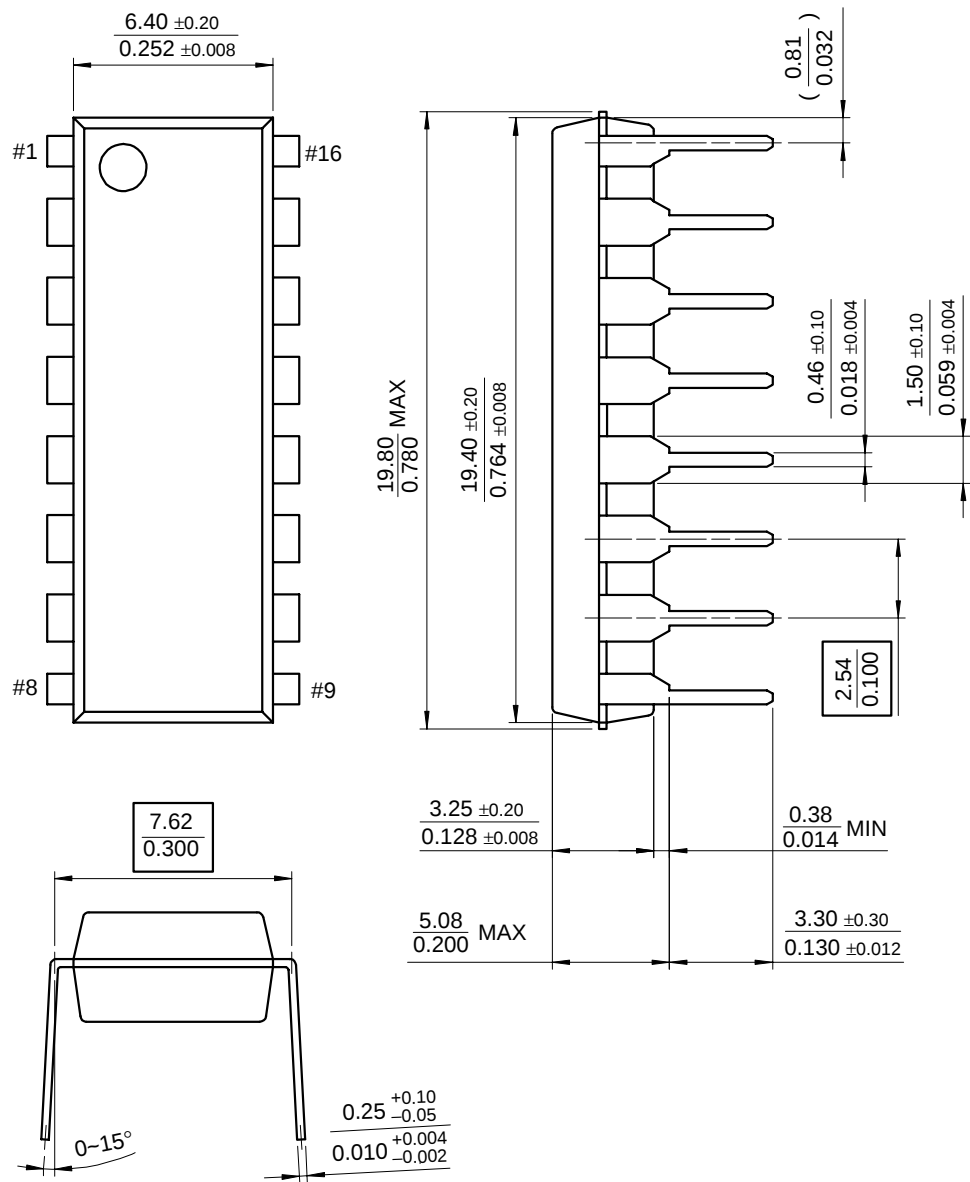


Mechanical Dimensions

Package

Dimensions in millimeters

16-DIP



# Ordering Information

| Product Number | Package | Operating Temperature |
|----------------|---------|-----------------------|
| KA3505         | 16-DIP  | -25°C ~ +85°C         |

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