# High-Efficiency CRM/CCM Multi-Mode Operation Power Factor Correction Controller

## General Description

AT6101Z is a active power factor corrected controller to drive PFC boost stages base on ATK patented Pseudo Digital Control(PDC) method.

In PDC loop ,AT6101Z classically operates in Critical conduction Mode(CRM) when the inductor current below a programmable value.

When the current is exceed this preset level ,the AT6101Z natural chage to Continuous conduction Mode(CCM).The loop stability and response is controlled by PDC Loop. AT6101Z features a robust suite of protection features to properly handel an arry of power supply operating and fault condition.

The devices is available in SOP-14L package and require few external devices for operation.

## Features

- **Pseudo Digital Control Loop without Analog multiplier(patent protected)**
- **Quick Transient Response**
- **Inteligent AC Power Sag Protection**
- **Multi-Mode CRM/CCM operation**
- **Programmable Soft Start**
- **Programmable CCM Operation Frequency 18kHz~130kHz**
- **Sourcing 1A/Sinking 1A High Drive Cability Driver**
- **Brown In/Out protection**
- **Bias-Supply UVLO ,Over-Voltage Protection ,Open-Loop Detection ,**
- **SOP-14L Package**

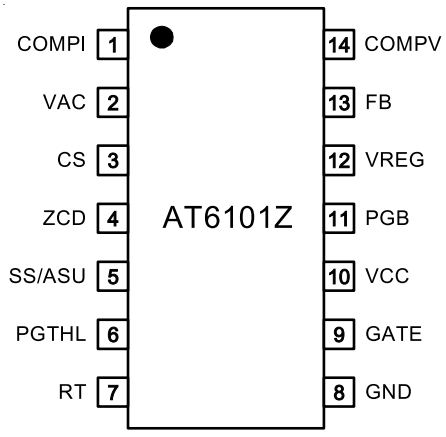
## Applications

- **High Efficiency Server and Desktop Power Supplies**
- **Telecom Rectifiers**
- **High Power Adaptor**
- **Off Line Appliances Requiring Power Factor Correction**

## Function Marking Information

| Top Marking | Switching Frequency | Vout Level Boost |
|---|---|---|
| AT6101Z | ADJ | Disable |

## Pin Configuration

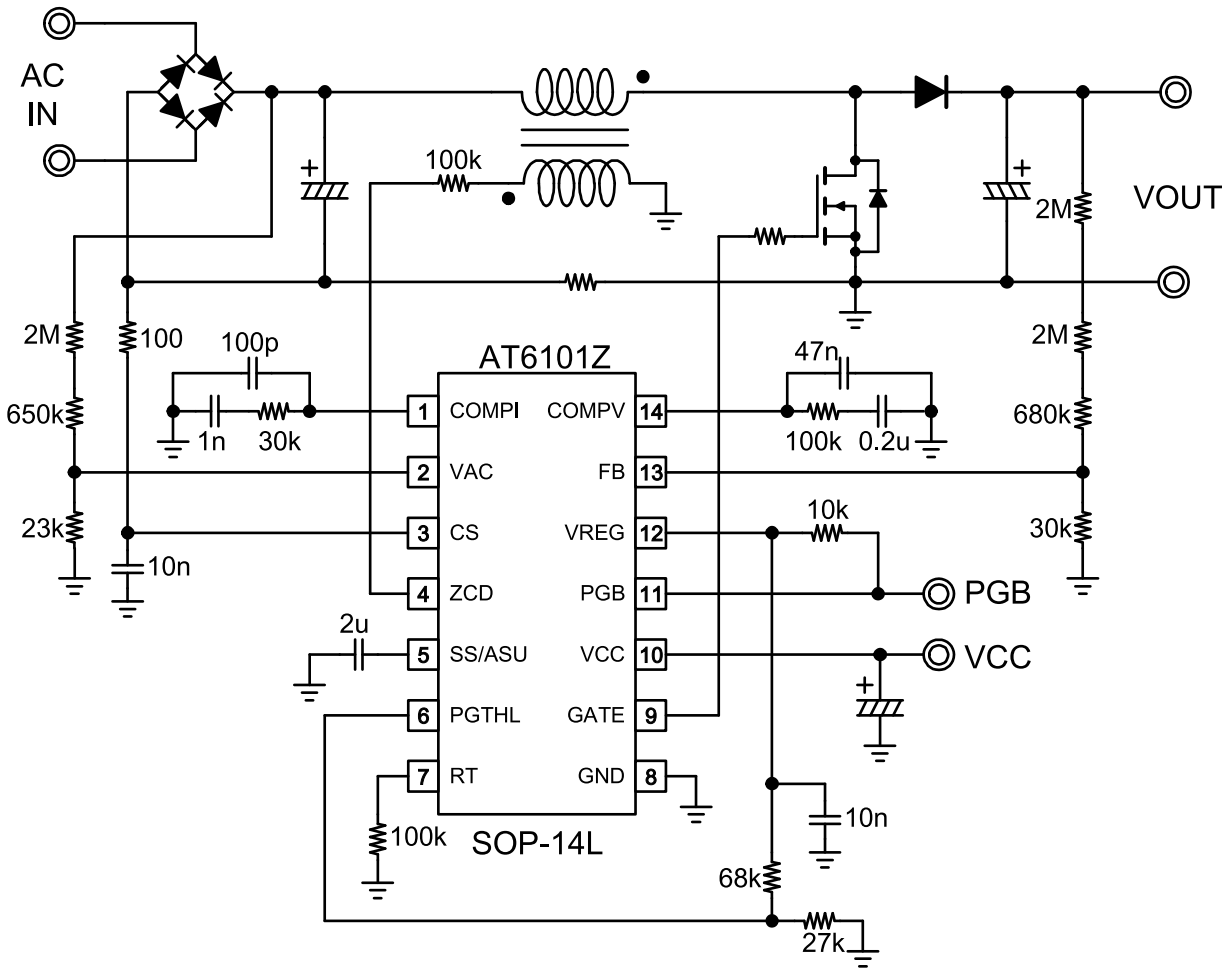



## Ordering and Marking Information

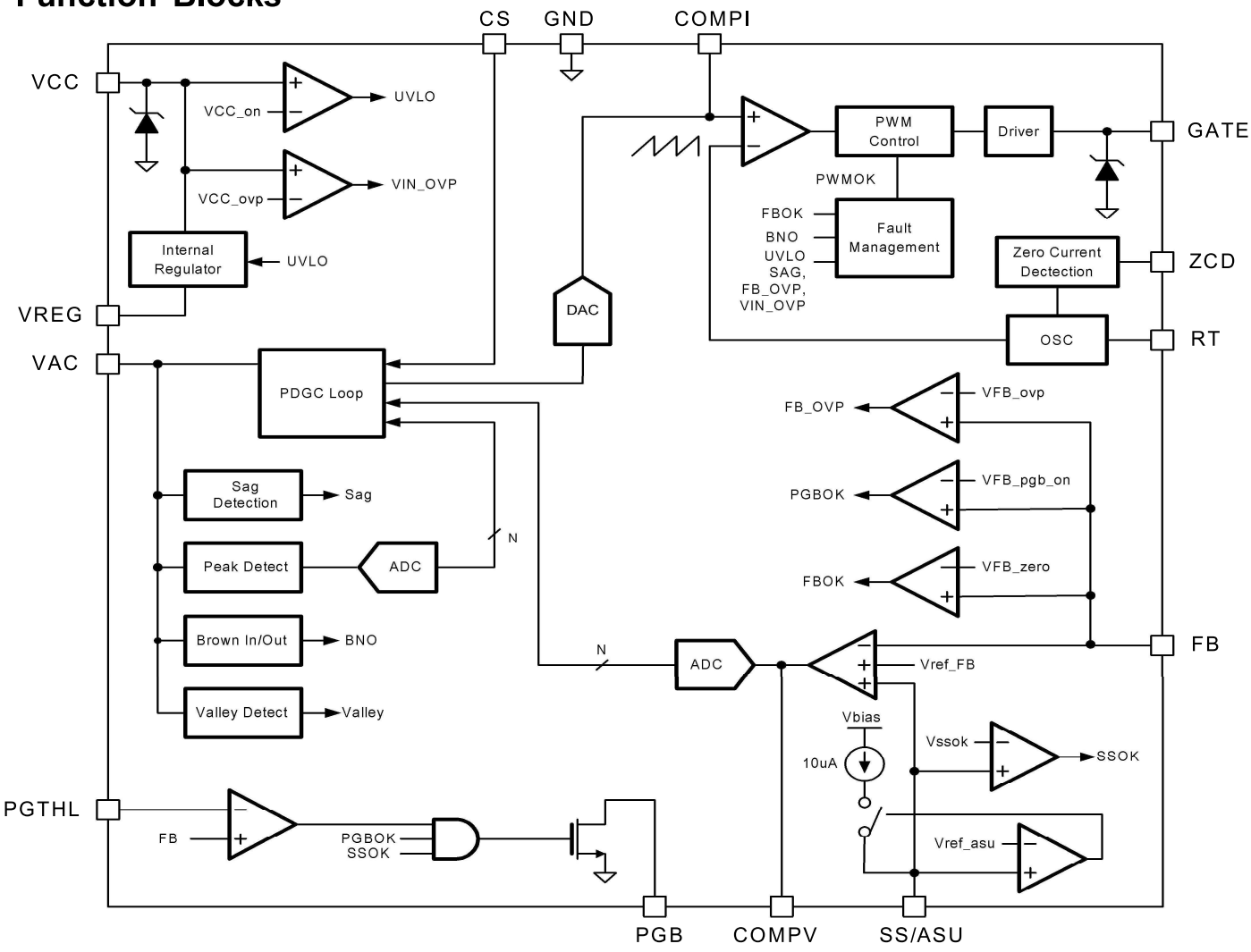
| Order Number | Package | Top Marking |
|---|---|---|
| AT6101ZSPC | SOP-14L | AT6101Z |

Note: Aplustek products are compatible with the current IPC/JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

## Typical Application Circuit



## Function Blocks




## Function Pin Description

| No. | Pin Name | Pin Function |
|---|---|---|
| 1 | COMPI | **Current error amplifier output.** |
| 2 | VAC | **AC line sense input pin.** |
| 3 | CS | **PFC current sense.** |
| 4 | ZCD | **Zero current detect input Pin.** |
| 5 | SS/ASU | **Soft Start time setting input pin.**Connect to 0.1uF output capacitor. |
| 6 | PGTHL | **An I/O pin.**Setting for Power Good threshold to determine PGB to be pull high level. |
| 7 | RT | **CCM switching Frequency input pin.** |
| 8 | GND | **Ground.** |
| 9 | Gate | **Gate Driver output Pin.** |
| 10 | VCC | **Positive Supply for AT6101Z.** |
| 11 | PGB | **Power Good comparetor output pin.** |
| 12 | VREG | **Reference Voltage output pin.** |
| 13 | FB | **Voltage error amplifier input.** |
| 14 | COMPV | **Voltage error amplifier output.** |

## Absolute Maximum Ratings

(Note1)

Supply Input Voltage, $V_{cc}$ ---------- -0.3V to +27V

PGB to GND DC ---------- -0.3V to +27V

CS to GND DC ---------- -6V to +0.3V

Gate to GND DC ---------- -0.3V to clamping voltage+6V(~21V)

COMPI,VAC,ZCD,SS/ASU,PGTHL,RT,VREG,FB,COMPV to GND DC ---------- -0.3V to +7V

Storage Temperature Range ---------- -65°C to +150°C

Junction Temperature ---------- -40°C to +150°C

Lead Temperature Range(Soldering 10sec) ---------- 260°C

ESD Rating (Note2)

HBM(Human Body Mode)----------2KV

MM(Mechine Mode)----------200V

## Thermal Characteristics

Package Thermal Resistance (Note3)

SOP-14L $\theta_{JA}$ ----------100°C/W

Power Dissipation, PD @ TA = 25°C

SOP14-14L ---------- 1W

## Electrical Characteristics

( $V_{CC}$ = 12V, $T_A$ = +25°C unless otherwise specified.)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **VCC Supply Input Section** | | | | | | |
| VCC operation range | | | 10 | -- | 21 | V |
| VCC UVLO threshold | $V_{CC,on}$ | VCC Rising | -- | 10 | -- | V |
| | $V_{CC,off}$ | VCC Falling | -- | 8 | -- | V |
| Over Voltage Protection Voltage | $V_{CC,ovp}$ | | | 24 | | V |
| Inter Zener Clamp | $V_{CC,clamp}$ | IVCC=10mA ,CL=0 | | 27 | | V |
| Startup current | $I_{CC,start}$ | | | 35 | 70 | uA |
| Normal operation current | $I_{CC\_op}$ | CL=2nF | -- | 2.5 | 3.5 | mA |
| **VAC Section** | | | | | | |
| Brown In Threshold | VAC_brown_in | | -- | 1 | -- | V |
| Brown In Debounce Time | Tdeb_brown_in | | | 200 | | uS |
| Brown Out Threshold | VAC_brown_out | | -- | 0.94 | -- | V |
| Brown Out Debounce Time | Tdeb_brown_out | | | 440 | | mS |
| Pull low Impedance | ZVAC | | | 500 | | kohm |
| High Line Threshold | VAC_hline | Sweep VAC from low to high | | 2.35 | | V |
| Low Line Threshold | VAC_lline | Sweep VAC from high to low | | 2.1 | | V |
| Low Threshold for Valley Detect | VAC_valley_l | | | 0.35 | | V |
| High Threshold for Valley Detect | VAC_valley_h | | | 0.72 | | V |
| SAG Debounce Time | Tdeb_sag | | | 5 | | mS |
| Product of VAC Peak and Internal VAC Peak | | | | 5.5 | | V*V |

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **CS Section** | | | | | | |
| Delay to Output | | | | 250 | | nS |
| Threshold to off PWM at low Line | VCS_max_lline | | -- | -1.56 | -- | V |
| Threshold to off PWM at lhigh Line | VCS_max_hline | | -- | -0.75 | -- | V |
| Input Impedance | ZCS | | 20 | | | kohm |
| Max Fain of CS over Internal VAC | | | | 0.2 | | V/V |
| **ZCD Section** | | | | | | |
| Negative Clamp Voltage | VZCD_clamp_l | | -- | -0.5 | -- | V |
| Positive Clamp Voltage | VZCD_clamp_h | | | 6.1 | | V |
| Falling Threshold for Zero Current Detection | VZCD_zero_fall | Sweep ZCD from high to low | | 0.4 | | V |
| Rising Threshold for Zero Current Detection | VZCD_zero_rise | Sweep ZCD from low to high | | 0.5 | | V |
| Threshold to Keep low to off CRM mode | VZCD_crm_off | | | 0.4 | | V |
| Threshold to Keep high to off PWM mode | VZCD_pwm_off | | | 0.5 | | V |
| **SS/ASU Section** | | | | | | |
| Voltage lower than VCC in Power On for ASU mode | | | | 2 | | V |
| Charging Current in SS mode | ISS | | | 10 | | uA |
| Soft Start Time in ASU mode | t_ss | | | 175 | | mS |
| **PGTHL Section** | | | | | | |
| FB voltage to pull PGB High at High FB mode | VFB_pgb_off_hfb | PGTHL=2V | 1.98 | | 2.02 | V |
| FB voltage to pull PGB High at Low FB mode | VFB_pgb_off_lfb | PGTHL=2V | 1.81 | | 1.89 | V |
| **RT Section** | | | | | | |
| Nominal Frequency | fosc | connect 100kohm to GND | | 65 | | kHz |
| Resister Range | | | 40 | | 400 | kohm |
| Frequency Variation vs.VCC | | | | | 2 | % |
| Frequency Variation vs. Temperature | | | | | 2 | % |

**Note 1.** Exceeding these limits may impaire the life of the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.

**Note 2.** $\theta_{JA}$ is measured with the component mounted on a high effective thermal conductivity test board in free air.The exposed pad of the package is soldered directly on the PCB.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **COMPI Section** | | | | | | |
| Transconductance | gm_compi | | | 72 | | uohm |
| Input Offset Voltage | vos_compi | | -1 | | 1 | mV |
| Max Sink Current | Isink_max_compi | | – | -36 | – | uA |
| Max Source Current | Isource_max_compi | | | 36 | | uA |
| Clamp High Voltage | VCOMPI_clamp_h | | | 4.3 | | V |
| Clamp Low Voltage | VCOMPI_clamp_l | | | 0.52 | | V |
| Threshold for Zero Duty | VCOMPI_zero | | | 0.77 | | V |
| **COMPV Section** | | | | | | |
| Transconductance | gm_compv | | | 72 | | uohm |
| Input difference with GM Boost | Vdiff_gn_boost | | | -100 | | mV |
| Transconductance with GM Boost | gm_compvl_boost | | | 163 | | uohm |
| Max Sink Current | Isink_max_compv | | | 36 | | uA |
| Max Source Current | Isource_max_compv | | | 36 | | uA |
| Clamp High Voltage | VCOMPV_clamp_h | | | 4.3 | | V |
| Clamp Low Voltage | VCOMPV_clamp_l | | | 0.72 | | V |
| Threshold for Zero Duty | VCOMPV_bs | | | 1 | | V |
| **FB Section** | | | | | | |
| Reference Voltage at High Feedback Mode | Vref_FB_hfb | | | 2.515 | | V |
| Threshold for FB OVP | VFB_ovp | Sweep FB from Low to High | | 2.75 | | V |
| Hysteresis of FB OVP Threshold | | | | 200 | | mV |
| Threshold for PGB Pull Low | VFB_pgb_on | | | 2.2 | | V |
| Threshold to off PWM | VFB_pwm_off | | | 0.4 | | V |
| **VREG Section** | | | | | | |
| Output Voltage | Vreg | | | 6 | | V |
| Line Regulation | | 0mA<I<3mA | | | 5 | mV |
| Load Regulation | | | | | 20 | mV |
| **PGB Section** | | | | | | |
| Output Voltage Low | Vpgb_ol | Io=1mA Sinking | | | 0.5 | V |

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| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Gate Section** | | | | | | |
| Maximum Duty Cycle | Dmax | | | 98 | | % |
| Output Voltage Low | Vol | VCC=12V,Io=20mA Sinking | | | 0.15 | V |
| Output Voltage High | Voh | VCC=12V,Io=20mA Sinking | 10 | | | V |
| Rising Time | tr | CL=2nF,VGATE from 2V to 6V | | 30 | | nS |
| Falling Time | tf | CL=2nF,VGATE from 6V to 2V | | 10 | | nS |
| Gate Clamping Voltage | Vgate_clamp | VCC=21V | 12 | 15 | 18 | V |
| **TSD Section** | | | | | | |
| Internal Thermal Protection | TSD_int | | | 150 | | Degr-ee |
| Hysteresis of Thermal Protection | TSD_int_hys | | | 20 | | |

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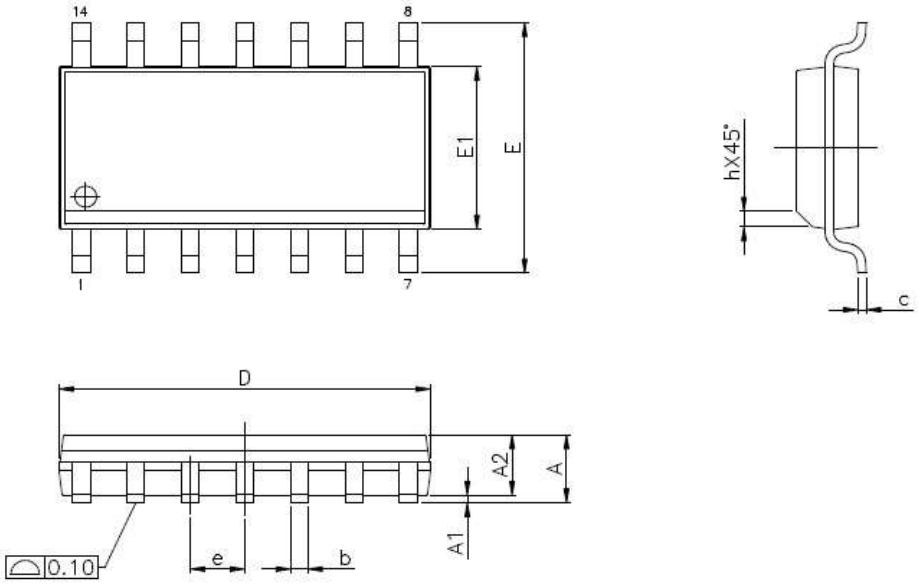
## Package Information

SOP-14L




| SYMBOLS | MIN. | MAX. |
|---|---|---|
| A | — | 1.75 |
| A1 | 0.10 | 0.25 |
| A2 | 1.25 | — |
| b | 0.31 | 0.51 |
| c | 0.10 | 0.25 |
| D | 8.65 BSC | |
| E | 6.00 BSC | |
| E1 | 3.90 BSC | |
| e | 1.27 BSC | |
| L | 0.40 | 1.27 |
| h | 0.25 | 0.50 |
| θ° | 0 | 8 |

UNIT : mm

Note

1. Package Outline Unit Description:
   BSC: Basic. Represents theoretical exact dimension .
   MAX: Maximum dimension specified.
   MIN: Minimum dimension specified.
   REF: Represents dimension for reference use only. The value is not the device specification.
   TYP: Represents as a typical value. The value is not the device specification.
2. All linear dimensions are in Millimeters.