HYASiC
Digital Power ASIC

PD3.1 USB TYPE-C PROTOCOL CONTROLLER HY930B

REVISION 0.3

DOCUMENTATION NUMBER:
DS_HY930B_R0.3

Table of Contents

1 Features 3
2 Applications 3
3 Description 3
4 Pin Configurations and Function Descriptions 4
5 Specification 5
5.1 Absolute Maximum Ratings 5
5.2 Recommended Operating Conditions 5
5.3 Electrical Characteristics 6
6 Function Description 8
6.1 Overview 8
6.2 Function Block 8
7 Application Notes 9
7.1 VIN PIN & VBUSC PIN 9
7.2 Constant Voltage and Constant Current 9
7.3 Line-Drop compensation 10
7.4 NTC Protection 10
7.5 Over Voltage Protection 10
7.6 OCP and short protection 10
8 Typical Application Circuit 11
8.1 AC/DC - OPTO feedback 11
8.2 DC/DC - FB feedback 12
9 Mechanical, Packaging & Orderable Info 13
9.1 Package Outline: DFN4X3-14L 13
9.2 Ordering Information 14
9.3 Tape and Reel Information 14
9.4 Marking and Date Code Information 14
10 Revision History 15
11 Important Notice 16
12 Contact Information 16

List of Figures

Fig. 1. Typical Application Schematic 3
Fig. 2. Packages Top View 4
Fig. 3. Function Block 8
Fig. 4. OPTO Feedback 9
Fig. 5. NTC Protection 10
Fig. 6. Application for ACDC 11
Fig. 7. Application for DCDC 12
Fig. 8. Package Outline 13

List of Tables

Table 1. Pin Function Descriptions 4
Table 2. Absolute Maximum Ratings 5
Table 3. Recommended Operating Conditions 5
Table 4. Electrical Characteristics 6
Table 5. OPTO feedback Application BOM list 11
Table 6. FB feedback Application BOM list 12

PD3.1/PPS/QC2.0/QC3.0/FCP/SCP/AFC Protocol Controller

1 Features

- USB PD3.1 SPR with PPS certified, **TID 9557**
- USB Type-C 2.2 and USB PD 3.1/2.0 Compliant
  - Support 5V, 9V, 12V, 15V and 20V FPDOs
  - Support 2 programmable APDOs
  - Support USB Type-C 2.2 DFP
- Support BC1.2 DCP and HVDCP Protocols
  - QC2.0/QC3.0/QC3.0+ Class A or Class B
  - Huawei FCP/SCP
  - Samsung AFC
  - Apple 2.4A
  - BC1.2 DCP
  - PE+1.1/2.0
- Safety Integration
  - Over voltage protection
  - Over current protection
  - Output short protection
  - Over-temperature Protection
  - CC1/CC2/DP/DM overvoltage protection
  - NTC
  - UVLO
- Integration 15mΩ R_{DSON} N-MOSFET
- Support external 5mΩ /10mΩ current sense
- Integration discharge
- Programable Cable drop compensation
- Support Constant Current and Constant Voltage Loop
- Adaptive power control by Temperature
- Support Online Update
- HBM ESD ±4 kV rating for all pins
- DFN-14L (4 mmx 3 mm)

2 Applications

- Adaptor
- Power Strip

3 Description

The HY930B is a high performance, high integration USB Type-C Power Delivery Source Controller. The HY930B supporting 5 FPDOs and 2 APDOs with programmable current and voltage which are fully compliant with USB Power Delivery Specification Revision 3.1, Version 1.8. Besides, the HY930B also supports BC1.2 DCP, Apple 2.4A, QC2.0/QC3.0/QC3.0+, AFC, FCP, SCP and PE+1.1/2.0 protocols.

The HY930B integrates a 15mΩ R_{DSON} N-MOSFET to enable the VBUS from VIN to protect the devices connected with VBUS.

The HY930B integrates perfect protection such as Over Voltage Protection (OVP), Under Voltage Lockout (UVLO), Over Current Protection (OCP), output short protection, CC or DPDM Over Voltage Protection and Over-temperature Protection.

The HY930B is available in DFN-14L (4 mmx3 mm) package.

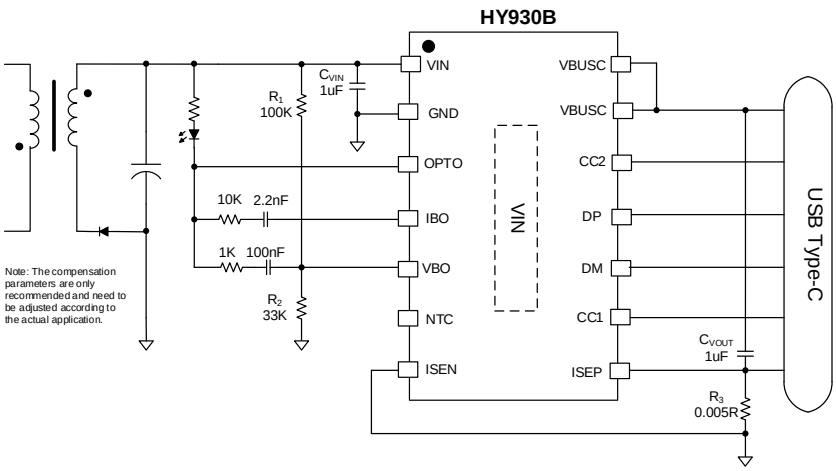
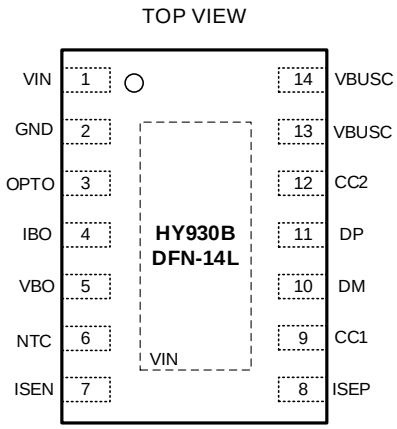


Fig. 1. Typical Application Schematic

4 Pin Configurations and Function Descriptions



DFN-14L (4 mmx3 mm)

Fig. 2. Packages Top View

Table 1. Pin Function Descriptions

Pin	Name	Description
1	VIN	Power supply for internal circuits and the input voltage sense, connect a 1uF capacitor from this pin to GND
2	GND	Ground
3	OPTO	Optical coupler
4	IBO	Current feedback compensation
5	VBO	Output voltage feedback and compensation
6	NTC	An external negative temperature coefficient resistor connected to this pin for remote temperature sensing
7	ISEN	Current detection negative point
8	ISEP	Current detection positive point
9	CC1	Configuration channel interface pin to USB Type-C
10	DM	USB DM
11	DP	USB DP
12	CC2	Configuration channel interface pin to USB Type-C
13,14	VBUSC	Internal N-MOSFET Source and the VBUS voltage sense, connected to USB Type-C VBUS
EP	VIN	Internal N-MOSFET Drin, must connected to Vin net

5 Specification

5.1 Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

Parameter	Min	Max	Unit
VBO, IBO, ISEN, ISEP, NTC	-0.3	6.5	V
VIN, VBUSC, OPTO, CC1, CC2, DP, DM	-0.3	28	V
Junction Temperature Range	-40	125	°C
Ambient Temperature Range	-40	85	°C
Storage Temperature Range	-55	150	°C
Lead Temperature Range (Soldering 10 sec)		260	°C
ESD Human Body Model (100pF Capacitance, Series 1.5KΩ)	-4000	+4000	V

Note: Exceeding the specified limits for the operating conditions of the device can result in permanent damage to the device. The parameters provided are only the limit values for the operating conditions, and operating the device outside of the recommended working conditions is not advisable. The device's reliability may be affected by prolonged operation under extreme conditions.

5.2 Recommended Operating Conditions

Table 3. Recommended Operating Conditions

Parameter	Min	Max	Unit
Input Voltage VIN	3	24	V
Junction Temperature Range	-40	125	°C

5.3 Electrical Characteristics

V_{in} = 5 V, T_{AMB} = 25 °C (unless noted otherwise)

Table 4. Electrical Characteristics

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
VIN						
V_{IN}	Input Voltage		3		24	V
V_{IN_UVLO}		Rising		3.27		V
$V_{IN\_UVLO\_HYS}$	Input Under-Voltage Lockout (UVLO)			0.2		V
I_Q	Input Quiescent Current	CC Locked		2.5		mA
		CC Unlocked		250		uA
VOUT						
V_{OVP_TH}	V_{OUT} = 5V	For fixed PDO. For the continuous mode, it will select the threshold based on the range		6		V
	V_{OUT} = 9V			10.5		V
	V_{OUT} = 12V			13.8		V
	V_{OUT} = 15V			17.8		V
	V_{OUT} = 20V			24		V
R_{DSON} of Internal Switch MOSFEET						
R_{DSON}	Internal N-MOSFET			15		mΩ
Discharge						
I_{DIS}	Discharge Current	VOUT=20V			130	mA
R_{VBUS}	Bleeding resistor			100		kΩ
Transmitter (CC1, CC2)						
$_Z$Driver	TX Output Impedance		30	54	70	Ω
V_{Swing}	BMC Amplitude		1.050	1.125	1.200	V
V_{TXLOW}	Transmit LOW				75	mV
$f_{BitRate}$	BMC Rate		270	300	330	kbps
Receiver (CC1, CC2)						
V_{RXHI}	Receiver HIGH	Rising edge		840		mV
V_{RXLOW}	Receiver LOW	Falling edge		530		mV
Type-C DFP specification (CC1, CC2)						
V_{D_SRC3A}	Detach threshold when detached in 3A DFP mode	Rising threshold	2.5	2.625	2.75	V
		Hysterias		0.05		V
V_{Rd_SRC3A}	Ra, Rd detection threshold in 3A mode (falling)	0V ⩽ V_{CCx} ⩽ 2.5V	0.75	0.79	0.83	V
		Hysterias		0.02		V
I_{RP_SRC}	CC1/CC2 Broadcasting current	3A DFP, R_D=5.1K	1.6	1.68	1.76	V
$T_{CCDebounce}$	Deglitch filter for UFP attach detection		120	150	180	ms
$T_{PDDebounce}$	Deglitch filter for UFP detach detection		12	15	18	ms
Constant Current						
CC	Constant current point	Configurable				
OCP	Short current protection	Rsense=5 mΩ		16		A

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
HVDCP interface (DP, DM)						
V_{DAT_REF}	Data threshold voltage		0.25	0.325	0.4	V
$T_{DP\_DEGLTICH\_HIGH}$	Denounce time for DP high detection			1.1		s
$T_{DM\_DEGLTICH\_LOW}$	Denounce time for DM low detection			1		ms
T_{VOUT_CHG}	Denounce time for VOUT variation		20	40	60	ms
R_{DP_LKG}	DP Leakage resistor			650		kΩ
R_{DM_DWN}	DM Pull down resistor			20		kΩ
V_{TH_PD}	Device connection threshold		0.25	0.325	0.4	V
TD_{PD}	Debounce time for device connection detection		120	160	200	ms
ΔI_{UP}	Voltage step up current	R_1 = 100 kΩ		0.2		μA
ΔI_{DOWN}	Voltage step down current	R_1 = 100 kΩ		0.2		μA
T_{DUR_STEP}	Step time for continuous mode	QC3.0 mode		120		μs
Apple 2.4A Mode						
V_{DAT_2P7}	VDP/VDM	Apple 2.4A mode Voltage	2.57	2.7	2.84	V
FCP mode						
V_{TX_VOH}	DM FCP TX valid high		1.8			V
V_{TX_VOL}	DM FCP TX valid low				0.3	V
V_{RX_VOH}	DM FCP RX valid high			1.2		V
V_{RX_VOL}	DM FCP RX valid low			0.9		V
UI	Unit interval for PHY	F_{CLK} = 125 kHz	144	160	176	μs
NTC						
I_{NTC}	NTC source current			48		μA
V_{NTC_TH}	NTC Protection Threshold	Rising		0.6		V
		Falling		0.3		V
V_{NTC_HYS}		Hysterias		0.3		V
OTP						
T_{J1}	Over temperature protection	Rising edge		145		°C
		Hysteresis		20		°C

6 Function Description

6.1 Overview

The HY930B is an integrated fast charging controller, which supports multiple fast charging protocols, including USB PD/PPS protocol, Qualcomm QC2.0/QC3.0, QC3.0+ protocol, Huawei FCP/SCP protocol, Samsung AFC, USB BC1.2 DCP and Apple 2.4A charging specifications. It is an ideal solution for power supply devices like car chargers, quick charger adapters, and smart power strips.

The HY930B integrates the CV and CC loop control, to eliminate TL431, so that the BOM is minimized.

The HY930B integrated a 15mΩ load switch MOSFET between VBUS and VIN, so it benefits to PCB Layout.

A current sampling resistor is connected to a 5mΩ alloy resistor on ISEN and ISEP for current sampling.

The output voltage of the HY930B has a programmable line compensation function. After the output current increases, the output voltage will be correspondingly increased to compensate for the voltage drop caused by the connection line impedance. For specific configuration requirements, please contact HYASiC.

The HY930B has multiple protection functions, including output over-voltage protection, output short circuit protection, data pin short circuit protection, over-current protection and over-temperature protection.

6.2 Function Block

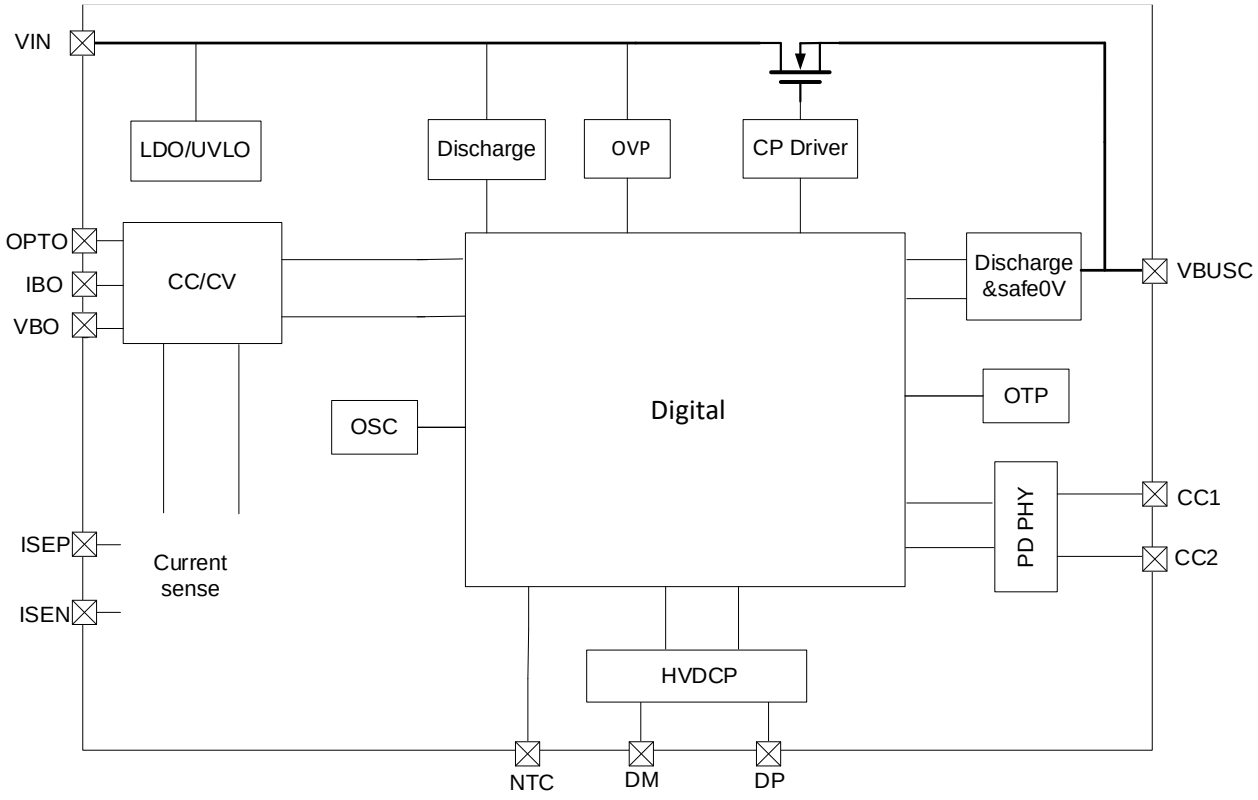


Fig. 3. Function Block

7 Application Notes

7.1 VIN PIN & VBUSC PIN

The VIN pin is the chip's internal power supply input and voltage sense input, connected to the AC-DC or DC-DC output, it is recommended to connect an external 1uF capacitor to GND near this pin. It is also an internal discharge drain pathway. Used to drain the charge stored by the output capacitor of the external AC/DC power supply when the device is removed or the device requests a step-down, so that the voltage is regulated to safe5V or the target voltage. This pin is also the internal N-MOSFET Drin, so we need use copper tie to power out when layout.

The VBUSC pin is used to sense the USB Type-C port voltage, and is also used as a USB Type-C port Discharge path, and it is recommended to connect an external 1uF capacitor to GND. This pin is also the internal N-MOSFET Source, so we need use copper tie to USB Type-C VBUS when layout.

7.2 Constant Voltage and Constant Current

The HY930B integrates CV and CC loop control. As shown in the figure below, CV loop control is realized through VBO and OPTO, where OPTO is connected to an external optocoupler and VBO is connected to a voltage divider network point composed of R1 and R2. When the device requests a voltage to step-up or step-down, the HY930B feeds back the network node according to sink or source current in 0.2uA/step through VBO. Whether it is VBO feedback or OPTO feedback, R1 must be 100K, R2 is 33K in OPTO feedback applications, and R2 is calculated based on the actual situation of the front-end power supply in FB feedback applications.

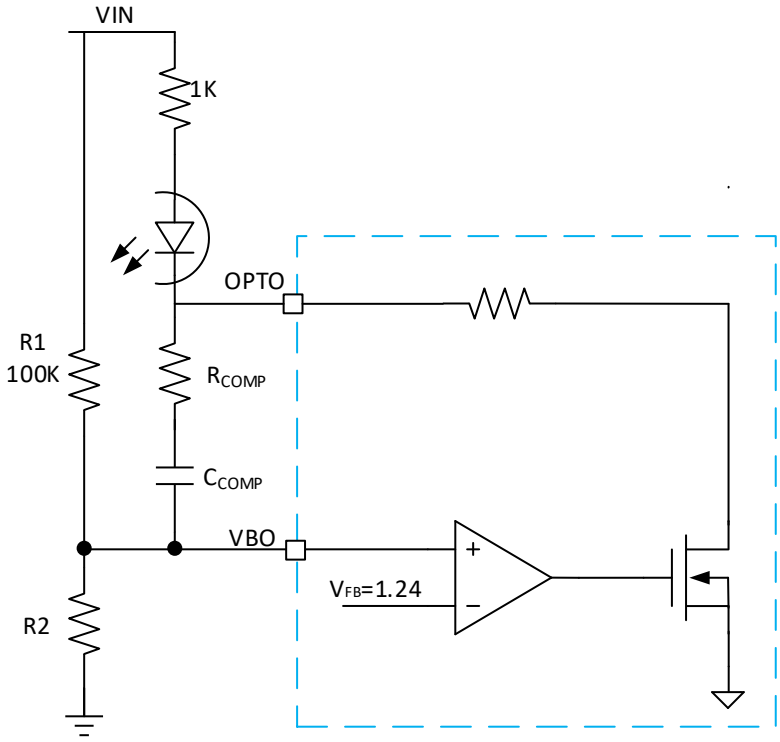


Fig. 4. OPTO Feedback

To suppose the input voltage is VIN, and VBO of the power source is regulated to V_{FB}, then there is how to calculate the resistance of R2:

$$R2 = \frac{V_{FB} \times \mathrm{R1}}{\mathrm{VIN} - V_{FB}}$$

Equation 1

The HY930B implements constant current control and current sampling via OPTO, IBO, and ISEN and ISEP with an external sampling resistor of 5mΩ. The sampling resistor should be layout in Kelvin connection, with one end being the ISEP and the other end being the ISEN of the chip. The sampled current information is also used by the HY930B to determine whether is over current or short circuit. The compensation network between OPTO and IBO needs to be adjusted for the specified application.

7.3 Line-Drop compensation

The Built-in line drop compensation function of the HY930B has programmable compensation coefficient to meet different application, according to output current. The HY930B currently supports five types of line drop compensation coefficients: 0mV/A, 50mV/A, 100mV/A, 150mV/A, 200mV/A. The default configuration is 100mV/A.

7.4 NTC Protection

The HY930B uses the NTC pin to sense the external temperature. As show in Fig.5, there is an internal current source 48 μA at the NTC pin. With an external NTC resistor from NTC pin to ground, the HY930B can detect the voltage across this NTC resistor and calculate the temperature per the T-R characteristics. When the NTC PIN is used to power reduction function, the threshold is 0.6V, when it used to protection function, the rising threshold is 0.6V and the falling threshold 0.3V.

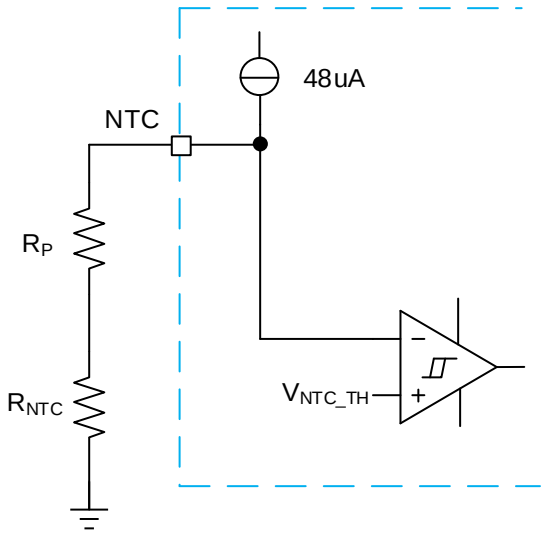


Fig. 5. NTC Protection

7.5 Over Voltage Protection

The HY930B supports OVP by monitoring the voltage of VIN pin, once the voltage exceeds the over voltage threshold of the required the OVP procedure will be triggered, and then the HY930B turns off internal NMOS FET quickly.

7.6 OCP and short protection

The HY930B monitors output current through the external 5mΩ sense resistor connected to ISEP and ISEN for over current and short-circuit protection. When the output current exceeds the over current protection threshold or short-circuit protection threshold corresponding to the requested, the over current or short-circuit protection procedure is triggered, and then the HY930B turns off internal NMOS FET quickly.

8 Typical Application Circuit

8.1 AC/DC - OPTO feedback

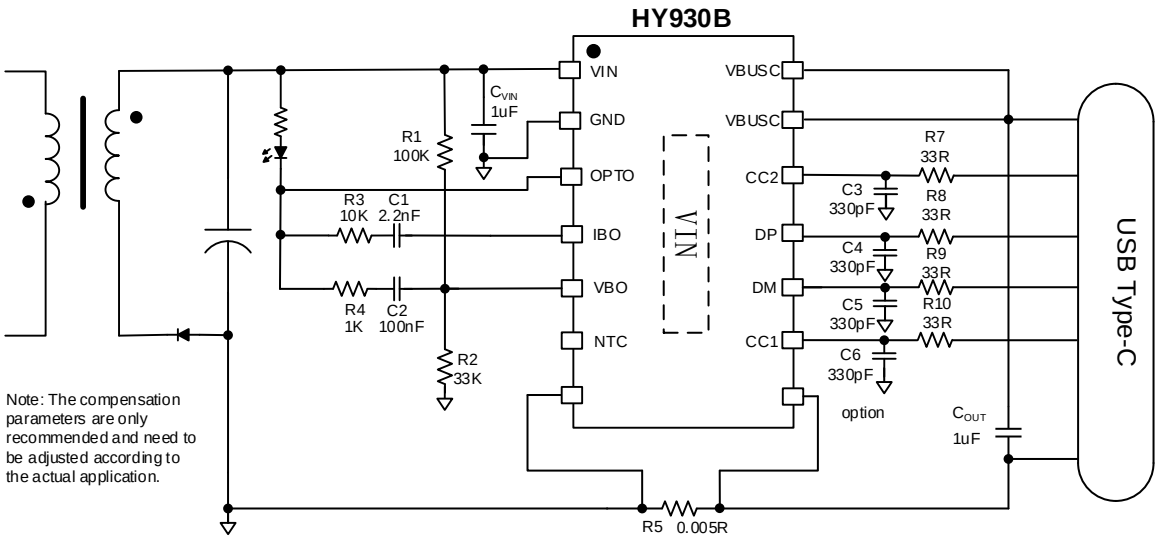


Fig. 6. Application for ACDC

Note: Must using Kelvin Connect to connect current sense resistor R5.

Table 5. OPTO feedback Application BOM list

No.	Part Name	Description	Unit	Qty	Location
1	IC	HY930B	PCS	1	
2	SMD capacitor	0603, 1uF, +/-20%, 25V, X5R	PCS	2	C_{VIN}, C_{OUT}
3	SMD capacitor	0603, 100nF, +/-20%, 25V, X5R	PCS	1	C1
4	SMD capacitor	0603, 2.2nF, +/-20%, 25V, X5R	PCS	1	C2
5	SMD resistor	0603, 330pF, +/-20%, 50V, X5R, for option	PCS	4	C3, C4, C5, C6
6	SMD resistor	0603, 100K, 1%	PCS	1	R1
7	SMD resistor	0603, 33K, 1%	PCS	2	R2
8	SMD resistor	0603, 1K, 5%	PCS	1	R3
9	SMD resistor	0603, 10K, 5%	PCS	1	R4
10	SMD resistor	1206, 5mohm, 1%, temperature coefficient less than 100ppm	PCS	1	R5
11	SMD resistor	0603, 33R, 5%, for option	PCS	4	R7, R8, R9, R10

8.2 DC/DC - FB feedback

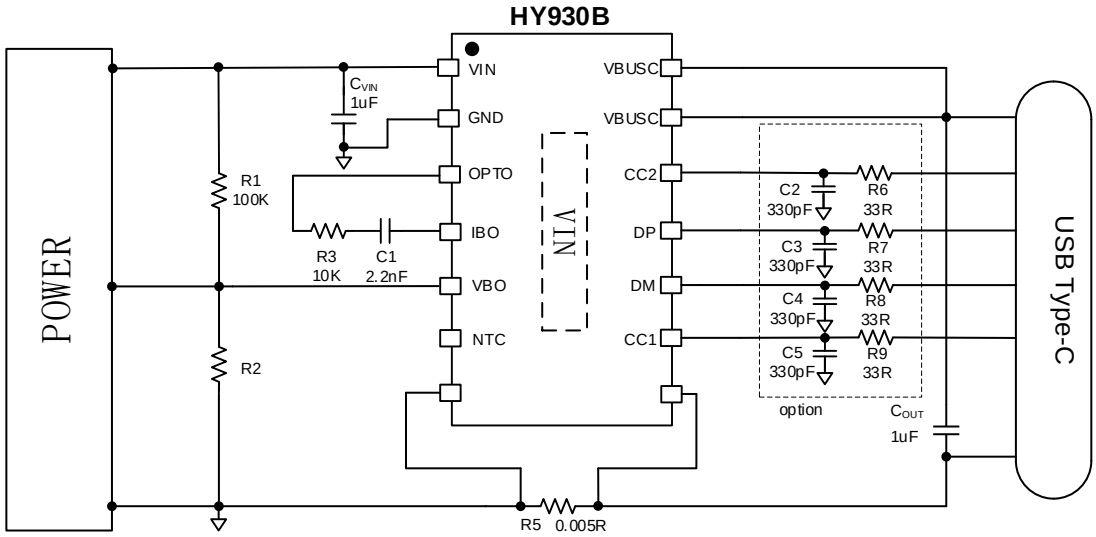


Fig. 7. Application for DCDC

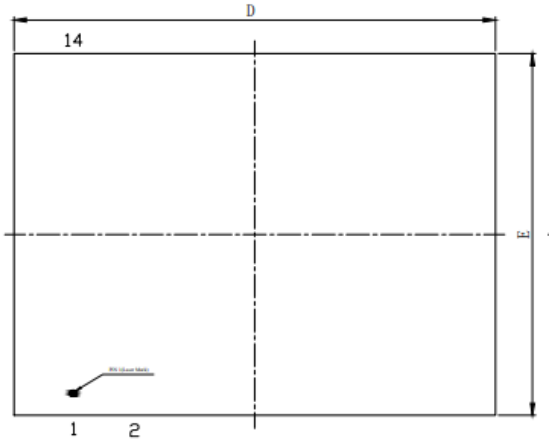
Note: Must using Kelvin Connect to connect current sense resistor R5.

Table 6. FB feedback Application BOM list

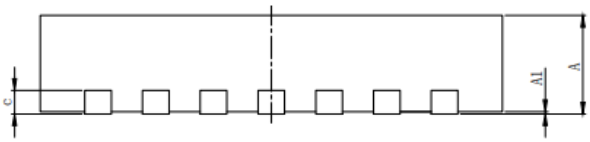
No.	Part Name	Description	Unit	Qty	Location
1	IC	HY930B	PCS	1	
2	SMD capacitor	0603, 1uF, +/-20%, 25V, X5R	PCS	2	C_{VIN}, C_{OUT}
3	SMD capacitor	0603, 2.2nF, +/-20%, 25V, X5R	PCS	1	C1
4	SMD resistor	0603, 330pF, +/-20%, 50V, X5R, for option	PCS	4	C2, C3, C4, C5
5	SMD resistor	0603, 100K, 1%	PCS	1	R1
6	SMD resistor	Calculated by FB voltage of VIN power	PCS	1	R2
7	SMD resistor	0603, 10K, 5%	PCS	1	R3
8	SMD resistor	1206, 5mohm, 1%, temperature coefficient less than 100ppm	PCS	1	R5
9	SMD resistor	0603, 33R, 5%, for option	PCS	4	R6, R7, R8, R9

9 Mechanical, Packaging & Orderable Info

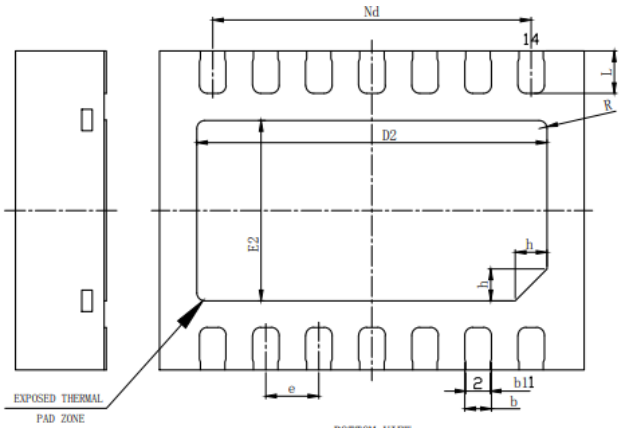
9.1 Package Outline: DFN4X3-14L



Top View



Side View



Bottom View

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
A1	—	0.02	0. 05
b	0. 20	0.25	0. 30
c	0. 18	0.20	0. 25
D	3. 90	4. 00	4. 10
D2	3. 15	3. 20	3. 25
e	0. 50BSC		
Nd	3. 00BSC		
E	2. 90	3. 00	3. 10
E2	1. 35	1. 40	1. 45
L	0. 45	0.50	0. 55
K	0. 25	0.30	0. 35
h	0. 25	0. 30	0. 35

Legend

DFN4X3-14L

Fig. 8. Package Outline

9.2 Ordering Information

Part Number	Configuration	Package	MOD
HY930BD30001D	FPDO:5V/3A,9V/3A,12V/2.5A,15V/2A,20V/1.5A	DFN-14L	5K/Reel
	PPS:3.3-11V/3A,3.3-16V/2A		
	QC2.0/QC3.0/QC3.0+(class A)/FCP/SCP/AFC/APPLE2.4A/BC1.2		
	Line drop compensation:100mV/A		
	OCP:110%		
HY930BD65001D	FPDO:5V/3A,9V/3A,12V/3A,15V/3A,20V/3.25A	DFN-14L	5K/Reel
	PPS:3.3-11V/3A,3.3-21V/3A		
	QC2.0/QC3.0/QC3.0+(class A)/FCP/SCP/AFC/APPLE2.4A/BC1.2		
	Line drop compensation:100mV/A		
	OCP:110%		
HY930BXXXXXXX	For part numbers not listed above, please contact Hyasic		

9.3 Tape and Reel Information

Package Type	PCs/Reel	Reel/Reel Box	Reel Box/Carton Box	PCs/Carton Box
DFN 4X3-14L	6K	1	5	30K

9.4 Marking and Date Code Information

XXXXXXX

Product Number

A BC XX

Year Code Week Code Internal Code

Year		Year Code
2009	2024	A
2010	2025	B
2011	2026	C
2012	2027	D
2013	2028	E
2014	2029	F
2015	2030	G
2016	2031	H
2017	2032	J
2018	2033	K
2019	2034	L
2020	2035	M
2021	2036	N
2022	2037	P
2023	2038	Q

10 Revision History

Revision	Date	Changes
0.1	2024-02-19	Initial datasheet
0.2	2024-03-04	Change Tape and Reel Information and Add NTC threshold
0.3	2024-03-08	Remove the 33K resistor between CSN and CSP

11 Important Notice

HYASiC Inc. reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and this document. This document is confidential and is for the use of the intended customer only. Any disclosure, copying or distribution of this datasheet without the explicit agreement of HYASiC Inc. is strictly prohibited.

12 Contact Information