

## Fast Charging Controller IC for multiple USB Interfaces

TypeC/PD2.0/PD3.1, QC5/QC4+/QC3+/QC3.0/QC2.0, FCP, SCP, AFC, SFCP, MTK PE+ 2.0/1.1, UFCS, Apple, BC1.2

### 1. Features

- **Support Charging standards including**
  - ✧ USB Type-C and USB Power Delivery
    - Two independent Type-C Source
    - Support USB PD2.0/PD3.1/PPS
    - PD with PPS USB-IF TID: 10103
    - Integrated VCONN power and switch for reading E-Marker cable
  - ✧ Support QC5/QC4+/QC3+/QC3.0/QC2.0
    - Compatible with Class B
  - ✧ Support FCP/SCP
  - ✧ Support AFC
  - ✧ Support SFCP
  - ✧ Support MTK PE+ 2.0/1.1
    - PE+ 2.0: 5~20V (0.5V/step)
    - PE+ 1.1: 5V, 7V, 9V, 12V
  - ✧ Support UFCS (only one port can enter UFCS when working in the dual port mode)
  - ✧ Support BC1.2, Apple 2.4A, SAMSUNG 2.0A
- **Independent built-in shunt regulator**
  - ✧ Programmable constant voltage control
  - ✧ Programmable constant current control
  - ✧ Integrated low side current sense amplifier
  - ✧ Cable drop compensation
- **Support multiple modes of voltage control**
  - ✧ Control of PWM controller feedback
  - ✧ Control of optocoupler
  - ✧ Control of I2C
- **Power management**
  - ✧ Integrated four independent NMOS driver and two of the four support VDS detecting
  - ✧ Integrated Bleeder
  - ✧ Support power saving mode
- **Programmable fault protections**
  - ✧ Over Voltage Protection (OVP)
  - ✧ Under Voltage Protection (UVP)
  - ✧ Over Current Protection (OCP)
  - ✧ Over Temperature Protection (OTP)
  - ✧ DP/DM/CC1/CC2 over voltage protection
- **Operating voltage 3V~25V**
- **Package**
  - ✧ QFN32

### 2. Description

The IP2738U is a highly integrated fast charging controller dedicated for multiple USB interfaces which supports many kinds of charging standards includes Type-C Source, PD2.0/PD3.1/PPS, HVDCP QC5/QC4+/QC3+/QC3.0/QC2.0 (Quick Charge), FCP (Hisilicon® Fast Charge Protocol), SCP (Super Fast Charge), AFC (Samsung® Adaptive Fast Charge), SFCP, MTK PE+ 2.0/1.1 (MediaTek Pump Express Plus 2.0/1.1), UFCS (Universal Fast Charging for Mobile Devices), BC1.2, Apple 2.4A, SAMSUNG 2.0A.

The IP2738U supports automatically detecting the connected device and switching standards type to respond to the fast charging requirements.

### 3. Applications

- Multiple USB power output ports for AC adapter, power bank, car charger, etc.
- Power supply for smart phones, tablets, netbooks, digital cameras, etc.

## Contents

|  |    |
|--|----|
| 1. FEATURES .....                        | 1  |
| 2. DESCRIPTION .....                     | 1  |
| 3. APPLICATIONS .....                    | 1  |
| 4. REVISION HISTORY .....                | 3  |
| 5. TYPICAL APPLICATION SCHEMATIC.....    | 4  |
| 6. PIN ASSIGNMENT .....                  | 7  |
| 7. ABSOLUTE MAXIMUM RATINGS .....        | 9  |
| 8. RECOMMENDED OPERATING CONDITIONS..... | 9  |
| 9. ELECTRICAL CHARACTERISTICS.....       | 10 |
| 10. PACKAGE.....                         | 12 |
| 11. TAPE AND REEL INFORMATION .....      | 16 |
| 12. MARKING SPECIFICATION .....          | 18 |
| 13. PICTURE OF MATERIAL OBJECT .....     | 18 |
| 14. SOLDER INSTRUCTION .....             | 19 |
| 15. IMPORTANT NOTICE .....               | 20 |

INJOINIC CORP.

## 4. Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

### Revision V1.00 (September 2022)

---

| Changes from Revision V1.00 (September 2022) to Revision V1.01 (December 2022) | Page |
|--|------|
|--|------|

---

- Update the typical application schematic of independent control of I2C.....6

---

| Changes from Revision V1.01 (December 2022) to Revision V1.02 (March 2023) | Page |
|--|------|
|--|------|

---

- Update the description of “Support UFCS”.....1

---

| Changes from Revision V1.02 (March 2023) to Revision V1.03 (November 2023) | Page |
|--|------|
|--|------|

---

- Update PD with PPS USB-IF TID.....1

INJOINIC CORP.

## 5. Typical Application Schematic

- Independent control of PWM controller feedback

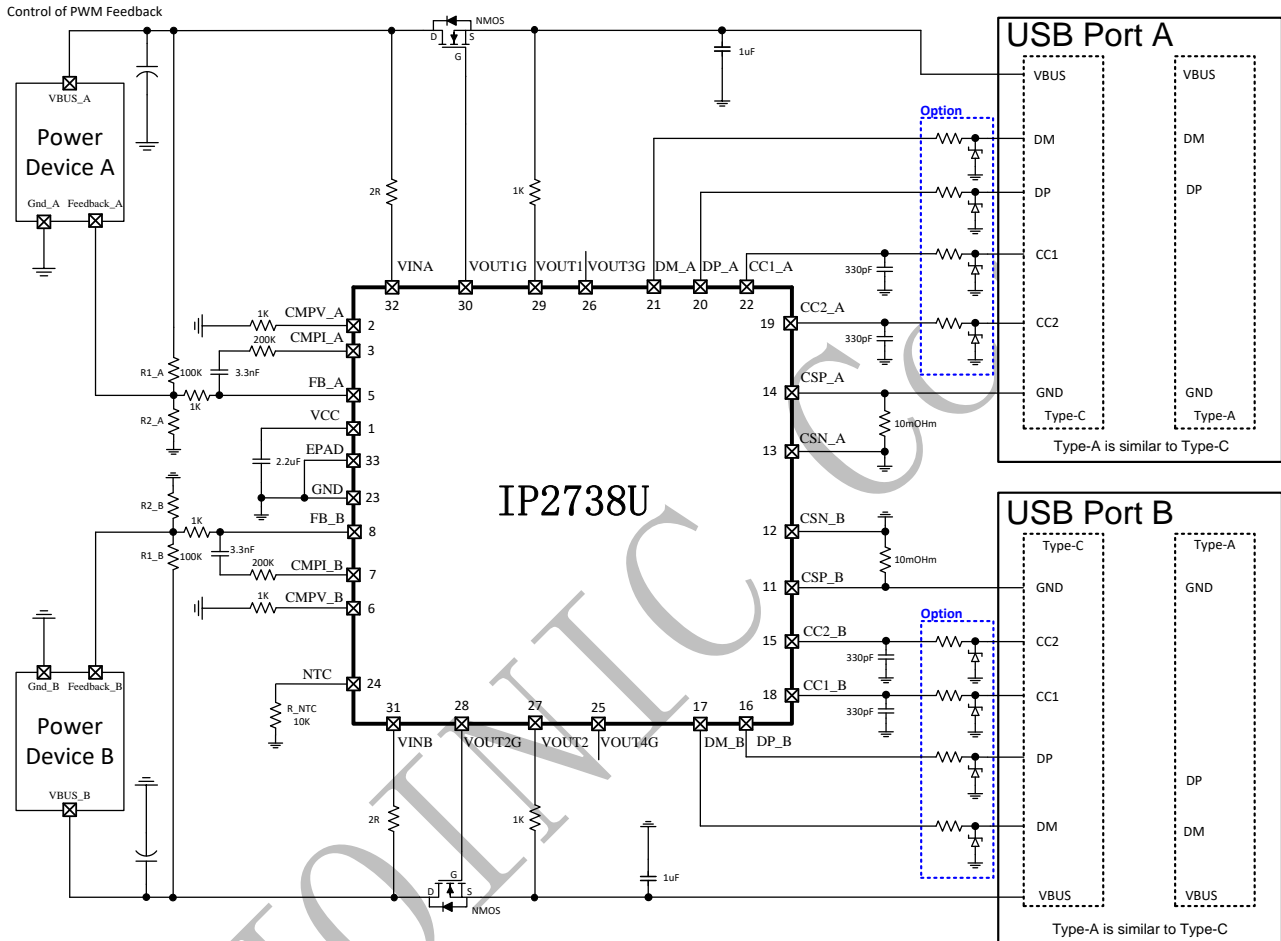


Figure 5-1. Typical application schematic of independent control of PWM controller feedback

**Note:**

- 1). 100kOhm(1%) R1\_A/R1\_B is recommended,  $R2 = (V_{fb} * R1) / (5 - V_{fb})$ ;
- 2).  $V_{dss} \geq 30V$  NMOS is recommended;
- 3). 10kOhm(B=3380K) R\_NTC is recommended;
- 4). The compensation capacitor and compensation resistor of CMPV/CMPI are adjustable refer to the power device;

- Independent control of optocoupler

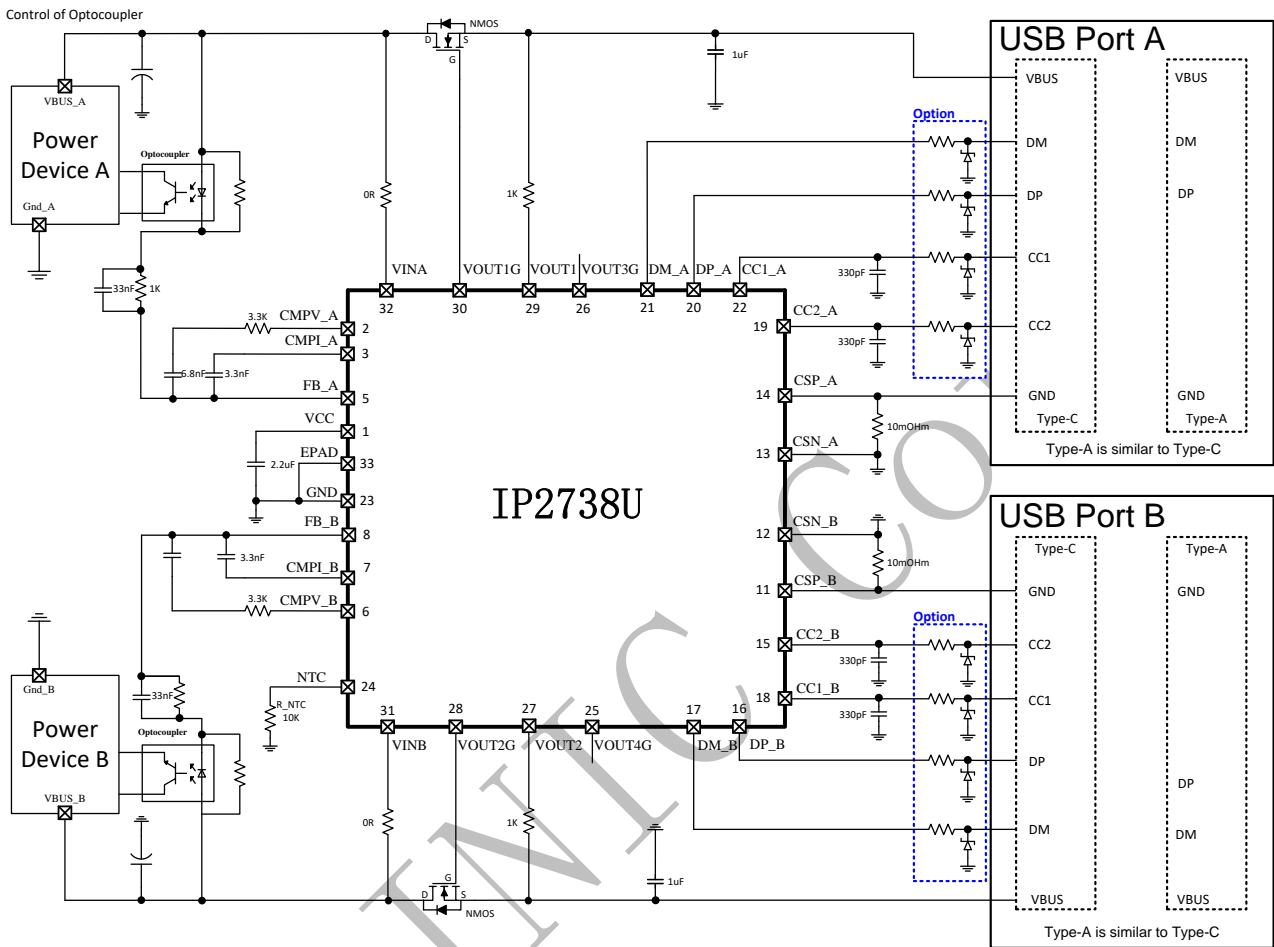


Figure 5-2. Typical application schematic of independent control of optocoupler

**Note:**

- 1).  $V_{dss} \geq 30V$  NMOS is recommended;
- 2).  $10k\Omega$  (B=3380K)  $R_{NTC}$  is recommended;
- 3). The compensation capacitor and compensation resistor of CMPV/CMPI are adjustable refer to the power device;

- independent control of I2C

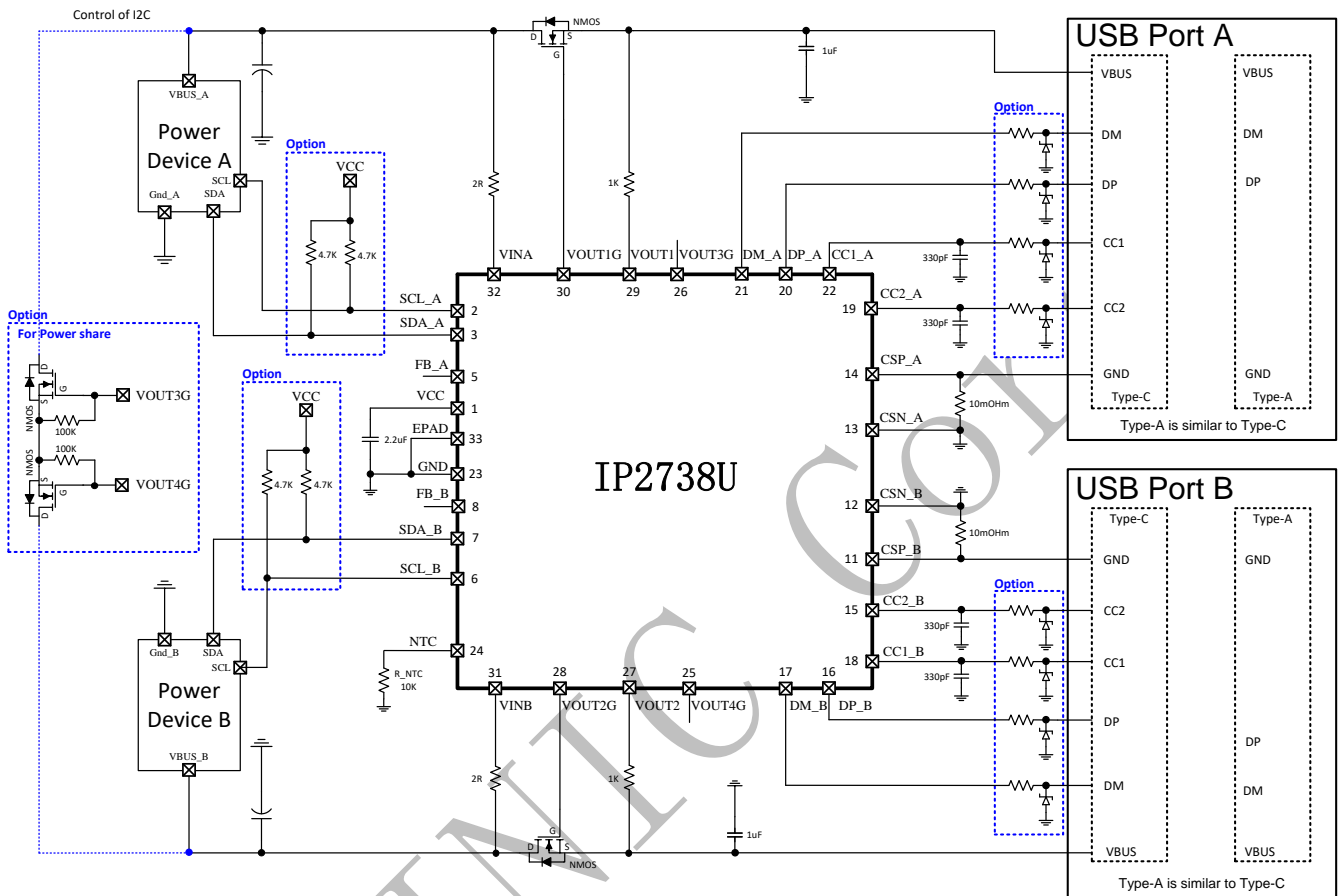


Figure 5-3. Typical application schematic of independent control of I2C

**Note:**

- 1). The external pull-up resistor is Optional which can be replace by internal pull-up resistor;
- 2).  $V_{dss} \geq 30V$  NMOS is recommended;
- 3).  $10k\Omega (B=3380K)$   $R_{NTC}$  is recommended;
- 4). For the power share function, designer should make sure that the  $Gnd\_A$  of Power Device A and the  $Gnd\_B$  of Power Device B are independent;

## 6. Pin Assignment

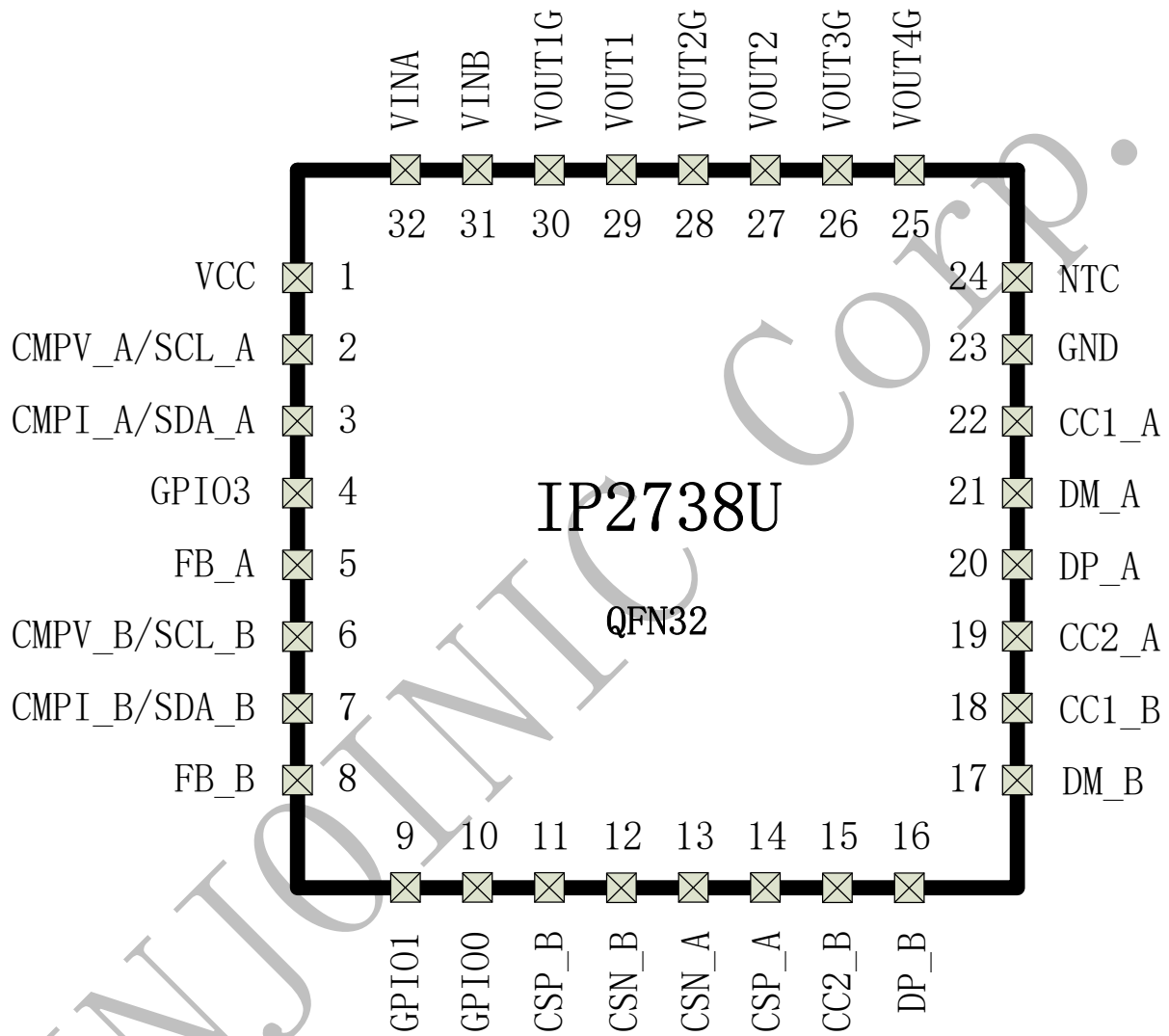


Figure 6-1. Pin Assignment (Top view)

Table 6-1. Pin Description

| Pin No. | Pin name     | Pin description  |
|---------|--------------|--|
| 1       | VCC          | Internal power supply output, it is recommended that an external capacitance 2.2uF is used |
| 2       | CMPV_A/SCL_A | PortA Loop compensation of voltage / PortA I2C clock                                       |
| 3       | CMPI_A/SDA_A | PortA Loop compensation of current / PortA I2C data  |
| 4       | GPIO3        | General purpose I/O 3  |
| 5       | FB_A         | PortA Loop feedback driver   |
| 6       | CMPV_B/SCL_B | PortB Loop compensation of voltage / PortB I2C clock                                       |
| 7       | CMPI_B/SDA_B | PortB Loop compensation of current / PortB I2C data  |
| 8       | FB_B         | PortA Loop feedback driver   |
| 9       | GPIO1        | General purpose I/O 1  |
| 10      | GPIO0        | General purpose I/O 0  |
| 11      | CSP_B        | PortB Positive input of current sense amplifier  |
| 12      | CSN_B        | PortB Negative input of current sense amplifier  |
| 13      | CSN_A        | PortA Negative input of current sense amplifier  |
| 14      | CSP_A        | PortA Positive input of current sense amplifier  |
| 15      | CC2_B        | PortB Type-C Configuration Channel2  |
| 16      | DP_B         | PortB USB DP   |
| 17      | DM_B         | PortB USB DM   |
| 18      | CC1_B        | PortB Type-C Configuration Channel1  |
| 19      | CC2_A        | PortA Type-C Configuration Channel2  |
| 20      | DP_A         | PortA USB DP   |
| 21      | DM_A         | PortA USB DM   |
| 22      | CC1_A        | PortA Type-C Configuration Channel1  |
| 23      | GND          | Ground   |
| 24      | NTC          | NTC Resistor input for temperature sense, built-in current source                          |
| 25      | VOU4G        | PortB Gate driver of load switch 4 (NMOS)  |
| 26      | VOU3G        | PortA Gate driver of load switch 3 (NMOS)  |
| 27      | VOU2         | PortB Path detect of load switch 2   |
| 28      | VOU2G        | PortB Gate driver of load switch 2 (NMOS)  |
| 29      | VOU1         | PortA Path detect of load switch 1   |
| 30      | VOU1G        | PortA Gate driver of load switch 1 (NMOS)  |
| 31      | VINB         | PortB Positive power supply  |
| 32      | VINA         | PortA Positive power supply  |
| 33      | EPAD         | Connect to ground  |



## 7. Absolute Maximum Ratings

| Parameters                                   | Symbol                                  | Value     | Unit  |
|--|---|-----------|-------|
| VINA, VINB Input Voltage Range               | VINA, VINB                              | -0.3 ~ 30 | V     |
| VOUT1, VOUT2 Input Voltage Range             | VOUT1, VOUT2                            | -0.3 ~ 30 | V     |
| VOUT1G, VOUT2G Input Voltage Range           | VOUT1G, VOUT2G                          | -0.3 ~ 30 | V     |
| VOUT3G, VOUT4G Input Voltage Range           | VOUT3G, VOUT4G                          | -0.3 ~ 30 | V     |
| DP_A, DM_A Input Voltage Range               | V <sub>DP_A</sub> , V <sub>DM_A</sub>   | -0.3 ~ 30 | V     |
| DP_B, DM_B Input Voltage Range               | V <sub>DP_B</sub> , V <sub>DM_B</sub>   | -0.3 ~ 30 | V     |
| CC1_A, CC2_A Input Voltage Range             | V <sub>CC1_A</sub> , V <sub>CC2_A</sub> | -0.3 ~ 30 | V     |
| CC1_B, CC2_B Input Voltage Range             | V <sub>CC1_B</sub> , V <sub>CC2_B</sub> | -0.3 ~ 30 | V     |
| FB_A, FB_B Input Voltage Range               | V <sub>FB_A</sub> , V <sub>FB_B</sub>   | -0.3 ~ 30 | V     |
| Other Pins Input Voltage Range               |   | -0.3 ~ 6  | V     |
| Junction Temperature Range                   | T <sub>J</sub>                          | -40 ~ 150 | °C    |
| Storage Temperature Range                    | T <sub>stg</sub>                        | -60 ~ 150 | °C    |
| Lead Temperature Range<br>(Soldering, 10sec) | T <sub>s</sub>                          | 260       | °C    |
| Ambient Temperature                          | T <sub>A</sub>                          | -40~120   | °C    |
| Package Thermal Resistance                   | θ <sub>JA</sub>                         | 90        | °C/W  |
| Package Thermal Resistance                   | θ <sub>JC</sub>                         | 39        | °C/W  |
| Human Body Model (HBM)                       | ESD                                     | 4         | KV    |
| Moisture Sensitivity Level (MSL)             | MSL                                     | 3         | Level |

\* Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

\* Voltages are referenced to GND unless otherwise noted.

## 8. Recommended Operating Conditions

| Parameter           | Symbol         | Min | Typ | Max | Unit |
|---------------------|----------------|-----|-----|-----|------|
| Input Voltage       | VINA, VINB     | 3   |     | 25  | V    |
| Ambient Temperature | T <sub>A</sub> | -20 |     | 115 | °C   |

\* Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

## 9. Electrical Characteristics

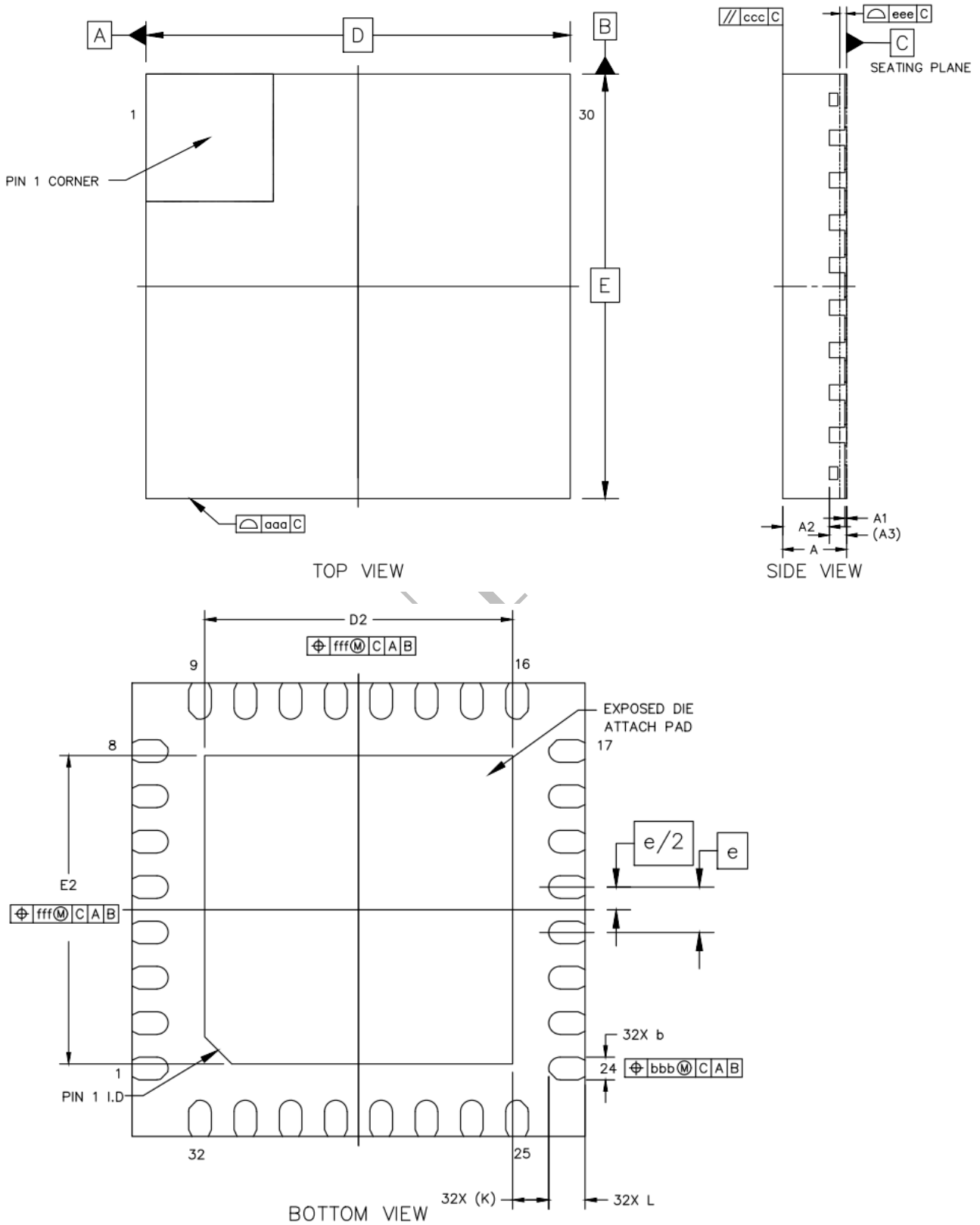
Unless otherwise specified, T<sub>A</sub> = 25 °C

| Parameter                               | Symbol                          | Test Conditions   | Min.   | Typ.  | Max    | Unit |
|---|---------------------------------|-------------------|--------|-------|--------|------|
| Input Voltage                           | VINA, VINB                      | Supplied directly | 3      |       | 25     | V    |
| Input UVLO Threshold                    | UVLO                            | VINA/VINB Falling | 2.5    |       | 2.9    | V    |
| VCC                                     | VCC                             |                   |        | 3.2   |        | V    |
| <b>TYPE-C</b>                           |                                 |                   |        |       |        |      |
| Rp_default                              | Default USB                     |                   |        | 80    |        | μA   |
| Rp_1.5A                                 | 1.5 A @ 5 V                     |                   |        | 180   |        | μA   |
| Rp_3.0A                                 | 3.0 A @ 5 V                     |                   |        | 330   |        | μA   |
| <b>HVDCP (QC2.0&amp;QC3.0&amp;QC3+)</b> |                                 |                   |        |       |        |      |
| Data Detect Voltage Threshold           | V <sub>DATA_REF</sub>           |                   | 0.25   | 0.325 | 0.4    | V    |
| DP High Glitch Filter Time              | T <sub>GLITCH(BC)_DP_H</sub>    |                   | 1000   | 1250  | 1500   | ms   |
| DM Low Glitch Filter Time               | T <sub>GLITCH(BC)_DM_L</sub>    |                   |        | 2     |        | ms   |
| Output Voltage Glitch Filter Time       | T <sub>GLITCH(V)_CHANGE</sub>   |                   | 20     | 40    | 60     | ms   |
| Continuous Mode Glitch Filter Time      | T <sub>GLITCH_CONT_CHANGE</sub> |                   | 100    |       | 200    | us   |
| DM Pull-down Resistance                 | R <sub>DM_DOWN</sub>            | VDP=0.6V          |        | 20    |        | kOhm |
| DP Pull-down Resistance                 | R <sub>DAT_LKG</sub>            | VDP=0.6V          |        | 768   |        | kOhm |
| <b>DCP</b>                              |                                 |                   |        |       |        |      |
| Samsung DP/DM Output Voltage            |                                 |                   | 1.08   | 1.2   | 1.32   | V    |
| Samsung DP/DM Output Impedance          |                                 |                   |        | 100   |        | kOhm |
| Apple 2.4A DP/DM Output Voltage         |                                 |                   | 2.64   | 2.7   | 2.76   | V    |
| Apple 2.4A DP/DM Output Impedance       |                                 |                   |        | 30    |        | kOhm |
| <b>GPIO</b>                             |                                 |                   |        |       |        |      |
| VIH                                     | Input high voltage              |                   | 0.7VCC |       |        | V    |
| VIL                                     | Input low voltage               |                   |        |       | 0.3VCC | V    |
| VOH                                     | Output high voltage             |                   |        | VCC   |        | V    |

|                  |                    |  |     |     |     |     |
|------------------|--------------------|--|-----|-----|-----|-----|
| VOL              | Output low voltage |  |     | GND |     | V   |
| Rpu              | Pull-up resistor   |  |     | 3   |     | k   |
| Rpd              | Pull-down resistor |  |     | 20  |     | k   |
| <b>I2C</b>       |                    |  |     |     |     |     |
| F <sub>I2C</sub> | Bit rate           |  | 100 |     | 400 | KHz |

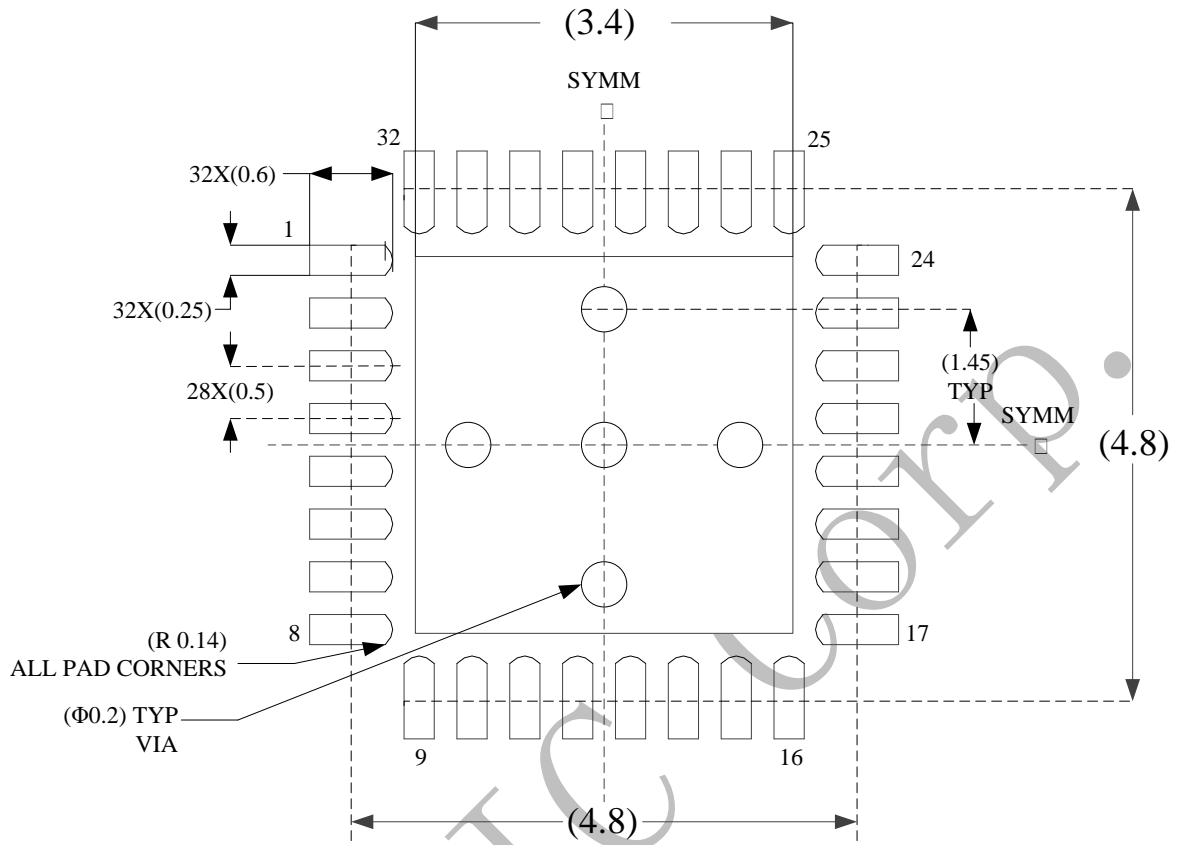
INJOINIC Corp.

## 10. Package

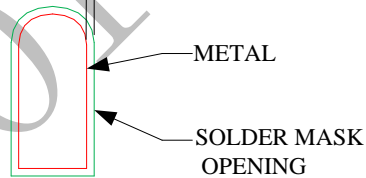


|                              |   | SYMBOL | MIN       | NOM   | MAX  |
|------------------------------|---|--------|-----------|-------|------|
| TOTAL THICKNESS              |   | A      | 0.7       | 0.75  | 0.8  |
| STAND OFF                    |   | A1     | 0         | 0.02  | 0.05 |
| MOLD THICKNESS               |   | A2     | ---       | 0.55  | ---  |
| L/F THICKNESS                |   | A3     | 0.203 REF |       |      |
| LEAD WIDTH                   |   | b      | 0.18      | 0.25  | 0.3  |
| BODY SIZE                    | X | D      | 4.9       | 5 BSC | 5.1  |
|                              | Y | E      | 4.9       | 5 BSC | 5.1  |
| LEAD PITCH                   |   | e      | 0.5 BSC   |       |      |
| EP SIZE                      | X | D2     | 3.3       | 3.4   | 3.6  |
|                              | Y | E2     | 3.3       | 3.4   | 3.6  |
| LEAD LENGTH                  |   | L      | 0.3       | 0.4   | 0.5  |
| LEAD TIP TO EXPOSED PAD EDGE |   | K      | 0.4 REF   |       |      |
| PACKAGE EDGE TOLERANCE       |   | aaa    | 0.1       |       |      |
| MOLD FLATNESS                |   | ccc    | 0.1       |       |      |
| COPLANARITY                  |   | eee    | 0.08      |       |      |
| LEAD OFFSET                  |   | bbb    | 0.1       |       |      |
| EXPOSED PAD OFFSET           |   | fff    | 0.1       |       |      |

INJOINIC

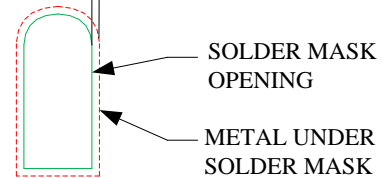


0.07 MAX  
ALL AROUND



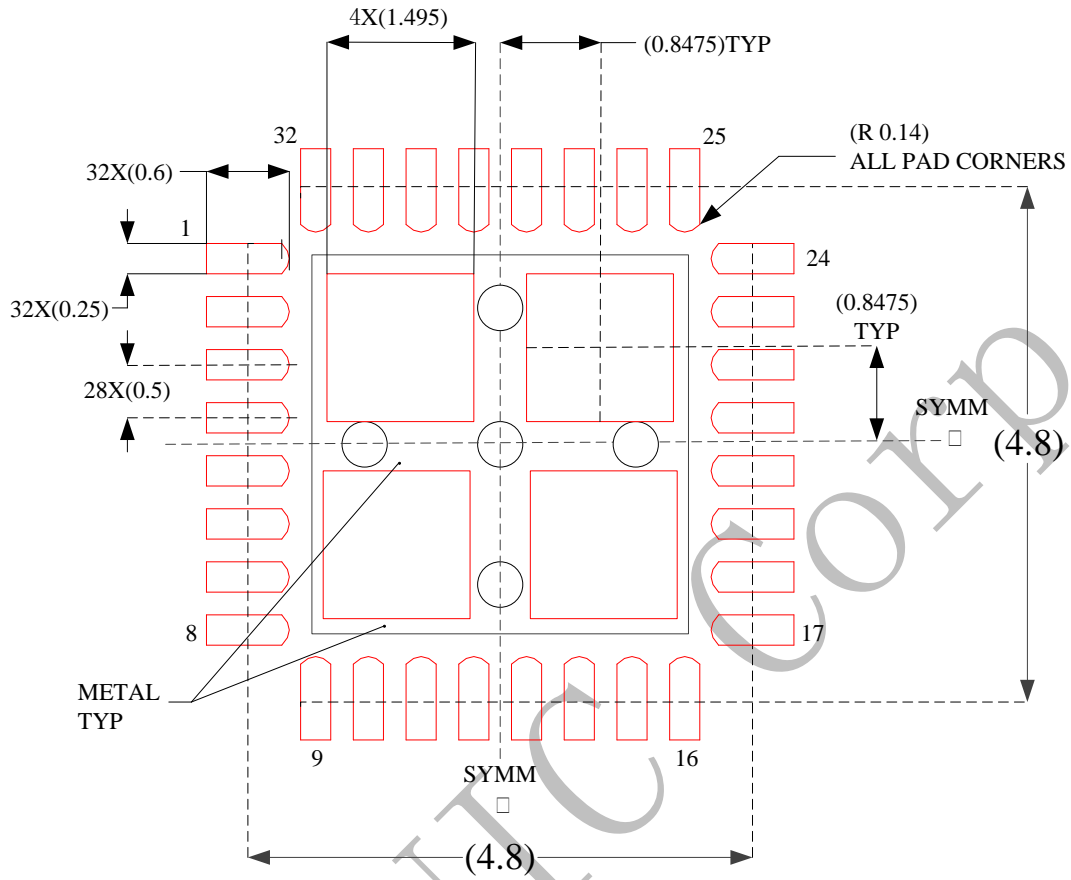
NON SOLDER MASK  
DEFINED  
(PREFERRED)

0.07 MAX  
ALL AROUND



SOLDER MASK  
DEFINED

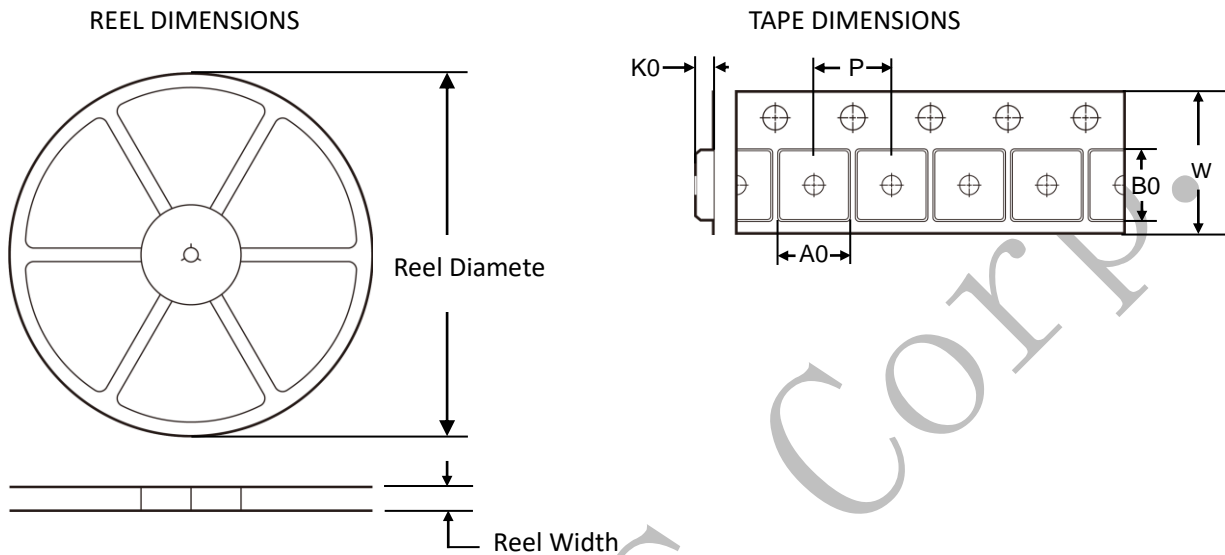
## SOLDER MASK DETAILS



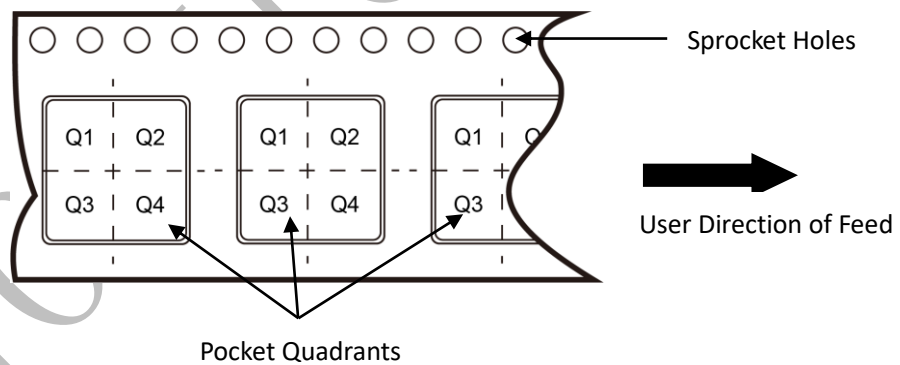
**SOLDER PASTE EXAMPLE**  
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD  
75% PRINTED SOLDER COVERAGE BY AREA

## 11. Tape and Reel Information



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE IS Q1

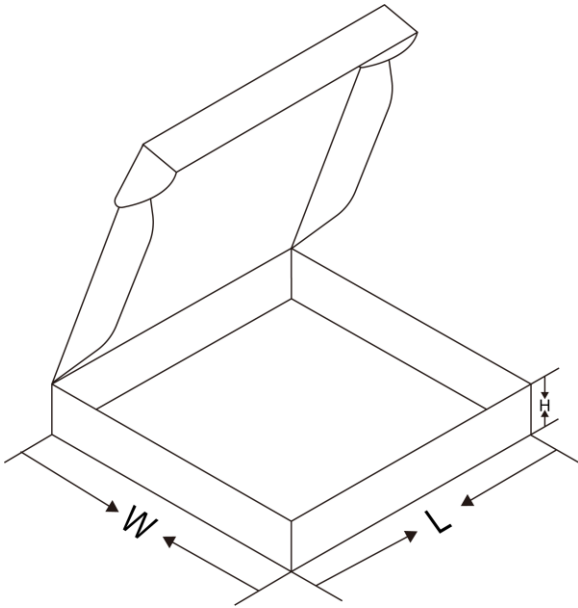


\* All dimensions are nominal

| Device  | Package Type | Pins | SPQ  | Reel Diameter (mm) | Reel Width (mm) | A0 (mm)           | B0 (mm)           | K0 (mm)           | P (mm)      | W (mm)     | Pin1 Quadrant |
|---------|--------------|------|------|--------------------|-----------------|-------------------|-------------------|-------------------|-------------|------------|---------------|
| IP2738U | QFN32        | 32   | 2500 | 330                | 12.5            | 5.30<br>±<br>0.10 | 5.30<br>±<br>0.10 | 1.25<br>±<br>0.10 | 8.0<br>±0.1 | 12<br>±0.3 | Q1            |



## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Package Type | PCS /Tape Reel | Tape Reel /Inner box | PCS /Inner box | Inner box /Carton | PCS /Carton | W (mm) | L (mm) | H (mm) |
|--------------|----------------|----------------------|----------------|-------------------|-------------|--------|--------|--------|
| QFN32        | 2500           | 2                    | 5000           | 6                 | 30000       | 360    | 360    | 50     |





外箱尺寸:385\*345\*380mm

内盒尺寸:360\*360\*50mm

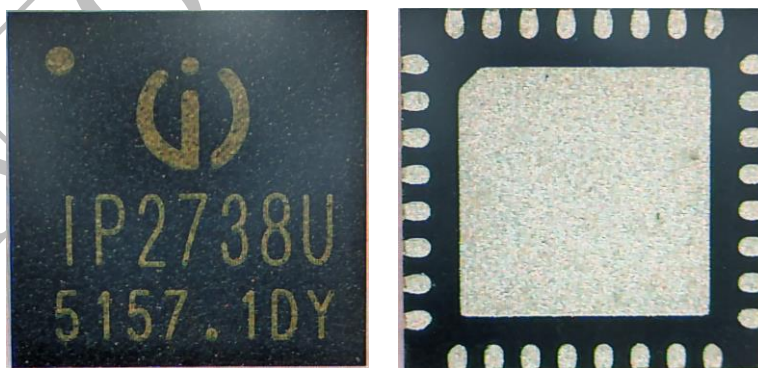
## 12. Marking Specification



说明:

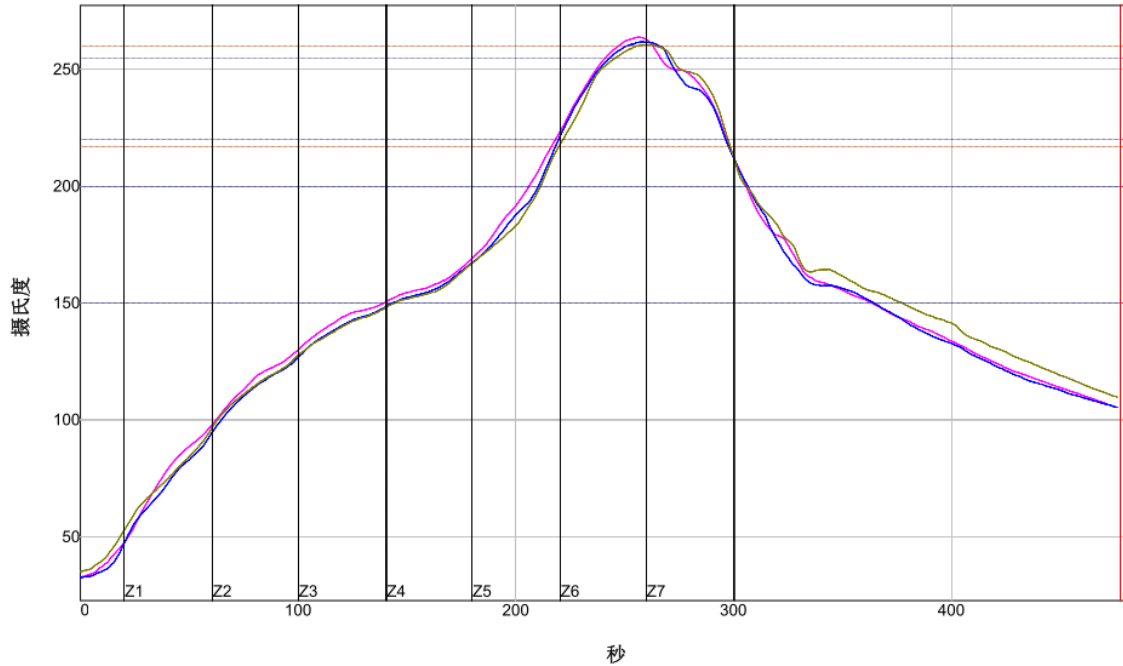
- 1、  —— 英集芯标志
- 2、 IP2738U —— 产品型号
- 3、 XXXXXXXXX —— 生产批号
- 4、  —— Pin 1脚位置标识

## 13. Picture of Material Object



## 14. Solder Instruction

| 温度设置 (摄氏度)    |      |     |     |     |     |     |     |
|---------------|------|-----|-----|-----|-----|-----|-----|
| 温区            | 1    | 2   | 3   | 4   | 5   | 6   | 7   |
| 上温区           | 130  | 140 | 160 | 160 | 200 | 320 | 265 |
| 下温区           | 130  | 140 | 160 | 160 | 200 | 320 | 265 |
| 传送带速度 (公分/分): | 39.0 |     |     |     |     |     |     |



| PWI=75% | 最高上升斜率 | 预热150至200C |       | 最高温度 | 总时间 /217C | 斜率1 (217-260C) | 预热220至255C-(2) |      | 总时间 /260C-2 | 距峰值5C区域时间 |       |      |       |      |       |      |
|---------|--------|------------|-------|------|-----------|----------------|----------------|------|-------------|-----------|-------|------|-------|------|-------|------|
| VP 1    | 1.69   | -31%       | 66.21 | -59% | 263.87    | 18%            | 80.99          | -70% | 1.70        | -30%      | 22.81 | -36% | 15.90 | -30% | 18.13 | -75% |
| VP 2    | 1.99   | -1%        | 66.91 | -54% | 261.84    | -9%            | 78.97          | -73% | 1.87        | -13%      | 23.44 | -33% | 15.74 | -31% | 23.64 | -31% |
| VP 3    | 1.83   | -17%       | 66.61 | -56% | 260.76    | -23%           | 78.19          | -74% | 1.88        | -12%      | 23.97 | -30% | 9.37  | -66% | 23.95 | -28% |
| 温差      | 0.30   |            | 0.70  |      | 3.11      |                | 2.80           |      | 0.18        |           | 1.16  |      | 6.53  |      | 5.82  |      |

制程界限:

| 统计数名称   | 最低界限 | 最高界限 | 单位    |
|---|------|------|-------|
| 锡膏: 260   |      |      |       |
| 最高温度上升斜率 (目标=2.0)<br>(计算斜率的时间距离= 20 秒)                | 1.0  | 3.0  | 度/秒   |
| 斜率1 (目标=2.0)<br>介于 217.0 和 260.0<br>(计算斜率的时间距离= 10 秒) | 1.0  | 3.0  | 度/秒   |
| 预热时间150-200摄氏度  | 60   | 90   | 秒     |
| 预热时间220-255摄氏度-(2)                                    | 10   | 50   | 秒     |
| 最高温度  | 255  | 270  | 度 摄氏度 |
| 在217摄氏度以上时间   | 60   | 200  | 秒     |
| 在260摄氏度以上时间-(2)                                       | 3    | 40   | 秒     |
| 距峰值5C区域时间   | 15   | 40   | 秒     |

## 15. IMPORTANT NOTICE

INJOINIC TECHNOLOGY and its subsidiaries reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to INJOINIC TECHNOLOGY's terms and conditions of sale supplied at the time of order acknowledgment.

INJOINIC TECHNOLOGY assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using INJOINIC TECHNOLOGY's components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of INJOINIC TECHNOLOGY's components in its applications, notwithstanding any applications-related information or support that may be provided by INJOINIC TECHNOLOGY. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify INJOINIC TECHNOLOGY and its representatives against any damages arising out of the use of any INJOINIC TECHNOLOGY's components in safety-critical applications.

Reproduction of significant portions of INJOINIC TECHNOLOGY's information in INJOINIC TECHNOLOGY's data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. INJOINIC TECHNOLOGY is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

INJOINIC TECHNOLOGY will update this document from time to time. The actual parameters of the product may vary due to different models or other items. This document voids all express and any implied warranties.

Resale of INJOINIC TECHNOLOGY's components or services with statements different from or beyond the parameters stated by INJOINIC TECHNOLOGY for that component or service voids all express and any implied warranties for the associated INJOINIC TECHNOLOGY's component or service and is an unfair and deceptive business practice. INJOINIC TECHNOLOGY is not responsible or liable for any such statements.