Fast Charging Physical Layer IC for USB Interfaces

TypeC PD2.0/PD3.0/PPS,QC3.0/QC2.0,FCP,SCP,AFC, Apple 2.4A, BC1.2

1. Features

- Support charging standards including :
  - Support QC4/QC4+
    - Compatible with QC2.0/QC3.0
    - Support Class B
  - USB PD2.0/PD3.0/PPS DFP
  - SCP, FCP
  - AFC
  - MTK PE+ 1.1&2.0
  - Apple 2.4A, Samsung 2.0A and BC1.2
- Support USB PD2.0/PD3.0/PPS
  - USB PD3.0 with PPS Certificate Number：TID:3135
  - Auto detect USB PD device plug in or out
  - Configurable SRC_CAP package broadcast
- Support Samsung® AFC
- Support Huawei® SCP (option)
- Support Huawei® FCP
- Support Apple 2.4A: DP=2.7V, DM=2.7V
- Support Samsung 2.0A: DP=1.2V, DM=1.2V
- Support BC1.2: DP short DM automatically
- Default 5 V mode operation
- Support NTC protection
- Support 100KHz~400KHz IIC interface
- Support DP,DM,CC1,CC2 overvoltage protection
- Support DP,DM weak short to GND protection
- VIN working voltage: 3.3V~30V
- Package: QFN24

2. Description

IP2723T is a fast charging Physical Layer IC dedicated for USB ports, which supports 11 kinds of fast charging standards, including USB PD2.0/PD3.0 /PPS (Programmable Power Supply), HVDCP QC2.0/QC3.0 (Quick Charge), AFC (Samsung® Adaptive Fast Charge)，SCP (Hisilicon® Super Charge Protocol) and FCP (Hisilicon® Fast Charge Protocol), MTK PE+ 1.1&2.0，Apple 2.4A, Samsung 2.0A and BC1.2.

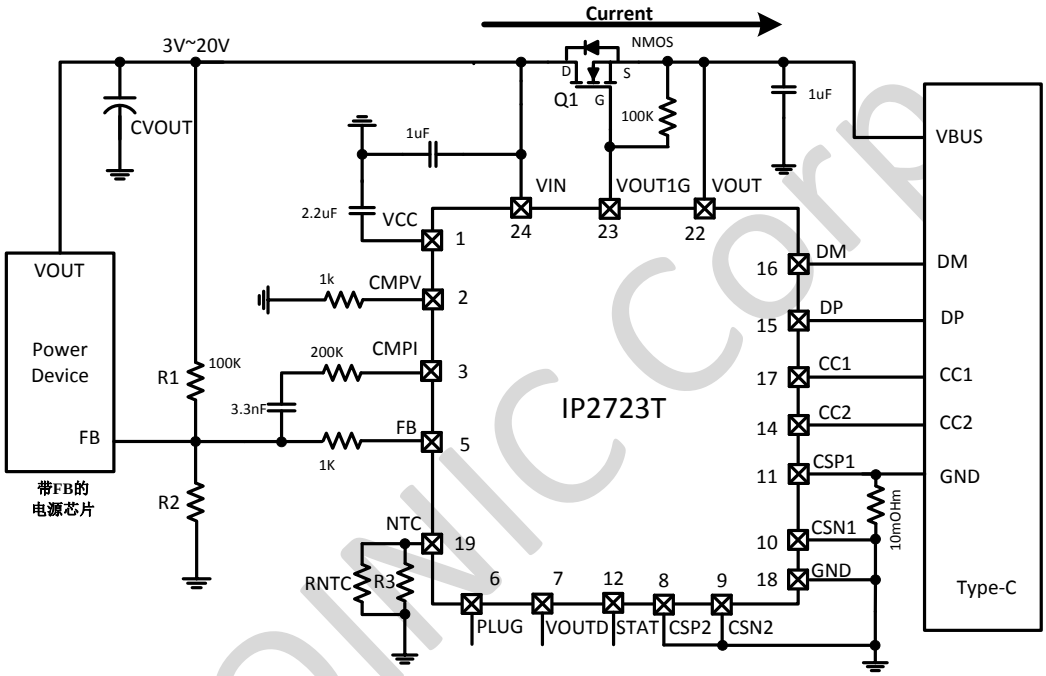
IP2723T support automatically detecting the connected device's type and switching standards type to responding for fast charging requirements.

3. Typical Applications

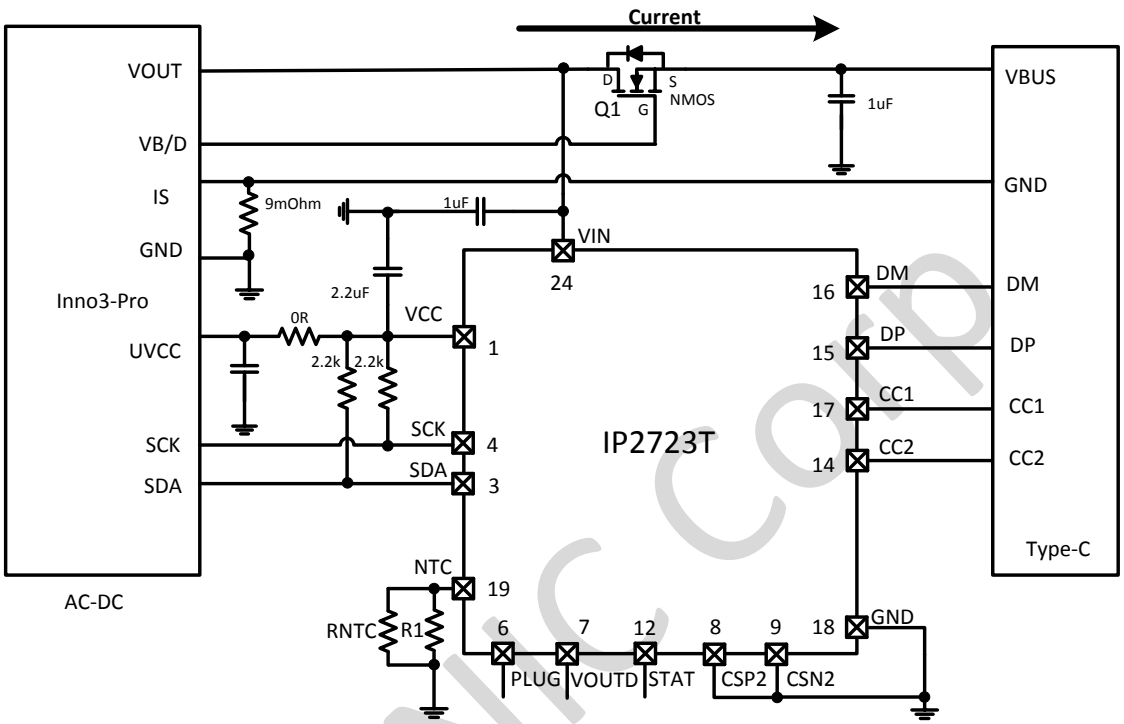
- USB power output ports for AC adapters, Power Banka, Car chargers
- Battery chargers for smart phones, tablets, netbooks, digital cameras, and Bluetooth accessories

4. Typical Application Schematic

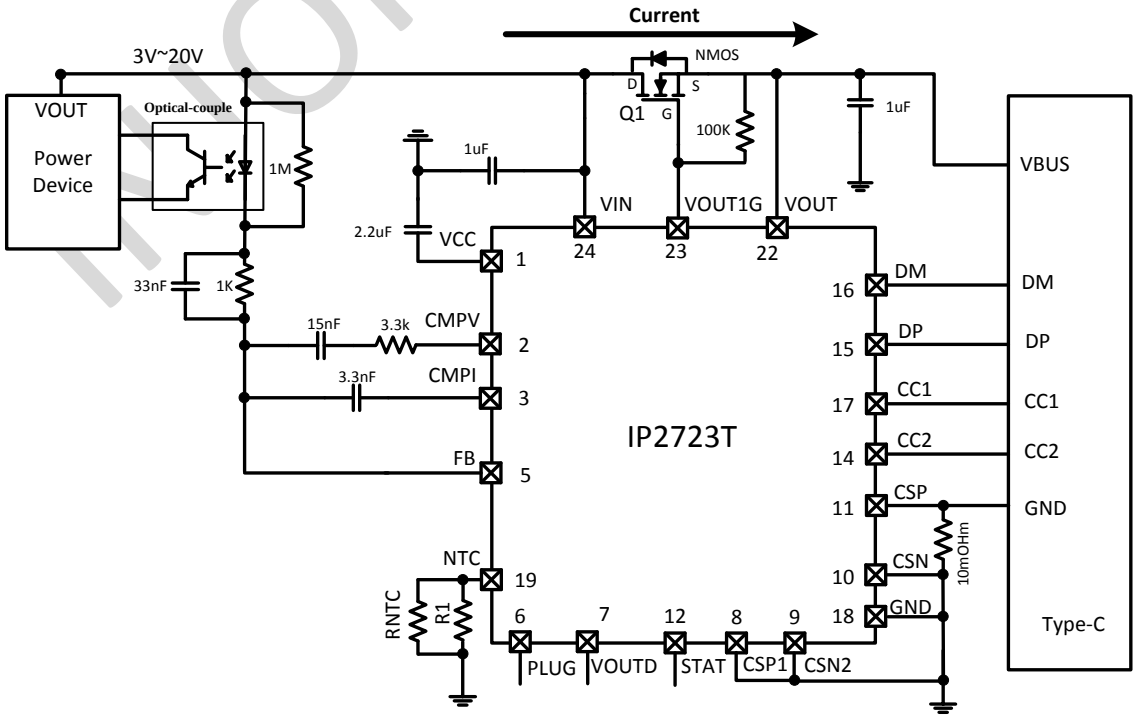
FB MODE



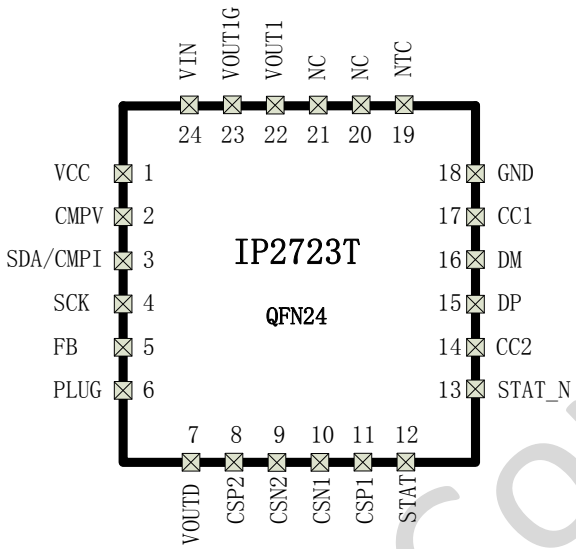
I2C MODE



Optocoupler MODE

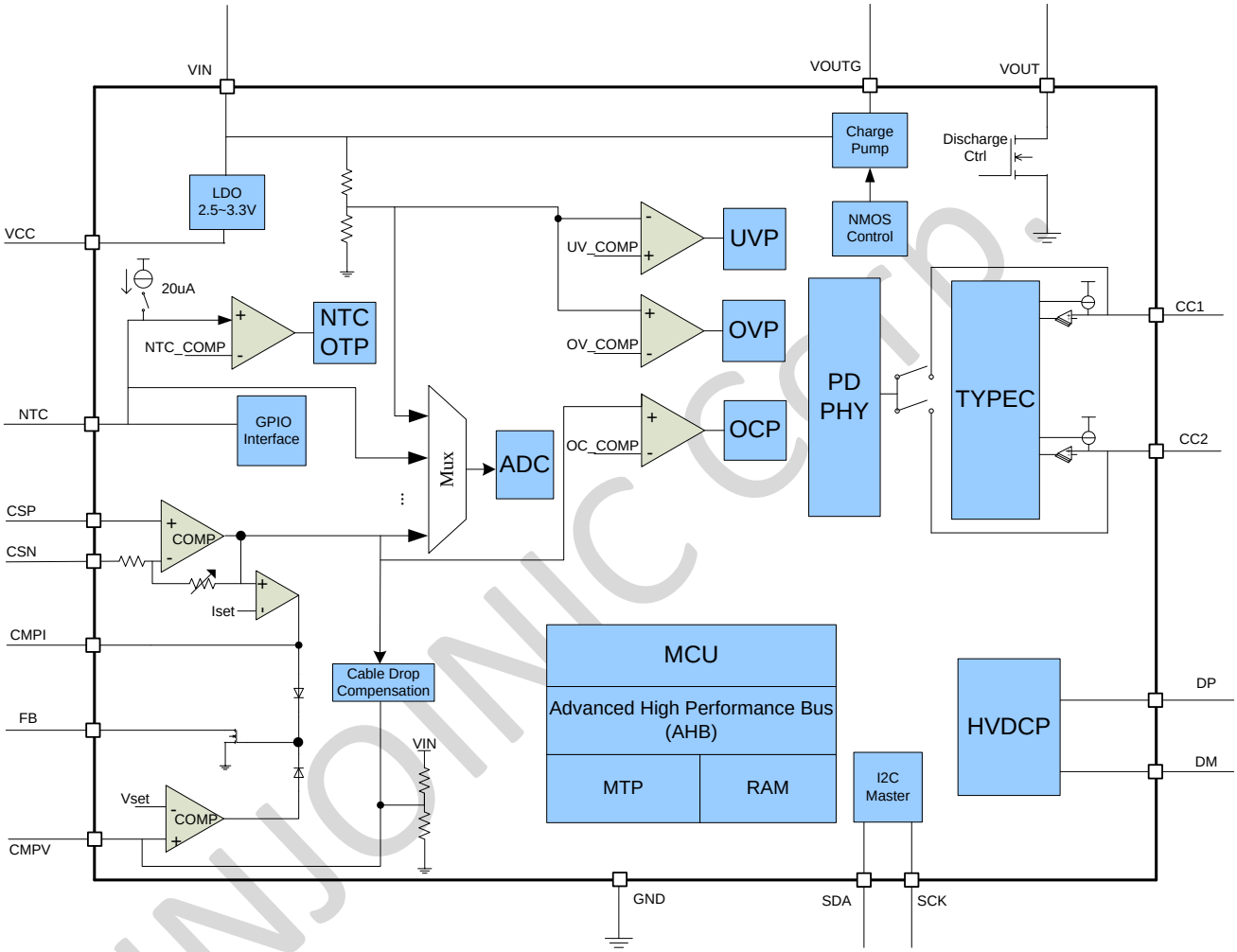


5. PIN Description



Pin No.	Pin name	Pin description
1	VCC	VCC Internal power supply output, need external 2.2 uF capacitance
2	CMPV	Feedback loop compensation of voltage
3	CMPI/SDA	Feedback loop compensation of current/I2C data
4	SCK	I2C clock
5	FB	Feedback PIN. Connect to the FB line of Regulator to the power device with FB control, current source/sink for voltage regulation
6	PLUGIN/GPIO2	General purpose IO2
7	VOUTD/GPIO1	Discharge Control /General purpose IO1
8	CSP2	ground
9	CSN2	ground
10	CSN1	Current sense negative PIN
11	CSP1	Current sense positive PIN
12	STAT	TypeC Connection Flag, Output Low Attached; Output High Detached
13	STAT_N	TypeC Connection Flag, Output High Attached; Output Low Detached
14	CC2	Type-C CC2 line
15	DP	USB DP data line
16	DM	USB DM data line
17	CC1	Type-C CC1 line
18	GND	ground
19	NTC	NTC Resistor input for temperature sense
20	NC	Not connect
21	NC	Not connect
22	VOUT	VOUT discharge pin
23	VOUTG	VOUT output path control on the NMOS
24	VIN	Power input

6. Internal Block Diagram



7. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
VIN Input Voltage Range	VIN	-0.3 ~ 30	V
VOUT Input Voltage Range	VOUT	-0.3 ~ 30	V
VOUTG Input Voltage Range	VOUTG	-0.3 ~ 30	V
VCC Input Voltage Range	VCC	-0.3 ~ 6	V
DP, DM Input Voltage Range	V_{DP}, V_{DM}	-0.3~25	V
CC1,CC2 Input Voltage Range	V_{CC1}, V_{CC2}	-0.3~30	V
Other Pins Input Voltage Range	V_{other}	-0.3~6	V
Junction Temperature Range	T_J	-40 ~ 150	℃
Storage Temperature Range	T_{STG}	-60 ~ 150	℃
Lead Temperature Range	T_s	260	℃

(Soldering, 10sec)			
Package Thermal Resistance	θ_{JA}	90	℃
Package Thermal Resistance	θ_{JC}	39	℃
Human Body Model (HBM)	ESD	2	**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	VIN	3		25	V
Ambient Temperature	T_A	-40		85	℃

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

9. Electrical Characteristics

Unless otherwise specified, T A =25℃

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage	VIN	Supplied directly	3		25	V
Input UVLO Threshold	UVLO	VIN/VCC Falling	2.5		2.9	V
Output Voltage Range	VOUT		3		21	V
Output Voltage Range Accuracy	△VOUT		-3		3	%
OVP Voltage point	V_{OVP}	VOUT=5V	6.0	6.2	6.7	V
		VOUT=9V	10.8	11	11.5	V
OCP current point	I_{OCP}	Rs=10mR	0.2		6.4	A
OCP current point accuracy	$\triangle I_{OCP}$	Rs=10mR	-150		+150	mA
Quiescent Current	I_{NOR}	No load, CC pin floating, VIN=5V	3	4	5	mA
	I_{STDBY}	MCU OFF, Standby mode, CC pin floating, VIN=5V	0.6	1.2	1.4	mA
HVDCP (QC2.0&QC3.0)						
Data Detect Voltage Threshold	V_{DATA_REF}		0.25	0.325	0.4	V

Output Voltage Selection Reference	V_{SEL_REF}		1.8	2	2.2	V
DP High Glitch Filter Time	$T_{GLITCH(BC)\_DP\_H}$		1000	1250	1500	ms
DM Low Glitch Filter Time	$T_{GLITCH(BC)\_DM\_L}$		1	2	3	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 and DP Short Resistance	R_{SHORT}	V_{DP}=0.6V	20	30	40	Ohm
DM Pull-down Resistance	R_{DM_DOWN}	V_{DP}=0.6V	14.25	20	24.8	kOhm
DP Pull-down Resistance	R_{DAT_LKG}	V_{DP}=0.6V	200	500	800	kOhm
DCP						
Samsung DP/DM Output Voltage			1.08	1.2	1.32	V
Samsung DP/DM Output Impedance			70	100	130	kOhm
Apple 2.4A DP/DM Output Voltage			2.64	2.7	2.76	V
Apple 2.4A DP/DM Output Impedance			20	30	40	kOhm
NTC						
NTC OTP Current Source	I_{OTP}		19.4	20	20.6	uA
NTC OTP Voltage Threshold	V_{OTP}		0.1		3	V

10. Function Description

DP/DM Quick Charge

IP2723T can automatically detects Quick Charge 2.0/3.0 capable devices with handshake by USB D+/D- data line. It's also complaint with BC1.2.

- BC1.2: Shorting D+ Line to D- Line.
- Quick Charge 2.0/3.0: D+ and D- line configuration see **Table 1**.

Table 1 QC2.0/3.0 DP/DM configuration:

DP	DM	Result(Class A)	Result(Class B)
0.6 V	GND	5 V	5 V
3.3 V	0.6 V	9 V	9 V

0.6 V	0.6 V	12 V	12 V
0.6 V	3.3 V	Continue Mode	Continue Mode
3.3 V	3.3 V	Keep	20V

TYPE-C /PD

The USB Type-C connector uses CC pins for configuration including the ability for a Source to advertise to its port partner (Sink) the amount of current it can apply:

- Default values defined by the USB Specification (500 mA for USB 2.0 ports, 900 mA for USB 3.1 ports)
- 1.5A
- 3.0A

Integrated with certification standard USB Power Delivery (PD) controller

Support PD2.0/PD3.0/PPS

PDO and PPS can be configured according to customer requirements.

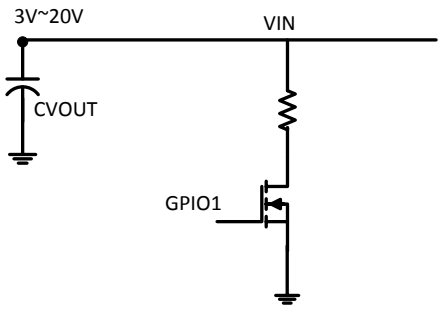
Discharge

When the output voltage is adjusted from high voltage to low voltage, especially from 20V to 5V, it requires a discharge current to fulfill the transition time specification of PD, and it cannot be greater than 285mS.

The internal 400ohm pull-down resistor is turned on, when the output voltage needs to be quickly discharged.

If the capacitance is relatively large and the internal bleeder is not enough, VOUTD/GPIO1 can control the external NMOS to strengthen the bleed.

The resistance value is based on the actual situation.



Voltage regulation mode

- **FB Mode**

IP2723T integrated FB control line used for accurate voltage regulation by source/sink current with precise 2uA/step in minimum. FB sink 40uA current for 9V output voltage; FB sink 70uA current for 12V output voltage; FB sink 150uA current for 20V output voltage; when the output voltage is default 5V, FB neither source nor sink current.

In typical applications, IP2723T FB connects to the regulator's FB line, resistor (R1) between VOUT and FB should apply 100kOhm with high precision (1%), resistor (R2) value between FB and GND should refer to the regulator adopted, resistance of R2 can be calculated by equation:

$$VFB = \frac{VOUT}{R1 + R2} * R2$$

➢ Optocoupler Mode

IP2723T integrates an optocoupler driver circuit, and the FB pin is connected to the Cathode end of the optocoupler for use in isolated power supplies. The value of external compensation network capacitance, resistance of CMPV and CMPI needs to be adjusted according to the specific parameters of the front-end power network, The CMPV compensation network is used to achieve VOUT output voltage stability. The CMPI compensation network is used to achieve stability of power control.

➢ I2C Mode

IP2723T integrate I2C master control interface, can cooperate with the power supply chip, such as Inno3 pro etc.

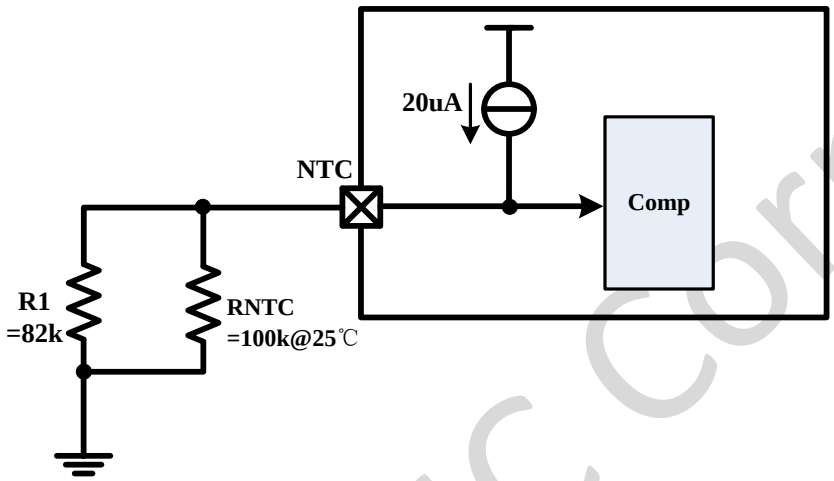
Cable Drop Compensation

IP2723T integrates the line compensation function, which can increase the output voltage in a certain proportion according to the current output current to compensate for linear loss. FB mode and Optocoupler mode can be increased according to the compensation coefficients of 0mV/A, 62.5mV/A, and 125mV/A.

For example, if the compensation coefficient of 125mV/A is selected, if the no-load output voltage is 5.0V, then the actual output voltage=5.0V+3A*125mV/A=5.375V when the output current is 3A

Protections

➢ NTC



IP2723T support NTC function used for temperature detection. NTC pin output 20uA current then detect the voltage on NTC pin to determine the present temperature.

➢ OVP and UVP

IP2723T realizes over-voltage and under-voltage protection functions by detecting the voltage of VIN. The over-voltage threshold (100%~140%) and the under-voltage threshold (0~100%) can be flexibly set according to the percentage of the current output voltage. When an abnormal event of over-voltage or under-voltage occurs, the Gate will be pulled low and the external path NMOS transistor will be closed. If the abnormal event disappears, the Type-C handshake and PD communication will be re-established.。

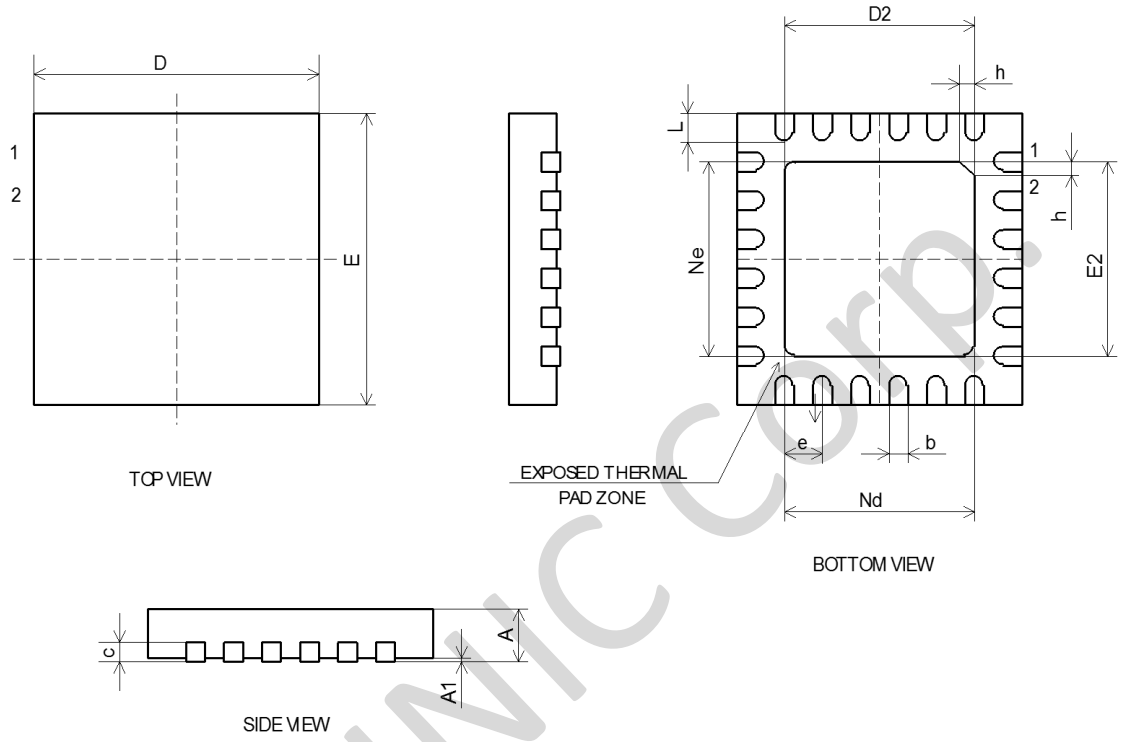
➢ OTP

IP2723T integrates internal junction temperature OTP protection. Junction temperature protection occurs when the junction temperature exceeds 135 ℃

➢ OCP

IP2723T realizes OCP overcurrent protection by detecting the current flowing through the sampling resistor. The overcurrent threshold can be flexibly set (100%~140%). When the current reaches the over-current threshold, the over-current abnormal protection occurs, and the Gate will be pulled low, closing the external path NMOS transistor. If the abnormal event disappears, the Type-C handshake and PD communication will be re-established.

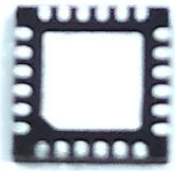
11. Package



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.40	2.50	2.60
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	3.90	4.00	4.10
E2	2.40	2.50	2.60
L	0.35	0.40	0.45
h	0.30	0.35	0.40

12. Marking Specification

The top and bottom pictures of IP2723T are shown as below:

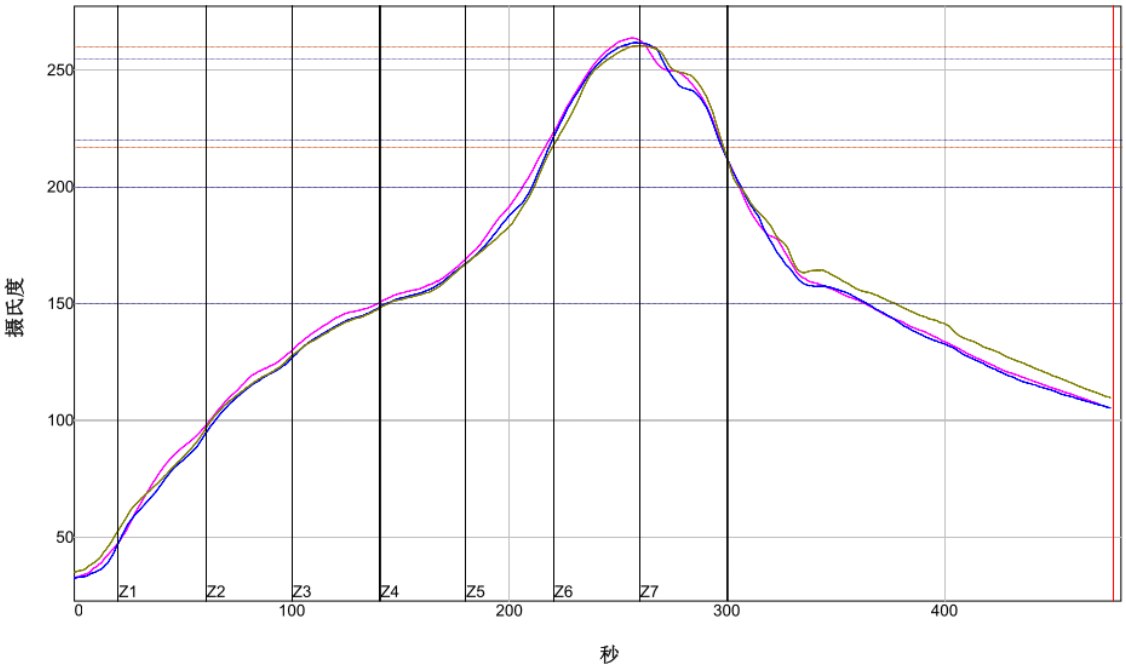


13. Solder Instruction

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:

锡膏: 260

统计数名称	最低界限	最高界限	单位
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

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