

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

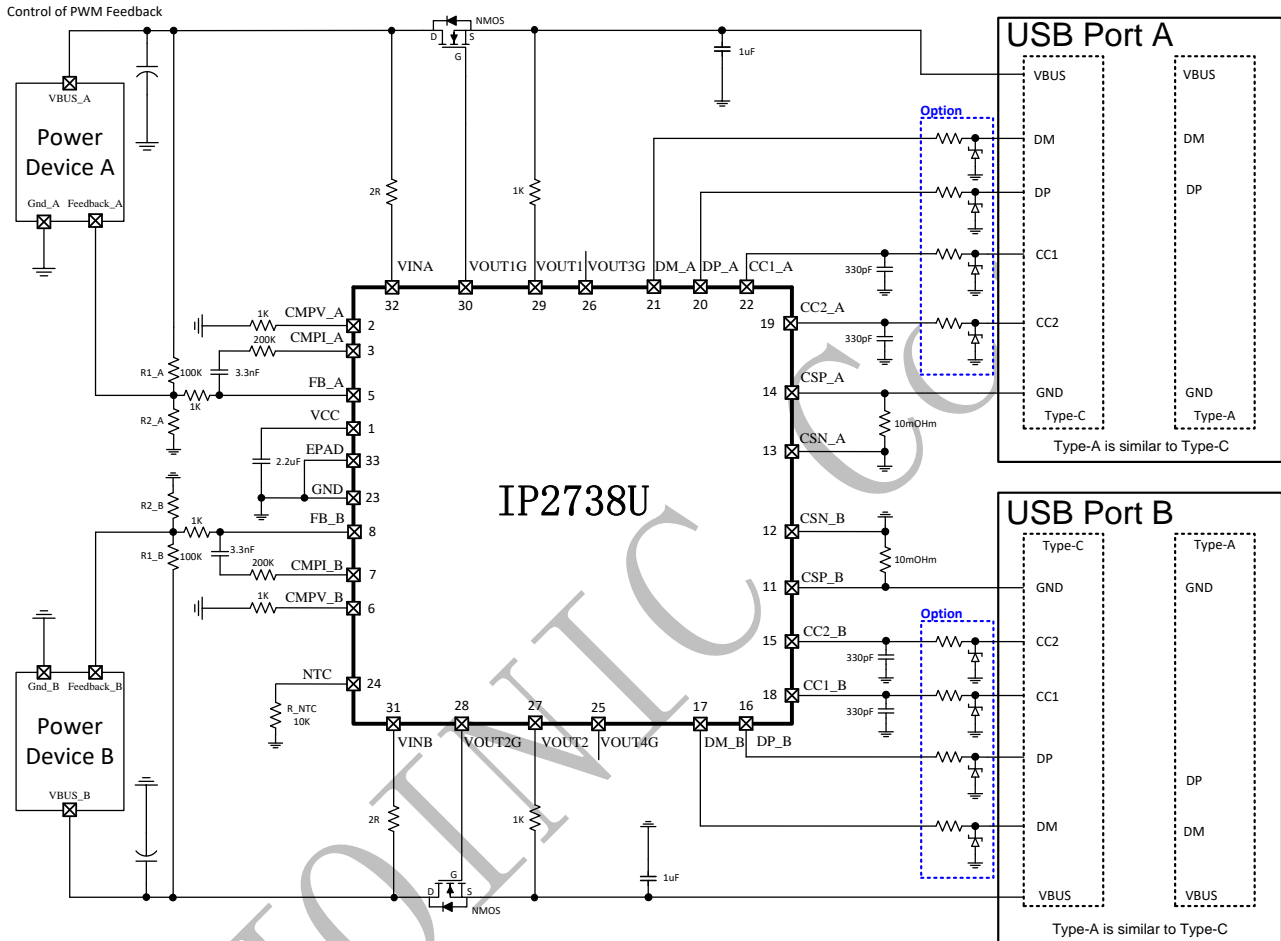


Figure 5-1. Typical application schematic of independent control of PWM controller feedback

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

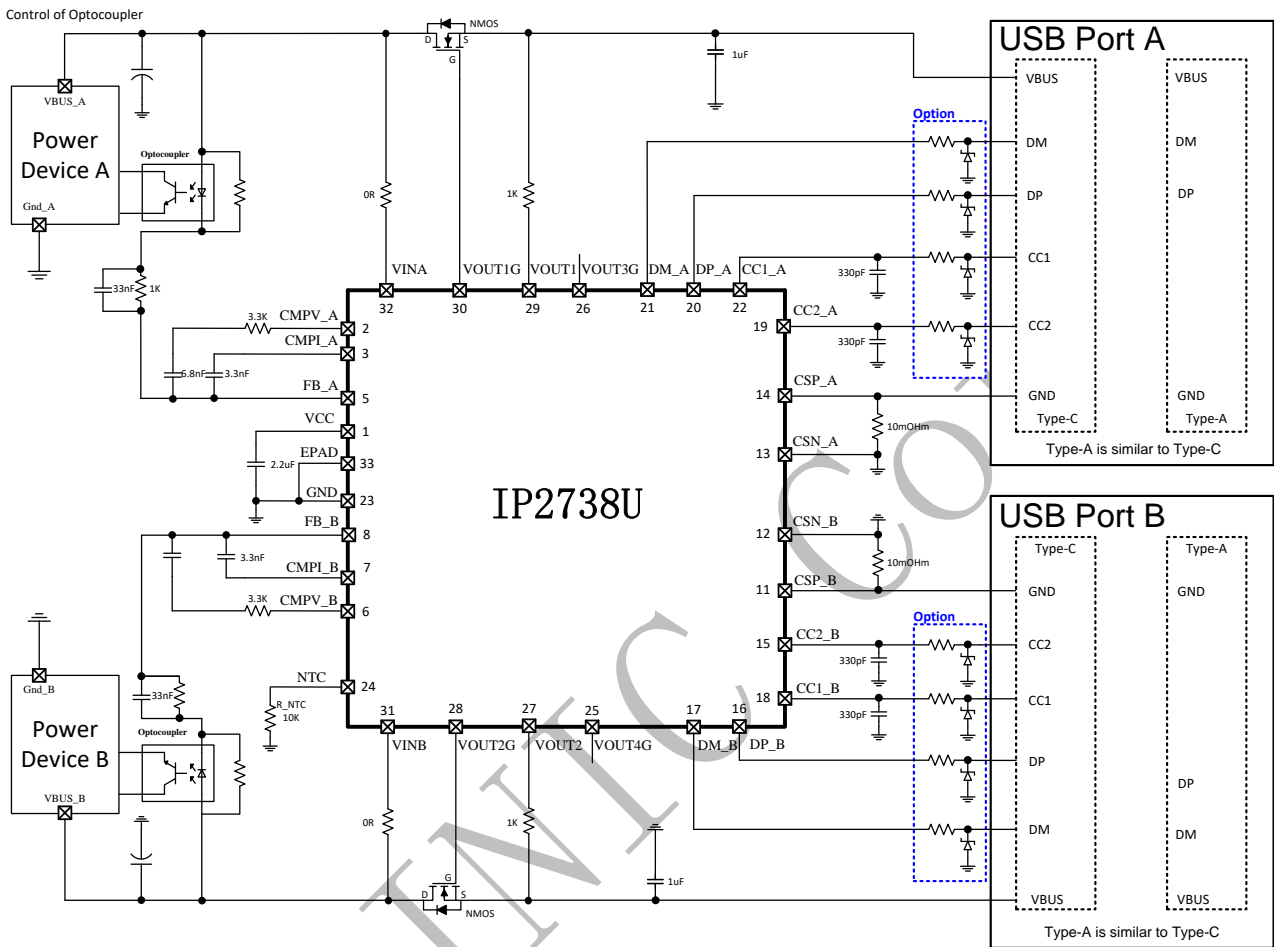


Figure 5-2. Typical application schematic of independent control of optocoupler

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

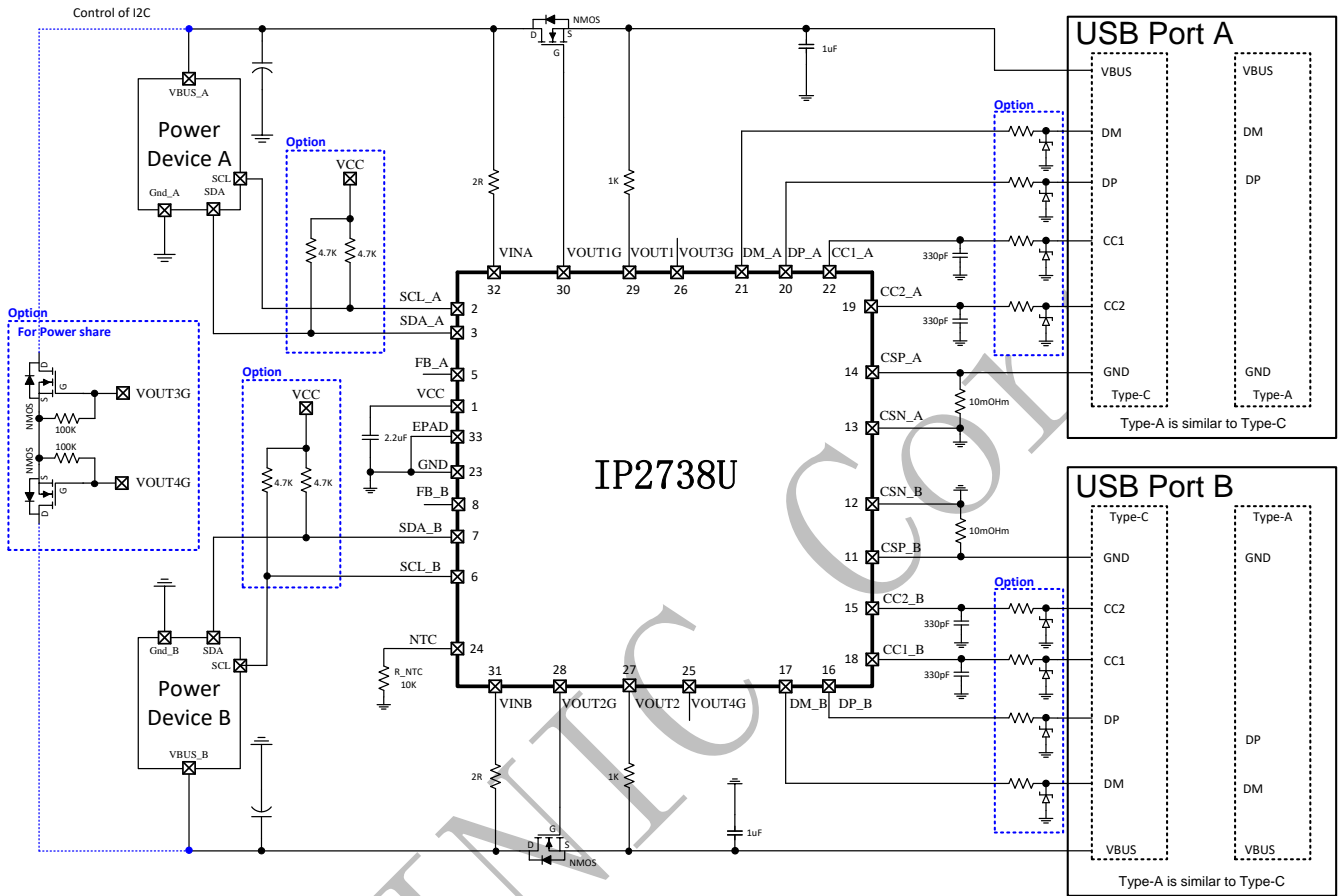


Figure 5-3. Typical application schematic of independent control of I2C

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

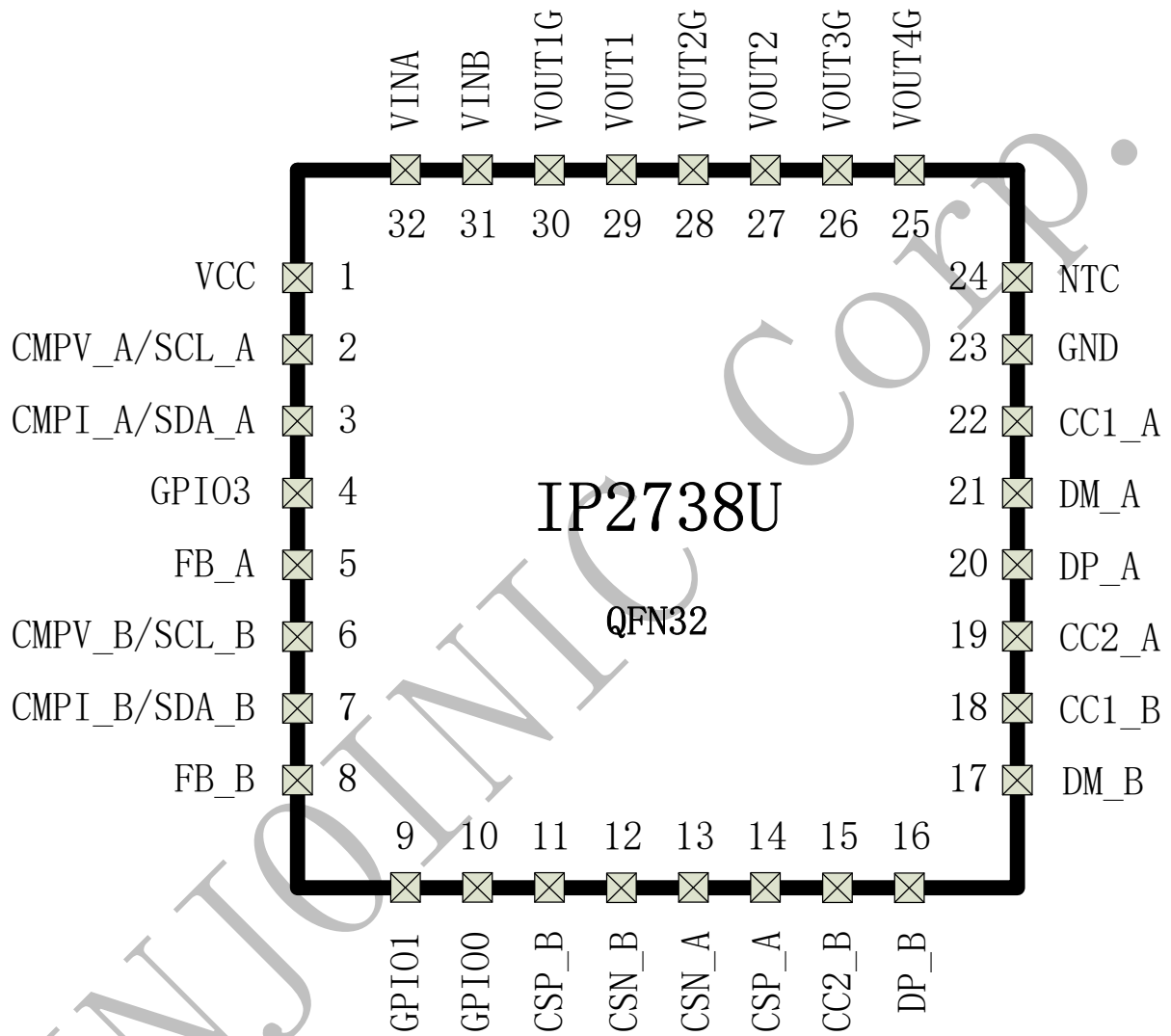


Figure 6-1. Pin Assignment (Top view)

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 _{DP_A} , V _{DM_A}	-0.3 ~ 30	V
DP_B, DM_B Input Voltage Range	V _{DP_B} , V _{DM_B}	-0.3 ~ 30	V
CC1_A, CC2_A Input Voltage Range	V _{CC1_A} , V _{CC2_A}	-0.3 ~ 30	V
CC1_B, CC2_B Input Voltage Range	V _{CC1_B} , V _{CC2_B}	-0.3 ~ 30	V
FB_A, FB_B Input Voltage Range	V _{FB_A} , V _{FB_B}	-0.3 ~ 30	V
Other Pins Input Voltage Range		-0.3 ~ 6	V
Junction Temperature Range	T _J	-40 ~ 150	°C
Storage Temperature Range	T _{stg}	-60 ~ 150	°C
Lead Temperature Range (Soldering, 10sec)	T _s	260	°C
Ambient Temperature	T _A	-40~120	°C
Package Thermal Resistance	θ _{JA}	90	°C/W
Package Thermal Resistance	θ _{JC}	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 _A	-20		115	°C

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

9. Electrical Characteristics

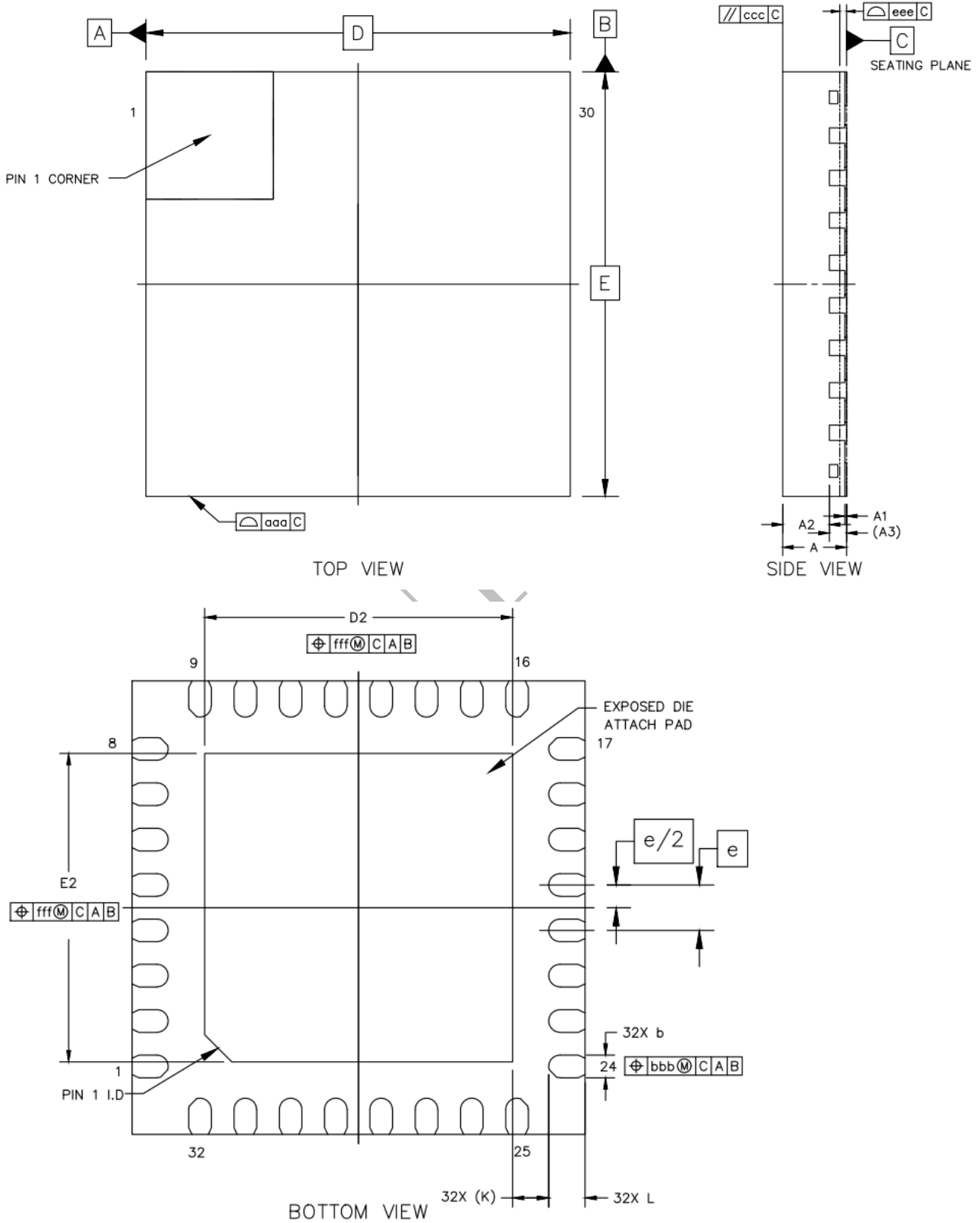
Unless otherwise specified, T_A = 25 °C

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
TYPE-C						
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
HVDCP (QC2.0&QC3.0&QC3+)						
Data Detect Voltage Threshold	V _{DATA_REF}		0.25	0.325	0.4	V
DP High Glitch Filter Time	T _{GLITCH(BC)_DP_H}		1000	1250	1500	ms
DM Low Glitch Filter Time	T _{GLITCH(BC)_DM_L}			2		ms
Output Voltage Glitch Filter Time	T _{GLITCH(V)_CHANGE}		20	40	60	ms
Continuous Mode Glitch Filter Time	T _{GLITCH_CONT_CHANGE}		100		200	us
DM Pull-down Resistance	R _{DM_DOWN}	VDP=0.6V		20		kOhm
DP Pull-down Resistance	R _{DAT_LKG}	VDP=0.6V		768		kOhm
DCP						
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
GPIO						
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
I2C						
F _{I2C}	Bit rate		100		400	KHz

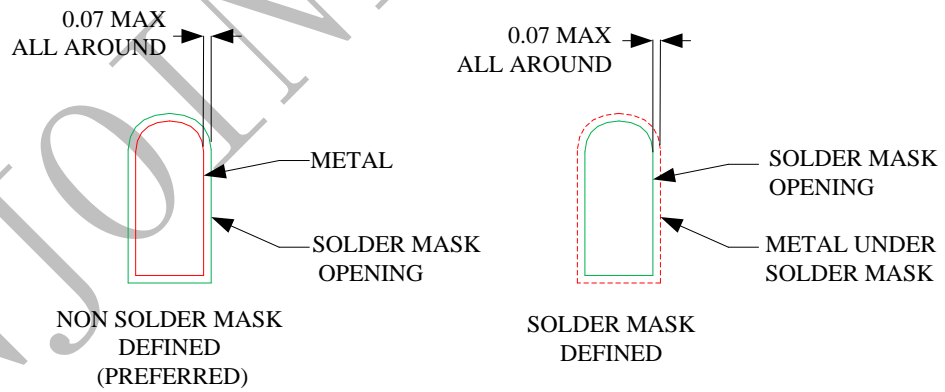
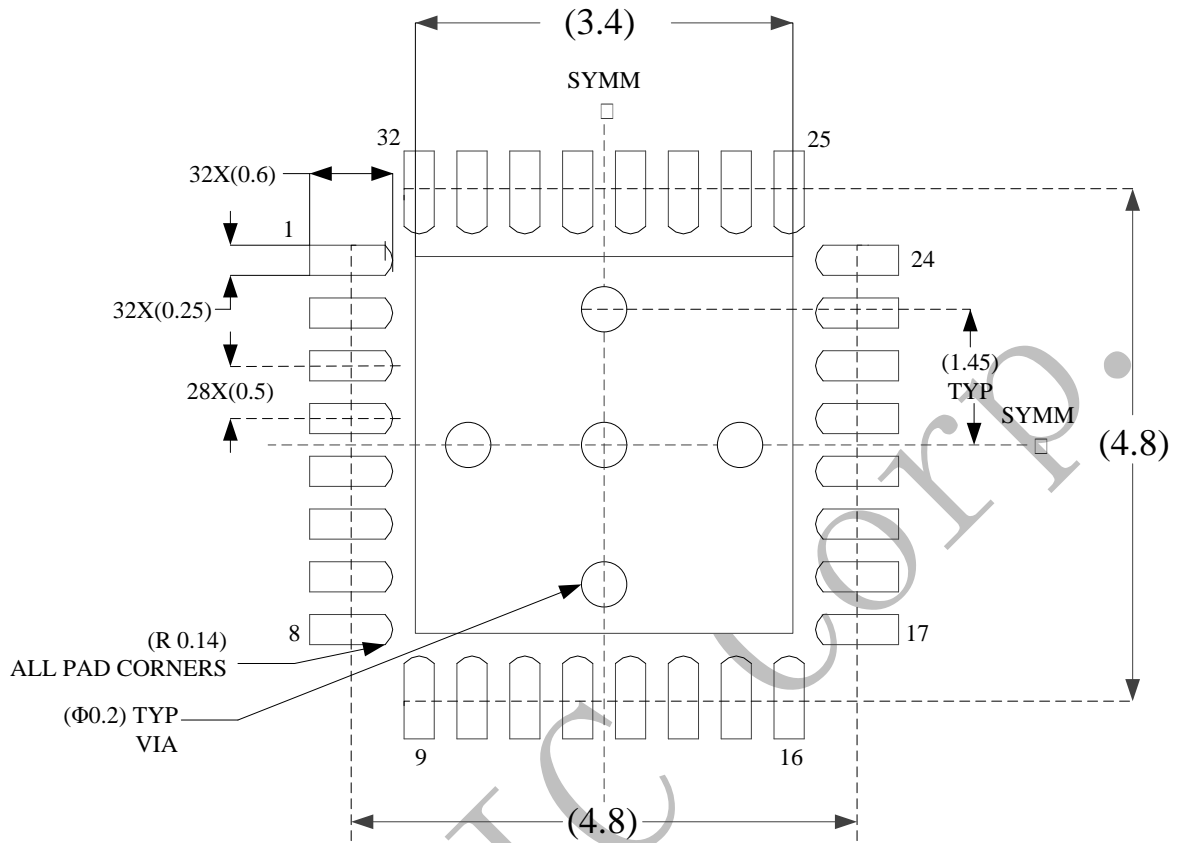
INJOINIC Corp.

10. Package



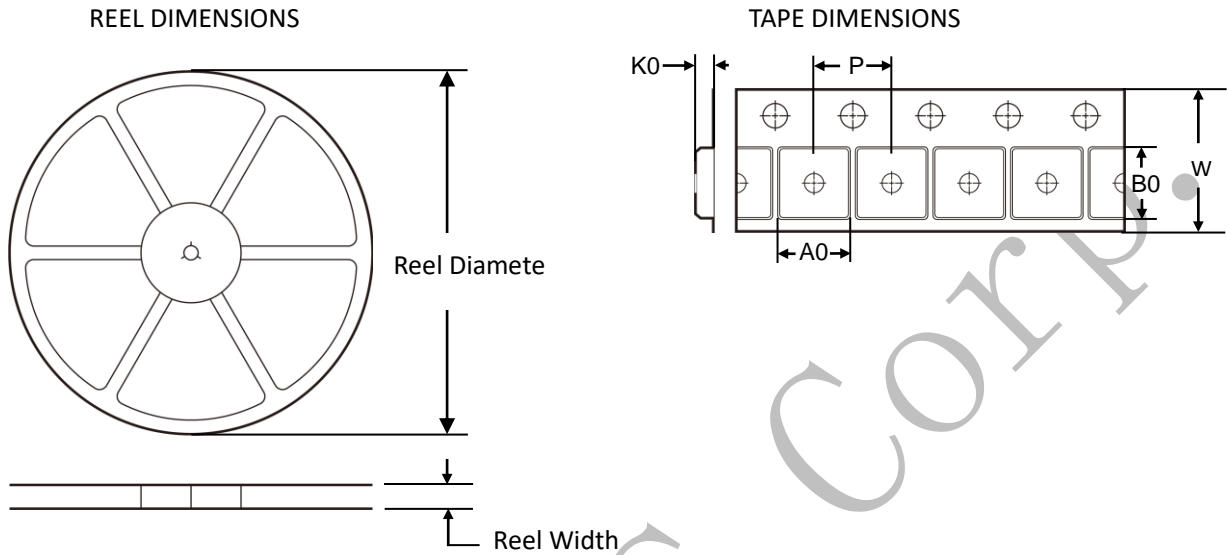
		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.55	---
L/F THICKNESS		A3	0.203 REF		
LEAD WIDTH		b	0.18	0.25	0.3
BODY SIZE	X	D	4.9	5 BSC	5.1
	Y	E	4.9	5 BSC	5.1
LEAD PITCH		e	0.5 BSC		
EP SIZE	X	D2	3.3	3.4	3.6
	Y	E2	3.3	3.4	3.6
LEAD LENGTH		L	0.3	0.4	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

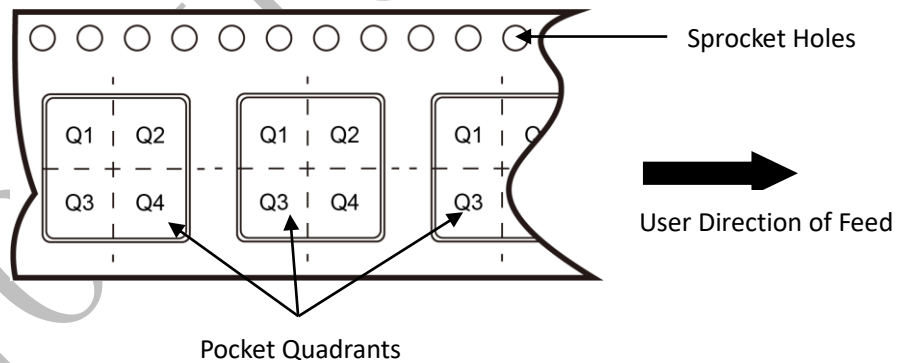


SOLDER MASK DETAILS

11. Tape and Reel Information



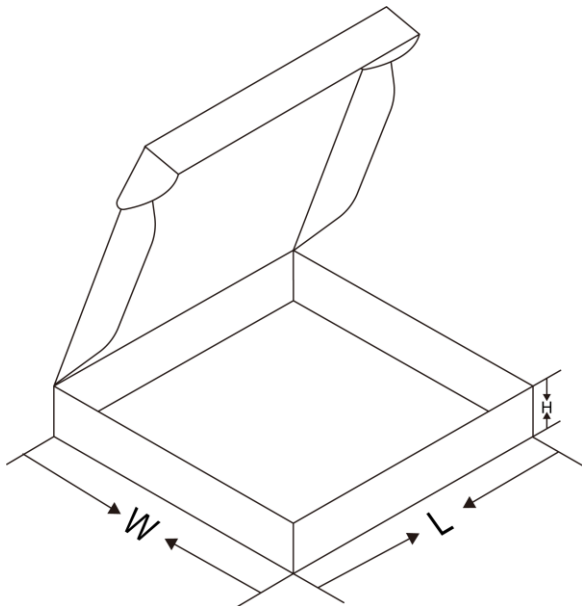
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE IS Q1



* 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 ± 0.10	5.30 ± 0.10	1.25 ± 0.10	8.0 ±0.1	12 ±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

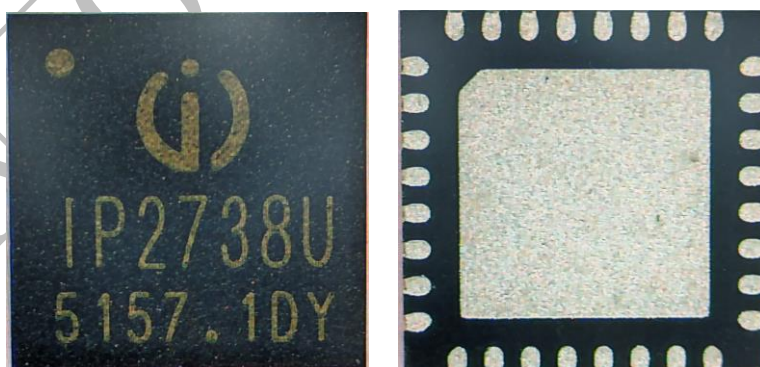
12. Marking Specification



说明:

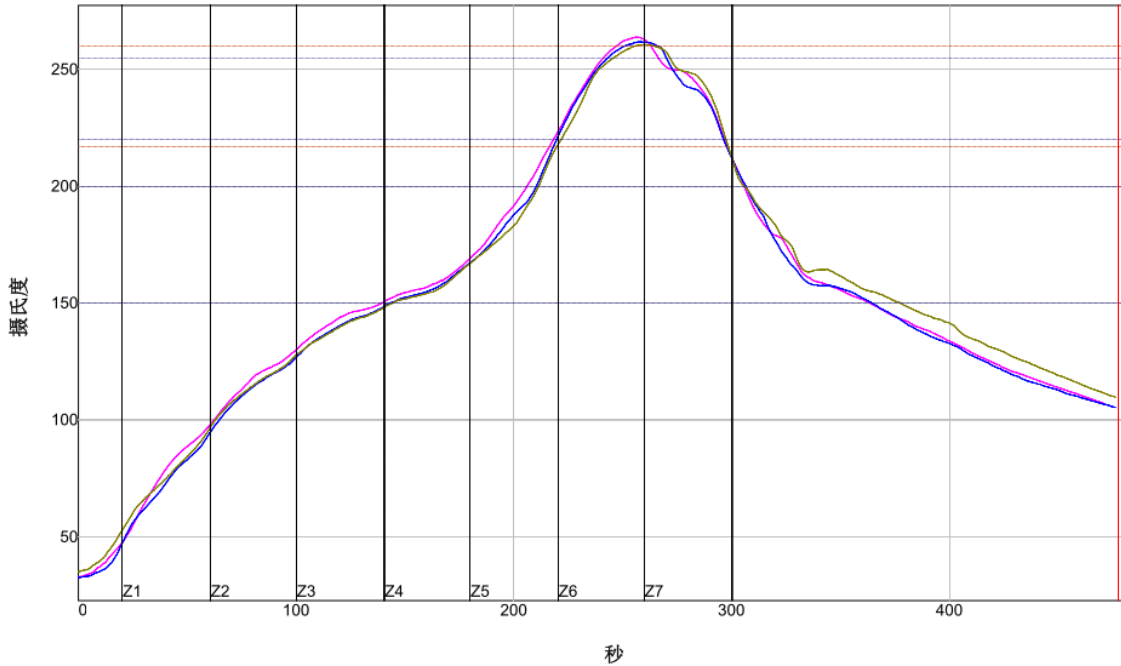
- 1、  ——英集芯标志
- 2、 IP2738U ——产品型号
- 3、 XXXXXXXXX ——生产批号
- 4、  ——Pin 1脚位置标识

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		总共时间 /217C		斜率1 (217-260C)		预热220至255C-(2)		总共时间 /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) (计算斜率的时间距离= 20 秒)	1.0	3.0	度/秒
斜率1 (目标=2.0) 介于 217.0 和 260.0 (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.