10W Fast Charging + Qi BPP Compliant Wireless Power Receiver and Power Supply

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Features

- Single-chip 10W Fast-charging Wireless Power Supply Receiver Solution
  - High Rectifier Efficiency up to 97%
  - Full Synchronous Rectifier
  - Output Voltage Adjustment
  - WPC Qi V1.2.4 Compliant communication
  - Control
  - Only IC Required Between RX Coil and Output
- Support 5W baseline power profile (BPP)
- WPC Qi V1.2.4 FOD Function
  - Highly Accurate Sense
  - Easy to debug for certification by Resistance
- Integrated Programmable Linear Regulator
  - Programmable output voltage: 4~15V
  - Output Current up to 2A
- Supports I^2C Interface
- Bi-directional channel communication
  - ASK modulation for PRx to PTx
  - FSK demodulation for PTx to PRx
- Support external protocol IC(PD/QC/SCP/FCP)
- Multiple General-purpose Input/Output(GPIO)
- Embedded MCU and MTP
- Programmable current limit by Resistance
- Dynamic Rectifier V_{RECT}
  - Improve the Load Transient Response
  - Optimize the dynamic efficiency for full load output
- Over Temperature, Over Voltage and Over Current Protection
- Two LED Indication interface
- Programmable Temperature Control
- Dedicated interface for Adapter or USB Input Application
- QFN 5mm*5mm 40Pin Pack
- WLCSP 3.3mm3.1mm 56 ball

Applications

- WPC compliant receivers
- Fast charging cellphone
- Power bank
- Accessories
- Portable Media players

Description

- The CP2101 is a high efficiency single-chip, advanced, flexible, Qi-compliant wireless power receiver targeted for application up to 10W. It has high integration, low power consumption. The CP2101 receiver the power that uses the near field electromagnetic induction principle, the power transfer is through coupling between the transmitter coil (primary) and receiver coil (secondary), Global feedback is established from the secondary to the primary to control the power transfer process using the Qi V1.2.4 protocol.
- The CP2101 integrated a low resistance synchronous rectifier (AC to DC), low-dropout regulator (LDO), accurate voltage and current loops to improve the high efficiency and decrease the power dissipation. The CP2101 also integrated a MCU as controller which comply with the Qi standard, it can calculate the amount of power received by the mobile device, the controller then communicates this information to the transmitter to allow the transmitter to determine if a foreign object is present within the magnetic interface

and introduces a higher level of safety within magnetic field. This foreign object detection (FOD) method is part of requirement under the WPC Qi specification.

- CP2101 Output stage is LDO with programmable out voltage from 4V to 15V with 100mV step. The output voltage is adjusted dynamically according to the output current to achieve the best transient and efficiency. The CP2101 supports I^2C interface, the host can use the I^2C interface to control the IC's behavior and get required information from the CP2101 to implement the specific application.

Application Schematics

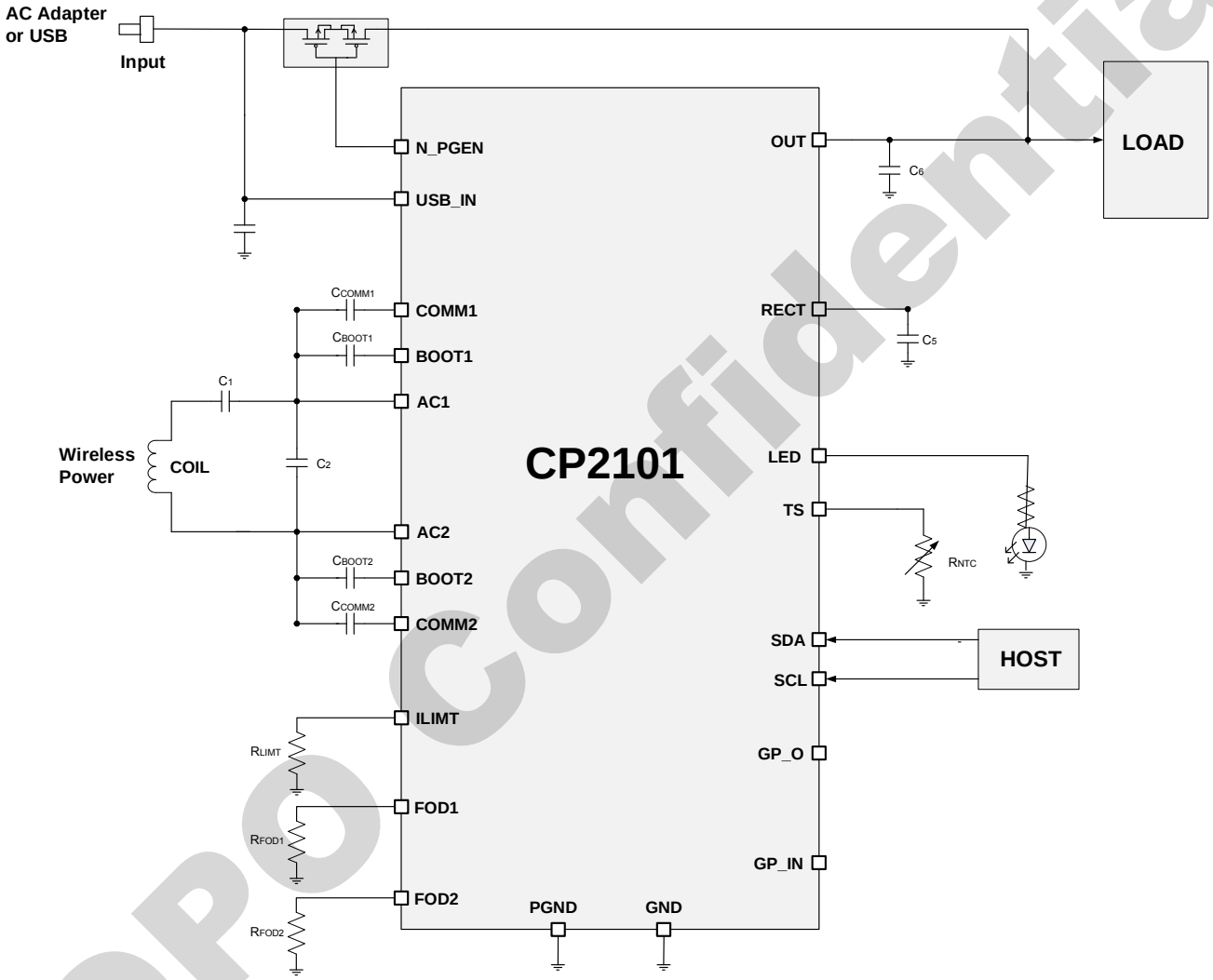


Figure 1. CP2101 application schematics

Simplified Block Diagram

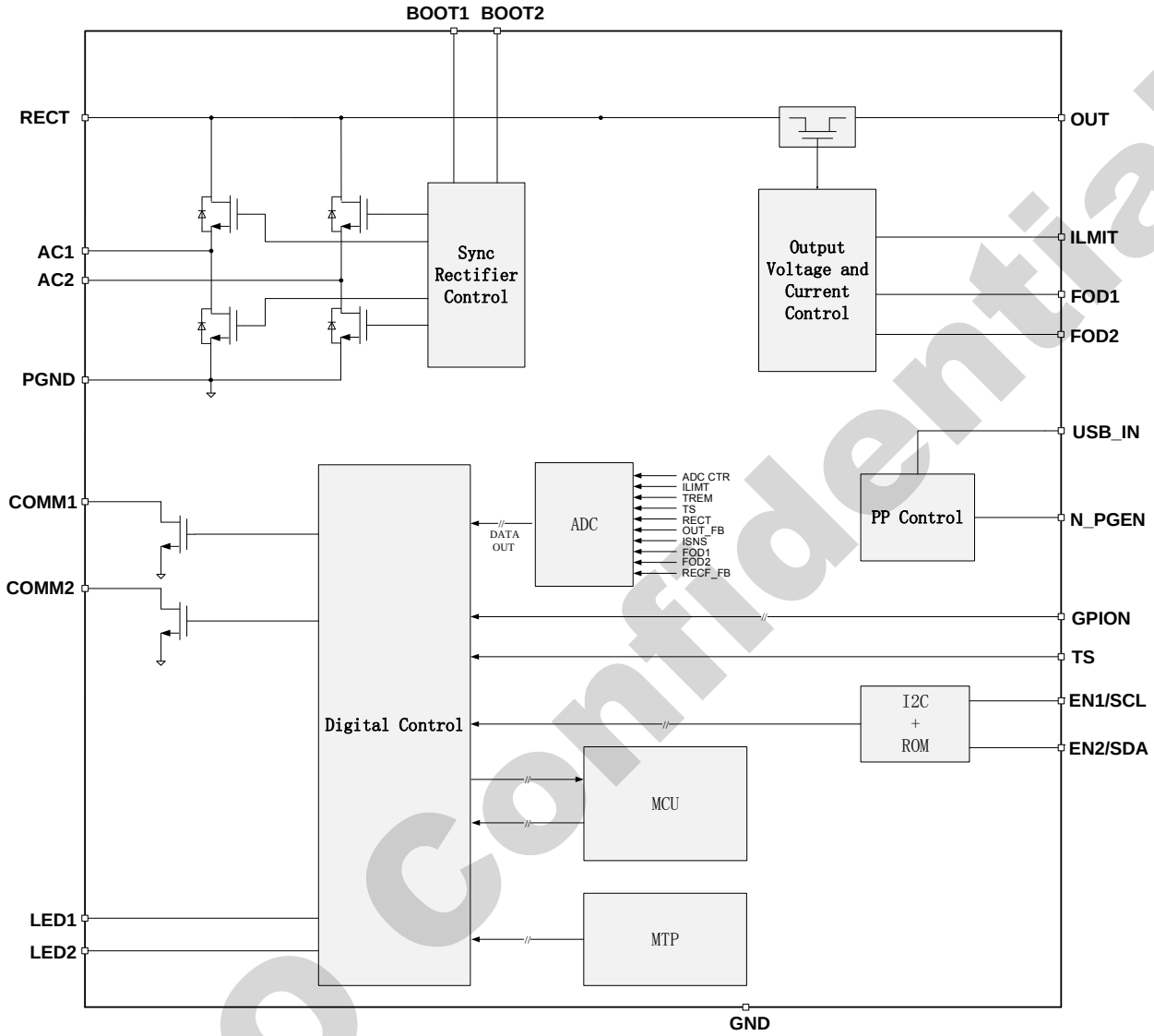


Figure 2. CP2101 bock diagram

Package and Pin Description

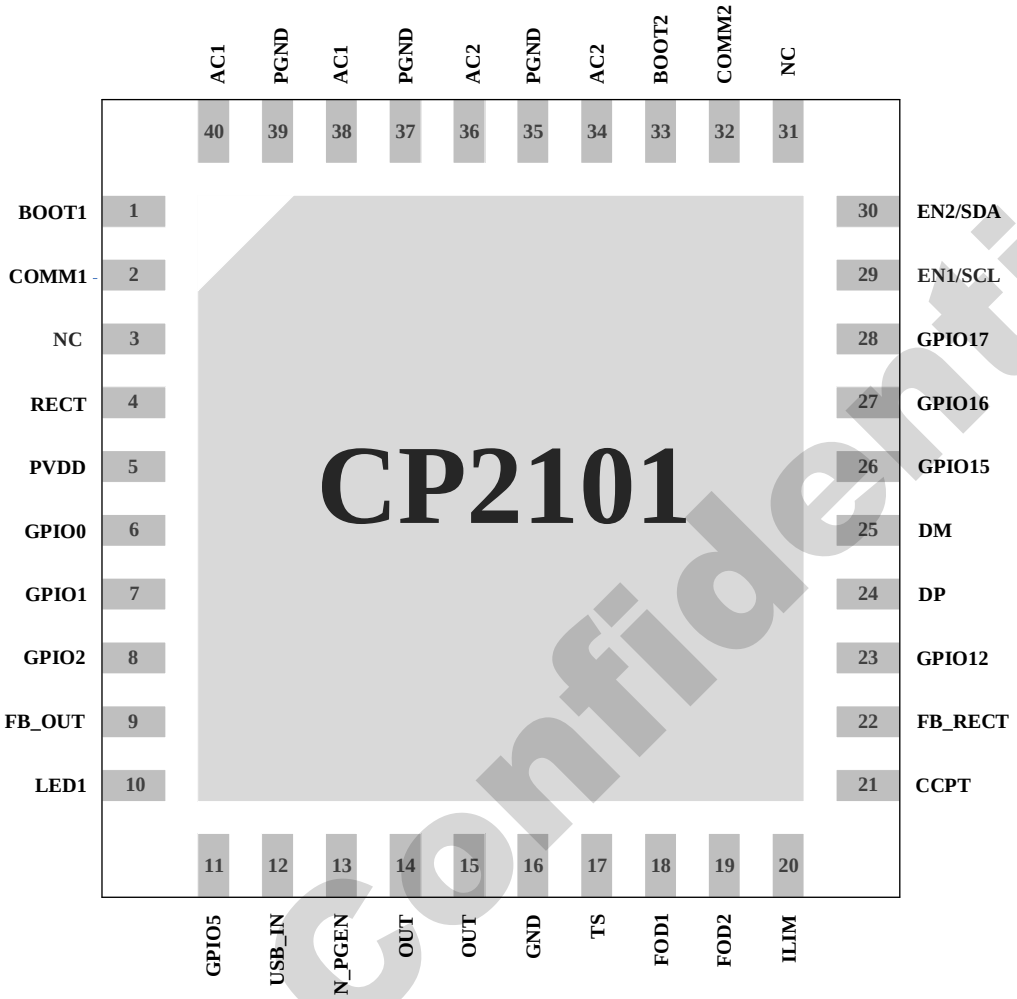


Figure 3. 40 Pin QFN Top View

Pin Description

Pin Name	RHL	I/O	Description
BOOT1	1	O	Bootstrap capacitors for driving the high side FETs of the synchronous rectifier. Connect a 10nF capacitor from BOOT1 to AC1.
COMM1	2	O	Open drain output used to communication with TX coil by varying reflected impedance. Connect through a capacitor to AC1for capacitive load modulation.
NC	3	-	Reserved
RECT	4	O	Filter capacitor for the inter rectifier. Connect to PGND with 22uF capacitor.
PVDD	5	O	5V power output. Connect to GND with 1uF capacitor.
GPIO0	6	-	General purpose IO

GPIO1	7	-	General purpose IO
GPIO2	8	-	General purpose IO
FB_OUT	9	I	Feedback of the OUT voltage.
LED1	10	O	LED indicator PIN
GPIO5	11	-	General purpose IO
USB_IN	12	I	Adapter or USB input
N_PGEN	13	O	Push-pull driver for external PFET connecting AD and OUT. This voltage tracks approximately 4V below AD when effective voltage is present at AD pin. Float this pin if unused.
OUT	14，15	O	Power output, delivers power to the load.
GND	16	GND	Analog ground。
TS	17	I	Temperature Sense (TS) functionality. If an NTC function is not desired, connect to PGND with a 10-kΩ resistor, See Temperature Sense Resistor Network (TS) for more details.
FOD_1	18	I	Input for received power measurement.
FOD_2	19	I	Input for received power measurement.
ILIM	20	O	Programming pin for the over current limit. Connect external resistor to GND. Sizing the RILIM with the following equation: RLIM = I_{LIM}*K_{IMAX}, ILIM is the Maximum output current.
CCPT	21	I	Charge complete input PIN
FE_RECT	22	I	Power output, delivers power to the load.
GPIO12	23	-	General purpose IO
DP	24	I	For fast charging protocol
DM	25	I	For fast charging protocol
GPIO15	26	-	General purpose IO
GPIO16	27	-	General purpose IO
GPIO17	28	-	General purpose IO
EN1/SDA	29	I/ O	I2C data pin/Enable PIN1
EN2/SCL	30	I	I2C clock pin//Enable PIN2
NC	31	-	Reserved
COMM2	32	I	Open drain output used to communication with TX coil by varying reflected impedance. Connect through a capacitor to AC2 for capacitive load modulation.
BOOT2	33	O	Bootstrap capacitors for driving the high side FETs of the synchronous rectifier. Connect a 10nF capacitor from BOOT2 to AC2.
AC2	34,36	I	AC input from receiver coil.
PGND	35,37,39	GND	Power ground.
AC1	38,40	I	AC input from receiver coil.

Specification

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)

Item(V/I)	Pin Name	Min	Max	Unit
Input Voltage	AC1/2	-0.8	25	V
	RECT, COMM1/2, OUT, N_WPG	-0.3	25	V
	BOOT1/2	-0.3	31	V
	AD, N_ADEN	-0.3	25	V
	FOD, ILIM, TS, CHG_CMPT, SDA, SCL	-0.3	7	V
Input Current	AC1/2		3	A
Output Current	OUT		2	A
Sink Current	COMM1/2, CLAMP1/2		1	A
	N_WPG		15	mA
ESD	HBM		2	KV
	CDM		500	V

1: All voltages are with respect to the VSS terminal, unless otherwise noted.

2: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

Thermal Information

Symbol	Description	Value	A
θ_{JA}	Thermal Resistance Junction to Ambient	35	℃/W
θ_{JC}	Thermal Resistance Junction to Case	30	℃/W
θ_{JB}	Thermal Resistance Junction to Board	2.4	℃/W
T_J	Operating Junction Temperature	0 to +125	℃
T_A	Ambient Operating Temperature	0 to +85	℃
T_{STG}	Storage Temperature	-55 to +150	℃
T_{LEAD}	Lead Temperature (soldering, 10s)	300	℃

Electrical Characteristics

Over operating free-air temperature range, -40 to 85°C

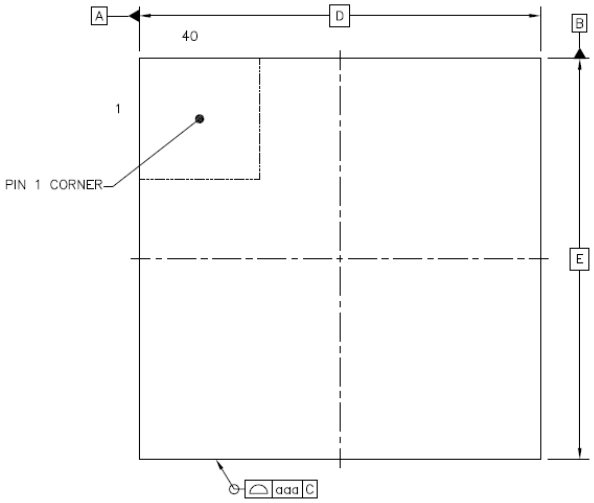
Parameter		Test Condition	Min	Typ	Max	Unit
RECT						
$V_{RECT-UV}$	V_{RECT} Under Voltage lock-out	V_{RECT}: 0V→3.3V	2.9	3	3.1	V

Parameter		Test Condition	Min	Typ	Max	Unit
	Hysteresis on UV			0.25		
$V_{RECT-CLAMP}$	V_{RECT} Over Voltage lock-out	V_{RECT}: 5V→20V	17.5	18	18.5	V
	Hysteresis on OV			3		
$V_{RECT-REG}$	Dynamic V_{RECTV} Threshold1	I_{LOAD} <= 100mA		V_{OUT}+1.5		V
	Dynamic V_{RECTV} Threshold2	100mA < I_{LOAD} <= 200mA		V_{OUT}+1		
	Dynamic V_{RECTV} Threshold3	200mA < I_{LOAD} <= 400mA		V_{OUT}+0.5		
	Dynamic V_{RECTV} Threshold4	I_{LOAD} > 400mA		V_{OUT}+0.08		
$I_{LOAD-HYS}$	ILOAD Hysteresis for dynamic V_{RECT} as a% of I_{MAX}			4%		
$V_{RECT-DPM}$	Rectifier under voltage protection, restrict I_{OUT} at $V_{RECT-DPM}$		3		6	V
OUT						
V_{OUT}	5V Output Voltage	BPP 5W TX	4.9	5	5.1	V
	9V Output Voltage	Fast Charger TX	8.82	9	9.18	
	12 Output Voltage	Fast Charger TX	11.76	12	12.24	
IOUT						
I_{OUT_MAX}	Maximum Output Current			2		A
Quiescent Current						
I_{RECT}	Active IC quiescent current consumption at V_{RECT}	I_{LOAD}=0, V_{RECT} =12V		2		mA
		I_{LOAD}=0, with Dummy Load		40		
		I_{LOAD}=800mA		15		
OUT Leakage Current						
I_Q	Quiescent current at the OUT when wireless power is disable	V_{OUT}=4.2V		42		uA
		V_{OUT}=5V		50		
		V_{OUT}=9V		9		
ILIM Short Current						
I_{OUT-CL}	Maximum output current limit	Maximum I_{LOAD} that will be delivered for 1mS when I_{LIM} is Short			2	A
OUTPUT						
K_{IMAX}	Current programming factor for the hardware protection	R_{LIM} = I_{LIM}*K_{IMAX}	97.5	100	102.5	KΩ/A
ACC_{ILIM}	Current limit accuracy	V_{OUT}=3.8V，I_{LOAD}=0.8A，-20°C-125°C	-5		5	%
TS						

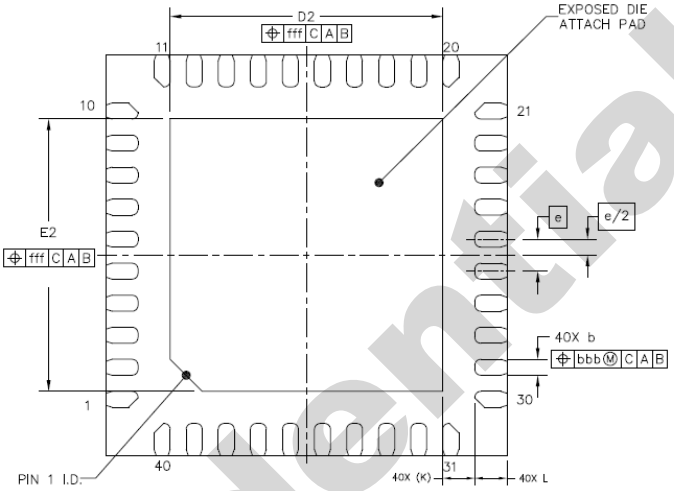
Parameter		Test Condition	Min	Typ	Max	Unit
V_{COLD}	Rising threshold	V_{TS}: 50%→60%		1.3		V
	Falling hysteresis			0.1		
V_{HOT}	Falling threshold	V_{TS}: 20%→15%	18.5	0.5	20.7	
	Rising hysteresis			0.1		
R_{TS}	V_{TS} output impedance		18	20	22	kΩ
t_{DB-TS}	Deglitch time for TS comparators			10		ms
Rectifier						
$I_{LOAD-FULL}$	IOUT at which the synchronous rectifier enters half-synchronous mode	I_{LOAD}: 0mA→200mA		10%		I_{MAX}
	Hysteresis			2%		
R_{ON}	Impendence of rectifier FET			30		mΩ
I2C Interface SCL SDA						
V_{IL}	Input Threshold Low V				0.7	V
V_{IH}	Input Threshold High V		1.4			V
I_{LKG}	Input Leakage Current		-1		1	uA
VOL	Output Logic Low V				0.36	V
FSCL	Clock Frequency				400	KHz
THD-STA	Hold Time for Start Condition		0.6			uS
THD-DAT	Data Hold Time		0			nS
TLOW	Clock Low Period		1.3			uS
THIGH	Clock High Period		0.6			uS
TSU-STA	Set-up Time for Repeated Start Condition		0.6			uS
TBUF	Bus Free Time Between STOP and Start Condition		1.3			uS
CB	SCL SDA Load Cap			150		pF
CI	SCL SDA Input Cap			5		pF
Thermal Protection						
T_{J-OFF}	Thermal shutdown temperature			155		°C
	Thermal shutdown hysteresis			40		

Package Information

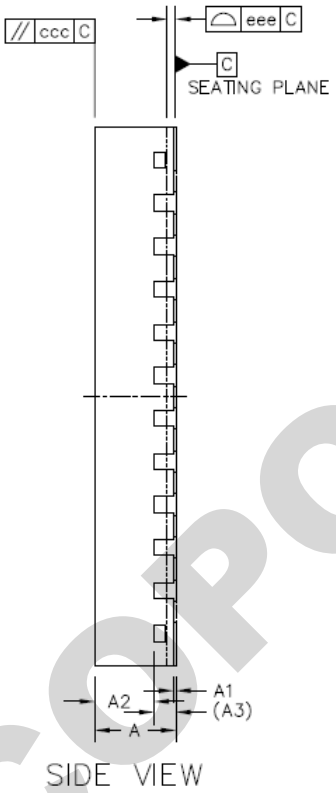
QFNWB5x5-40L(P0.40T0.75) Package Outline Dimensions



TOP VIEW



BOTTOM VIEW



SIDE VIEW

		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	0.15	0.2	0.25
BODY SIZE	X	D		5 BSC	
	Y	E		5 BSC	
LEAD PITCH		e		0.4 BSC	
EP SIZE	X	D2	3.3	3.4	3.5
	Y	E2	3.3	3.4	3.5
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		0.07	
EXPOSED PAD OFFSET		fff		0.1	

Revision History

Date	Revision #	Description	Page
2019.11	V1.0	Original	

Ordering Information

Part Number	Package	PINs	SPQ	Description
CP2101	QFN	40	3000	10W Fast charging and BPP

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