

*Parameters Subject to Change Without Notice*

## DESCRIPTION

The JW<sup>®</sup>5068A is a monolithic buck switching regulator based on I<sup>2</sup> architecture for fast transient response. Operating with an input range of 4V~26V, JW5068A delivers 8A of continuous output current with two integrated N-Channel MOSFETs. The internal synchronous power switches provide high efficiency without the use of an external Schottky diode. At light loads, the regulator operates in low frequency to maintain high efficiency and low output ripples.

JW5068A guarantees robustness with output short protection, thermal protection, current run-away protection, and input under voltage lockout.

JW5068A is available in QFN3X3-20 package, which provide a compact solution with minimal external components.

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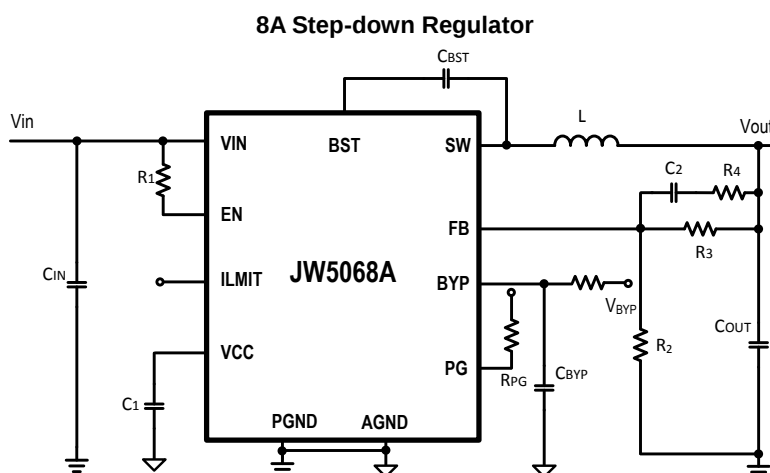
## FEATURES

- 4V to 26V operating input range
- 8A continuous / 16A peak output current
- Up to 95% efficiency
- High efficiency at light load
- 500kHz switching frequency
- External bypass input
- Programmable valley current limit
- Power good indicator
- Input under voltage lockout
- Output discharge function
- Output Over Voltage latch off protection
- Output short protection
- Thermal protection
- Available in QFN3X3-20 package

## APPLICATIONS

- Industrial and commercial low power system
- Notebook
- LDO monitors and TVs
- Green Electronics/ Appliances

## TYPICAL APPLICATION



## ORDER INFORMATION

| DEVICE <sup>1)</sup> | PACKAGE   | TOP MARKING <sup>2)</sup> |
|----------------------|-----------|---------------------------|
| JW5068AQFNF#TRPBF    | QFN3X3-20 | JW5068A<br>XXXXXX         |

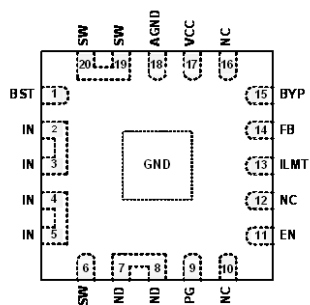
## Notes:

1) JW       #TRPBF  
 Part No.      Package Code      PB Free  
 Tape and Reel (If "TR" is not shown, it means tube)

2) Line 1 of top marking means Part No., and the line 2 of top marking means Date Code.

## PIN CONFIGURATION

TOP VIEW

ABSOLUTE MAXIMUM RATING<sup>1)</sup>

|                                             |                  |
|---------------------------------------------|------------------|
| VIN, EN, PG, SW, ILMT Pin.....              | -0.3V to 28V     |
| BST Pin .....                               | SW-0.3V to SW+5V |
| All other Pins .....                        | -0.3V to 6V      |
| Junction Temp. <sup>2) 3)</sup> .....       | 150°C            |
| Lead Temperature .....                      | 260°C            |
| ESD Susceptibility (Human Body Model) ..... | 2kV              |

## RECOMMENDED OPERATING CONDITIONS

|                           |                |
|---------------------------|----------------|
| Input Voltage VIN .....   | 4V to 26V      |
| Output Voltage Vout ..... | 0.8V to VIN-3V |

THERMAL PERFORMANCE<sup>4)</sup>
 $\theta_{JA}$        $\theta_{JC}$ 

|                |               |
|----------------|---------------|
| QFN3*3-20..... | 30....4.5°C/W |
|----------------|---------------|

## Note:

- 1) Exceeding these ratings may damage the device.
- 2) The JW5068A guarantees robust performance from -40°C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.
- 3) The JW5068A includes thermal protection that is intended to protect the device in overload conditions. Thermal protection is active when junction temperature exceeds the maximum operating junction temperature. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.
- 4) Measured on JESD51-7, 4-layer PCB.

## ELECTRICAL CHARACTERISTICS

| <i>V<sub>IN</sub>=12V, T<sub>A</sub>=25 °C, Unless otherwise stated.</i> |                          |                                                                   |         |      |      |                  |
|--------------------------------------------------------------------------|--------------------------|-------------------------------------------------------------------|---------|------|------|------------------|
| Item                                                                     | Symbol                   | Conditions                                                        | Min.    | Typ. | Max. | Unit             |
| V <sub>IN</sub> Under Voltage Lock-out Threshold                         | V <sub>IN_MIN</sub>      | V <sub>IN</sub> rising                                            |         | 3    |      | V                |
| V <sub>IN</sub> Under voltage Lockout Hysteresis                         | V <sub>IN_MIN_HYST</sub> |                                                                   |         | 200  |      | mV               |
| Shutdown Current                                                         | I <sub>SD</sub>          | V <sub>EN</sub> =0V                                               |         |      | 1    | μA               |
| Supply Current                                                           | I <sub>Q</sub>           | V <sub>EN</sub> =5V, V <sub>FB</sub> =1.2V                        |         | 60   |      | μA               |
| EN Input High Voltage                                                    | V <sub>EN_H</sub>        |                                                                   |         | 1.8  |      | V                |
| EN Input Low Voltage                                                     | V <sub>EN_L</sub>        |                                                                   |         | 1.5  |      | V                |
| Feedback Voltage                                                         | V <sub>FB</sub>          | 4V<V <sub>IN</sub> <26V                                           | 594     | 600  | 606  | mV               |
| Top Switch Resistance <sup>5)</sup>                                      | R <sub>DS(ON)T</sub>     |                                                                   |         | 20   |      | mΩ               |
| Bottom Switch Resistance <sup>5)</sup>                                   | R <sub>DS(ON)B</sub>     |                                                                   |         | 10   |      | mΩ               |
| Top Switch Leakage Current                                               | I <sub>LEAK_TOP</sub>    | V <sub>IN</sub> =26V, V <sub>EN</sub> =0V,<br>V <sub>SW</sub> =0V |         |      | 1    | μA               |
| Bottom Switch Leakage Current                                            | I <sub>LEAK_BOT</sub>    | V <sub>IN</sub> =26, V <sub>EN</sub> =0V,<br>V <sub>SW</sub> =26V |         |      | 1    | μA               |
| Bottom Switch Current Limit                                              | I <sub>LIM</sub>         | I <sub>LIM</sub> ="0"                                             | 8       |      |      | A                |
|                                                                          |                          | I <sub>LIM</sub> =Floating                                        | 12      |      |      | A                |
|                                                                          |                          | I <sub>LIM</sub> ="1"                                             | 16      |      |      | A                |
| ILMIT Rising Threshold                                                   | V <sub>LIMTH</sub>       |                                                                   | VCC-0.8 |      | VCC  | V                |
| ILMIT Falling Threshold                                                  | V <sub>LIMTL</sub>       |                                                                   |         |      | 0.8  | V                |
| Minimum On Time <sup>5)</sup>                                            | T <sub>ON_MIN</sub>      |                                                                   |         | 100  |      | ns               |
| Minimum Off Time <sup>5)</sup>                                           | T <sub>OFF_MIN</sub>     | V <sub>FB</sub> =0.4V                                             |         | 100  |      | ns               |
| Discharge FET Ron                                                        | R <sub>DIS</sub>         |                                                                   |         | 50   |      | Ω                |
| Soft-Start Time                                                          | T <sub>SS</sub>          |                                                                   |         | 400  |      | us               |
| VCC Output                                                               | V <sub>CC</sub>          | V <sub>IN</sub> =4V                                               | 4.9     | 5    | 5.1  | V                |
| Power Good Threshold                                                     | PGD <sub>_TH</sub>       | FB falling                                                        | 88%     | 90%  | 92%  | V <sub>REF</sub> |
| Power Good Hysteresis                                                    | PGD <sub>_HYS</sub>      |                                                                   |         | 5%   |      | V <sub>REF</sub> |
| Power Good Delay Time <sup>5)</sup>                                      | PGD <sub>_DLY</sub>      |                                                                   |         | 200  |      | us               |
| Power Good Sink Current                                                  | I <sub>PG</sub>          | PG=0.5V                                                           | 8       |      |      | mA               |
| Output Over-voltage Threshold                                            |                          | V <sub>OUT</sub> Rising                                           | 115%    | 120% | 125% | V <sub>REF</sub> |
| Output Over-voltage Hysteresis                                           |                          |                                                                   |         | 5%   |      | V <sub>REF</sub> |
| Output Over-voltage Delay Time                                           |                          |                                                                   |         | 20   |      | us               |
| Output Under-voltage Threshold                                           |                          | V <sub>FB</sub> Falling                                           | 60%     | 65%  | 70%  | V <sub>REF</sub> |
| Output Under-voltage Delay Time                                          |                          | FB forced below<br>UV threshold                                   |         | 200  |      | us               |
| Bypass Switch Ron                                                        | R <sub>BYP</sub>         |                                                                   |         | 3    |      | Ω                |
| Bypass Switch Turn-on Voltage                                            | V <sub>BYP_ON</sub>      |                                                                   | 4.5     | 4.7  |      | V                |

| VIN=12V, T <sub>A</sub> =25 °C, Unless otherwise stated. |                       |            |      |      |      |                 |
|----------------------------------------------------------|-----------------------|------------|------|------|------|-----------------|
| Item                                                     | Symbol                | Conditions | Min. | Typ. | Max. | Unit            |
| Bypass Switch Switchover Hysteresis                      | V <sub>BYP_HYS</sub>  |            |      | 0.2  |      | V               |
| Bypass Switch OVP                                        | V <sub>BYP_OVP</sub>  |            |      | 120% |      | V <sub>CC</sub> |
| Thermal Shutdown <sup>5)</sup>                           | T <sub>TSD</sub>      |            |      | 150  |      | °C              |
| Thermal Shutdown hysteresis <sup>5)</sup>                | T <sub>TSD_HYST</sub> |            |      | 15   |      | °C              |

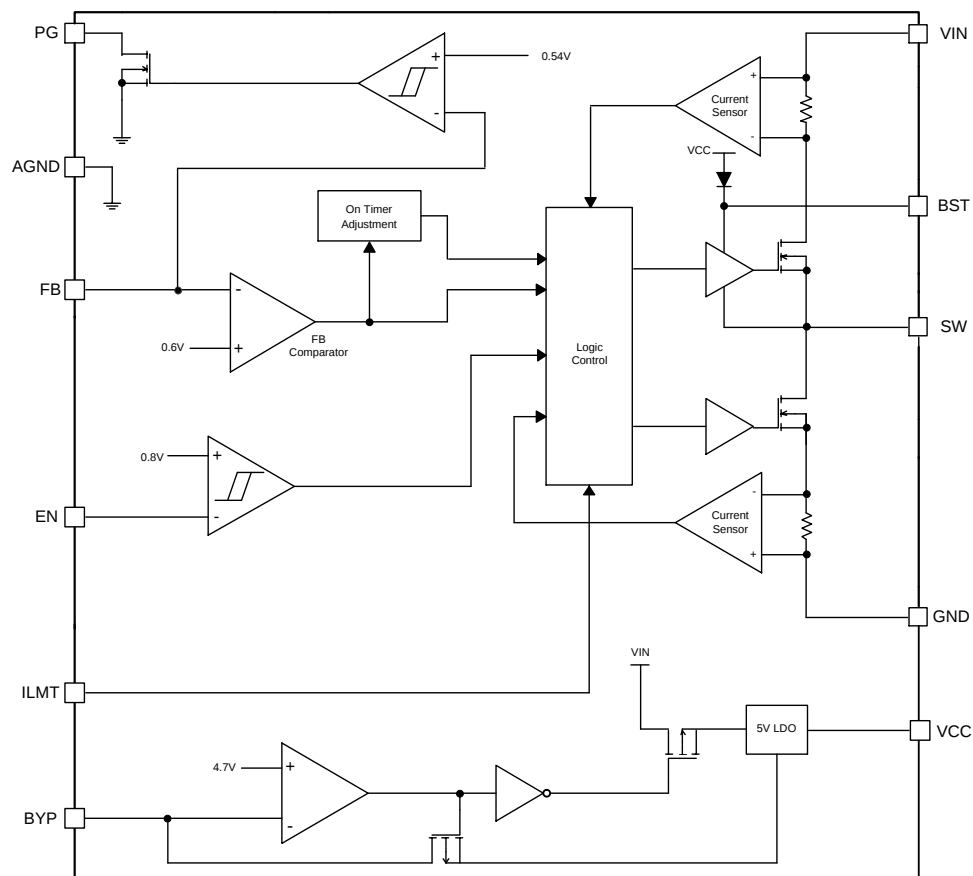
**Note:**

5) Guaranteed by design.

## PIN DESCRIPTION

| Pin      | Name | Description                                                                                                                                                                                                                                               |
|----------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | BST  | Connect a 0.1uF capacitor between BST and SW pin to supply current for the top switch driver.                                                                                                                                                             |
| 2,3,4,5  | VIN  | Input voltage pin. VIN supplies power to the IC. Connect a 4V to 26V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.                                                                       |
| 6,19,20  | SW   | SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.                                                                                                                                      |
| 7,8,EP   | GND  | Ground pin                                                                                                                                                                                                                                                |
| 9        | PG   | Power good monitor output. This is an open-drain output so a resistor should be connected at this pin to the VCC pin.                                                                                                                                     |
| 11       | EN   | Enable Control. Pull this pin high to turn on the Buck. Do not leave this pin floating.                                                                                                                                                                   |
| 10,12,16 | NC   |                                                                                                                                                                                                                                                           |
| 13       | ILMT | Current Limit Setting Pin. The current limit is set to 8A, 12A or 16A when this pin is pull low, floating or pull high respectively.                                                                                                                      |
| 14       | FB   | Output feedback pin. FB senses the output voltage and is regulated by the control loop to 0.6V. Connect a resistive divider at FB.                                                                                                                        |
| 15       | BYP  | Bypass input for the internal LDO. BYP is externally connected to the output of switching regulator. When the BYP voltage rises above the bypass switch turn-on threshold, the power supply of the internal LDO regulator changes to the external source. |
| 17       | VCC  | 5V Linear Regulator Output for Internal Control Circuit. A capacitor (typical 4.7uF) should be connected to AGND. Don't connect to external Load.                                                                                                         |
| 18       | AGND | Signal ground pin.                                                                                                                                                                                                                                        |

BLOCK DIAGRAM

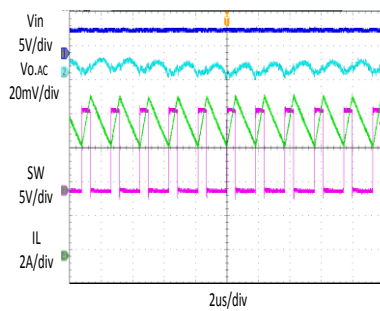


## TYPICAL PERFORMANCE CHARACTERISTICS

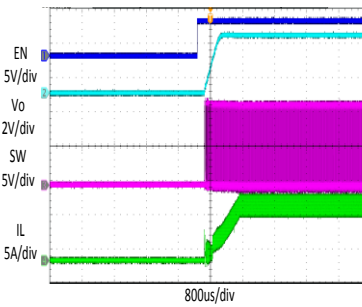
$V_{in} = 12V$ ,  $V_{out} = 3.3V$ ,  $L = 1.5\mu H$ ,  $C_{out} = 5 \times 22\mu F$ ,  $C2 = 10pF$ ,  $R4 = 0$ ,  $T_A = +25^\circ C$ , unless otherwise noted

**Steady State Test**

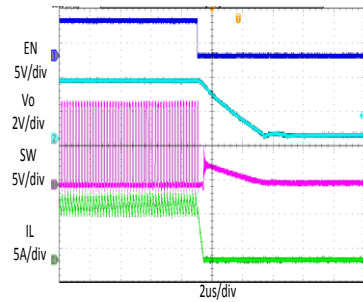
$V_{in} = 12V$ ,  $V_{out} = 3.3V$   
 $I_{out} = 8A$

**Startup through Enable**

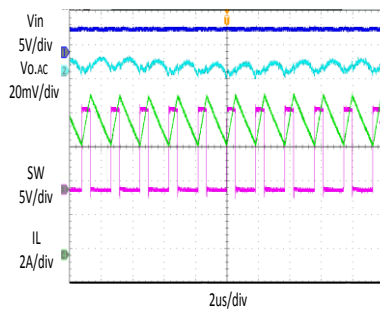
$V_{in} = 12V$ ,  $V_{out} = 3.3V$   
 $I_{out} = 8A$  (Resistive load)

**Shutdown through Enable**

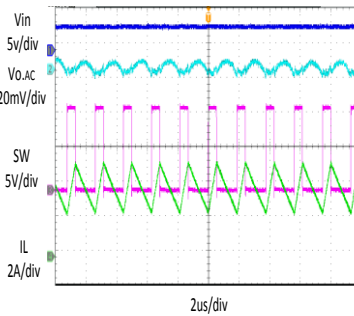
$V_{in} = 12V$ ,  $V_{out} = 3.3V$   
 $I_{out} = 3A$  (Resistive load)

**Heavy Load Operation**

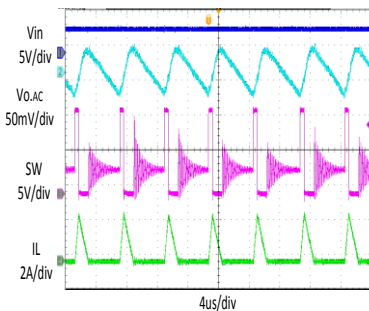
8A LOAD

**Medium Load Operation**

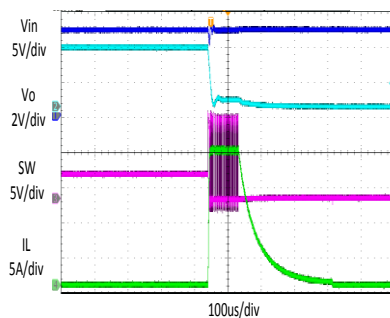
4A LOAD

**Light Load Operation**

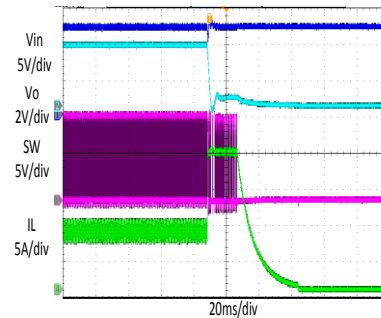
0.4 A LOAD

**Short Circuit Protection**

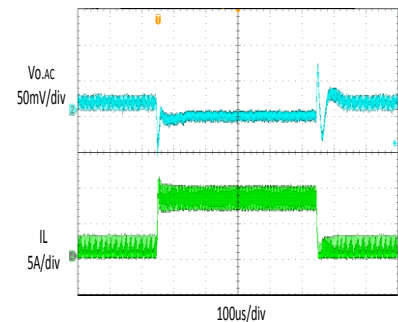
$V_{in} = 12V$ ,  $V_{out} = 3.3V$   
 $I_{out} = 0A$  - Short

**Short Circuit Protection**

$V_{in} = 12V$ ,  $V_{out} = 3.3V$   
 $I_{out} = 8A$  - Short

**Load Transient**

$C2 = 10pF$ ,  $R4 = 0k$   
 $0.8A \text{ LOAD} \rightarrow 8A \text{ LOAD} \rightarrow 0.8A \text{ LOAD}$



## FUNCTIONAL DESCRIPTION

JW5068A is a synchronous step-down regulator based on I2 control architecture. It regulates input voltages from 4V to 26V down to an output voltage as low as 0.6V, and is capable of supplying up to 8A continuous, 16A peak load current.

### Power Switch

N-Channel MOSFET switches are integrated on the JW5068A to down convert the input voltage to the regulated output voltage. Since the top MOSFET needs a gate voltage great than the input voltage, a boost capacitor connected between BST and SW pins is required to drive the gate of the top switch. The boost capacitor is charged by the internal 3.7V rail when SW is low.

### Vin Under-Voltage Protection

In addition to the enable function, the JW5068A provides an Under Voltage Lock-out (UVLO) function that monitors the input voltage. To prevent operation without fully-enhanced internal MOSFET switches, this function inhibits switching when input voltage drops below the UVLO-falling threshold. The IC resumes switching when input voltage exceeds the UVLO-rising threshold.

### Soft Start

The JW5068A has an internal soft-start function to prevent large inrush current and output voltage overshoot when the converter starts up. The soft-start (SS) automatically begins once the chip is enabled. During soft-start, it clamps the ramping of internal reference voltage which is compared with FB signal. The typical soft-start duration is 0.4ms.

### Enable and Disable

The JW5068A's EN is used to control converter, the enable voltage (EN) has low and high threshold voltage. When VEN is below its high threshold voltage, the IC enters shutdown mode. When VEN exceeds its high threshold voltage, the converter is fully operational. In shutdown mode, the entire regulator of JW5068A is off.

### Power Good

The JW5068A has power-good (PG) output. The PG pin is the open drain of a MOSFET. Connect to Vcc or another voltage source through a resistor. When the output voltage becomes within -10% of the target value, internal comparators detect power good state and the power good signal becomes high. If the feedback voltage goes under 10% of the target value, the power good signal becomes low.

### Output Voltage Over-voltage Protection

JW5068A integrates both output over-voltage protection and under-voltage protection. If the output voltage rises above the regulation level, the high-side MOSFET naturally remains off and the synchronous rectifier will turn on until the inductor current reaches the zero. If the output voltage exceeds the OVP threshold for longer than 20  $\mu$ s (typical), the OVP function is triggered. If the output voltage drops below the UVP trip threshold for longer than 200  $\mu$ s (typical), the UVP function is triggered.

JW5068A use latch-off mode in OVP and UVP. When the protection function is triggered, the IC will shut down. The IC stops switching and is latched off. To restart operation, toggle EN or power the IC off and then on again.

### Current Limit

The JW5068A current limit is adjustable

(8A,12A,16A) by ILMT pin and it is a cycle-by-cycle “ valley ” mechanism, measuring the inductor current through the synchronous rectifier during the off-time while the inductor current ramps down. The current is determined by measuring the voltage between source and drain of the synchronous rectifier, adding temperature compensation for greater accuracy. If the current exceeds the current limit, the turn-on signal of top MOSFET is inhibited until the inductor current ramps down below the current limit. Thus, only when the inductor current is well below the current limit, another on-time is permitted. If the output current exceeds the available inductor current (controlled by the current limit mechanism), the output voltage will drop. If it drops below the output under-voltage protection level, the IC will stop switching to avoid excessive heat.

### **Linear Regulator (VCC)**

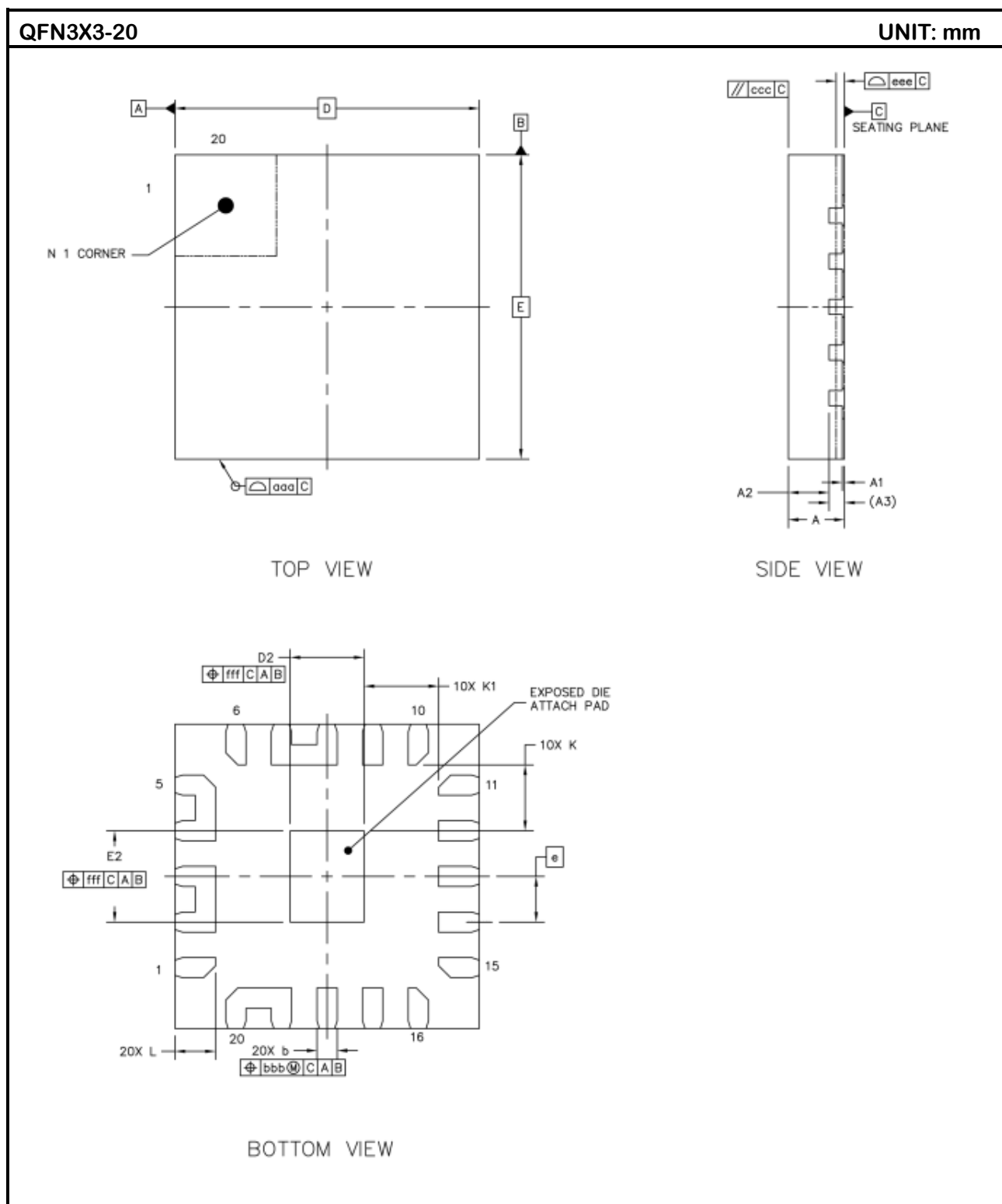
The JW5068A integrates a 5V linear regulator

(VCC). When the input voltage of BYP pin is lower than the switch over threshold 4.7V, the VCC regulator steps down input voltage to supply both internal circuitry and gate drivers. When the input voltage of BYP pin is higher than the switch over threshold 4.7V, an automatic circuit will change the power source of linear regulator from VIN path to external path, therefore the power dissipation of linear regulator will be decrease efficiently. A 4.7uF ceramic capacitor is recommended to bypass VCC to GND. Do not connect the VCC pin to external loads.

### **Thermal Protection**

When the temperature of the JW5068A rises above 150°C, it is forced into thermal protection (OTP). The JW5068A uses latch-off mode in OTP. When the protection function is triggered, the IC will shut down. The IC stops switching and is latched off. To restart operation, toggle EN or power the IC off and then

## PACKAGE OUTLINE



QFN3X3-20

UNIT: mm

| Symbol | Dimensions In Millimeters |      | Dimensions In Inches |       |
|--------|---------------------------|------|----------------------|-------|
|        | Min.                      | Max. | Min.                 | Max.  |
| A      | 0.5                       | 0.6  | 0.020                | 0.024 |
| A1     | 0                         | 0.05 | 0.000                | 0.002 |
| A2     | 0.4                       |      | 0.016                |       |
| A3     | 0.152 REF                 |      | 0.006                |       |
| b      | 0.15                      | 0.25 | 0.006                | 0.010 |
| D      | 3 BSC                     |      | 0.118 BSC            |       |
| E      | 3 BSC                     |      | 0.118 BSC            |       |
| e      | 0.45BSC                   |      | 0.018 BSC            |       |
| D2     | 0.63                      | 0.83 | 0.025                | 0.033 |
| E2     | 0.8                       | 1    | 0.031                | 0.039 |
| L      | 0.3                       | 0.5  | 0.012                | 0.020 |
| K      | 0.65 REF                  |      | 0.026 REF            |       |
| K1     | 0.735 REF                 |      | 0.029 REF            |       |
| aaa    | 0.1                       |      | 0.004                |       |
| ccc    | 0.1                       |      | 0.004                |       |
| eee    | 0.08                      |      | 0.003                |       |
| bbb    | 0.1                       |      | 0.004                |       |
| fff    | 0.1                       |      | 0.004                |       |

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