IOT POWER

HT3000 Series – HT3328

High-Efficiency, IoT-Enabled, External MOSFET Dual-Buck DC-DC Controller with Selectable 150kHz/250kHz/350kHz Frequency

APPLICATION

- IoT (Internet of Things) Smart Home Appliance
- Mobile apps controllable DC source
- Automotive ADAS/LED Power Supply
- LCD Monitor Power Supply
- Wireless Router Power Supply
- Remote Power Management
  - Power Scheduler
  - CC-CV
- Low EMI Application (Patent Pending)

GENERAL DESCRIPTION

HT3328 is a high efficiency, dual-channel, Internet of Things (IoT) enabled, synchronous step-down switching controller designed for high-power applications.

HT3328 consists of an I^2C interface to connect with other wireless communication modules (e.g. Bluetooth/Wi-Fi); hence it allows ON/OFF, output voltage and current limit control using mobile apps. As a result, HT3328 enhances productivity and efficiency by enabling remote power management of various IoT devices at homes, office buildings, automobiles, and factories, etc.

HT3328 allows a wide input voltage range from 4.7V to 36V, and provides a wide range of output. The HT3328 enables power delivery of up to 100W or higher by using the appropriate FETs at each channel, while also offering selectable switching frequencies for circuit designs with varying sizes of inductors or capacitors, ensuring high conversion efficiency.

HT3328 has soft start function, which prevents the inrush current at startup from affecting the stability of the input power. On the protection side, it has a variety of protections for both input and output against over voltage, short circuit or under voltage conditions (see Multi-Protection section).

FEATURES

Internet of Things (IoT) Enable function

- ON/OFF control
- Programmable using I^2C serial interface
- Wireless connection with mobile apps

A sample IoT function is illustrated below flowchart:

Multi-Protection

- Input under-voltage lockout (UVLO)
- Output over-voltage protection (OVP)
- Output short-circuit protection (SCP)
- Over-temperature protection (OTP)

Device Information

Part Number	Package	Dimensions (mm)
HT3328	WQFN32	5.0 x 5.0 x 0.75

See package outline and dimension on page 10.

Typical Application Circuit

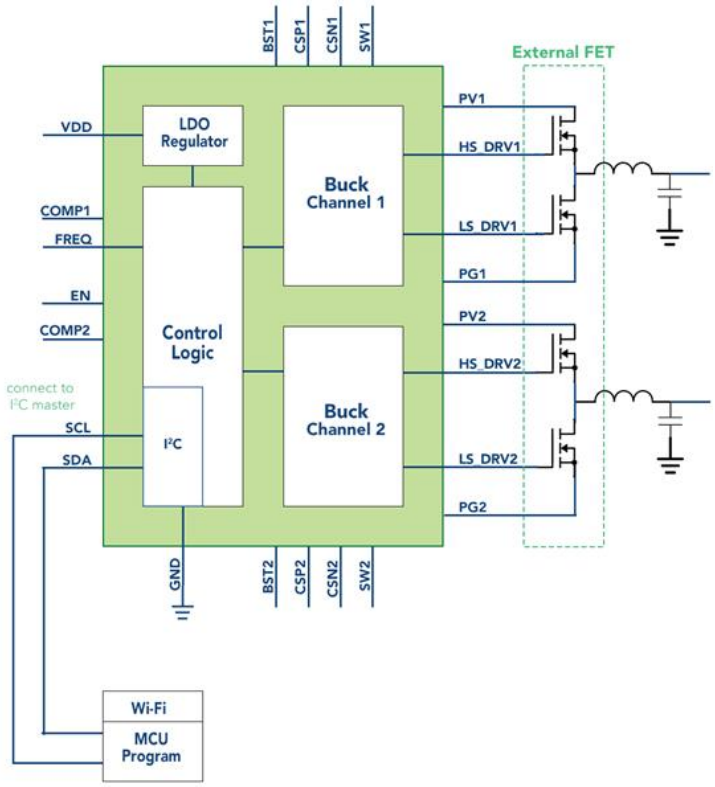


Fig. 1.1 - HT3328 Application Circuit

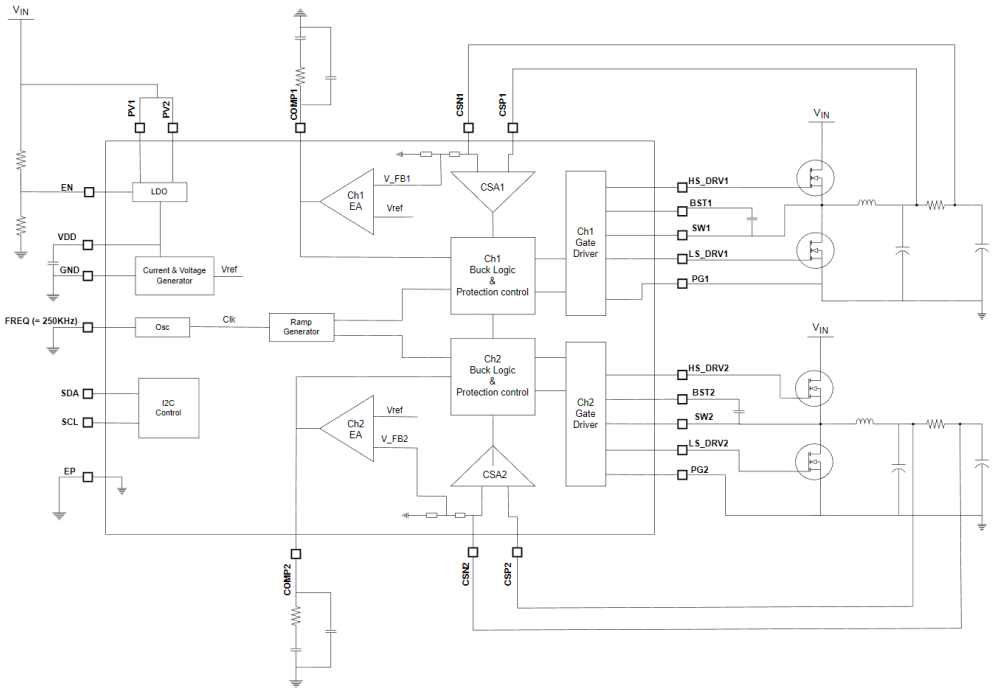


Fig. 1.2 - Detailed HT3328 Application Circuit

Pin Configuration

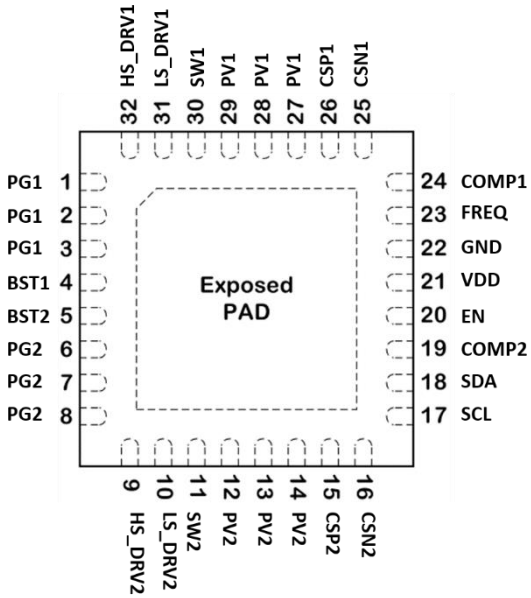


Fig. 2 - 32-pin QFN, 5x5 mm^2, 0.5mm pitch TOP VIEW

Pin Functions

Pin	Name	Description	Pin	Name	Description
1	PG1	Power Ground Channel 1	**17**	SCL	I^{2}C Clock
2	PG1	Power Ground Channel 1	**18**	SDA	I^{2}C Data
3	PG1	Power Ground Channel 1	**19**	COMP2	Compensation Pin 2
4	BST1	Bootstrap Channel 1, Connect a capacitor (recommended 0.1uF) to SW1.	**20**	EN	Chip Enable, 1.35V enables the device
5	BST2	Bootstrap Channel 2, Connect a capacitor (recommended 0.1uF) to SW2.	**21**	VDD	VDD Regulator Connect a decoupling capacitor to GND. Recommended 2.2uF.
6	PG2	Power Ground Channel 2	**22**	GND	Signal Ground
7	PG2	Power Ground Channel 2	**23**	FREQ	Frequency Selection, See the Application Information Section for details.
8	PG2	Power Ground Channel 2	**24**	COMP1	Compensation Pin 1
9	HS_DRV2	High Side Gate Drive Channel 2	**25**	CSN1	Current Sense Negative 1
10	LS_DRV2	Low Side Gate Drive Channel 2	**26**	CSP1	Current Sense Positive 1
11	SW2	Inductor Connection Channel 2	**27**	PV1	Input Power Channel 1
12	PV2	Input Power Channel 2	**28**	PV1	Input Power Channel 1
13	PV2	Input Power Channel 2	**29**	PV1	Input Power Channel 1
14	PV2	Input Power Channel 2	**30**	SW1	Inductor Connection Channel 1
15	CSP2	Current Sense Positive 2	**31**	LS_DRV1	Low Side Gate Drive Channel 1
16	CSN2	Current Sense Negative 2	**32**	HS_DRV1	High Side Gate Drive Channel 1
33	EPAD	Signal Ground & Thermal Dissipation Pad			

Absolute Maximum Rating

PV1, PV2, SW1, SW2, EN, BST1, BST2	-0.3V to 40V
HS_DRV1, LS_DRV1, HS_DRV2, LS_DRV2	-0.3V to 36V
CSP1, CSN1, CSP2, CSN2	-0.3V to 22V
VDD, COMP1, COMP2, SCL, SDA, FREQ	-0.3V to 6V
Operating Temperature Range	-40°C to 85°C
Maximum Junction Temperature	125°C
Storage Temperature Range	-65°C to 125°C
Soldering Temperature	300°C

Electrical Characteristics (V_{IN}=8V, TA=25°C unless specified)

Parameters	Symbol	Test Conditions	Rating			Unit
			MIN	TYP	MAX	
Input Characteristics						
Operating Input Supply Voltage	V_{IN}		4.7		36	V
EN Threshold	V_{EN}			1.35		V
EN Hysteresis	V_{ENHYS}			110		mV
Quiescent Current	I_Q	Output at no load		1.5		mA
Shutdown Current	I_{stb}	V_{EN} = 0V		10		μA
Output Characteristics						
Output Voltage Range	V_{OUT}	V_{IN} = 24V	3.6		20	V
Output Current Limit	I_{Limit_FB}	R_{SENSE} = 10mΩ		3.3		A
Reference Voltage						
Output Voltage Reference	V_{FB}	Measured at FB1, FB2		1		V
Regulator Reference	V_{DD}	Measured at VDD		5.4		V
Switching Characteristics						
Switching Frequency	f_{sw}	FREQ=Z		150		kHz
		FREQ=L		250		kHz
		FREQ=H		350		kHz
Minimum On-Time	$t_{ON, Min}$			80		ns
Dither Generator						
Dither Modulation Frequency	f_{DITH}			TBD		kHz
Maximum Switching Frequency	f_{OSCMAX}			TBD		kHz
Minimum Switching Frequency	f_{OSCMIN}			TBD		kHz

Electrical Characteristics (T_A=25°C unless specified)

Parameters	Symbol	Test Conditions	Rating			Unit
			MIN	TYP	MAX	
Output control by PROG (For both channel1 and channel2)						
Single Channel Output Voltage (PROG)	V_{OUT_PROG}	V_{IN}=24V, DAC_CV = 0.5V		5		V
		V_{IN}=24V, DAC_CV = 0.9V		9		V
		V_{IN}=24V, DAC_CV = 1.2V		12		V
		V_{IN}=24V, DAC_CV = 2V		20		V
	V_{STEP_PROG}	DAC_CV step		100		mV
Single Channel Output Current (PROG)	I_{OUT_PROG}	R_{SENSE} =10mΩ, DAC_CC = 1.2V		3.3		A
		R_{SENSE} =10mΩ, DAC_CC = 0.8V		2.1		A
		R_{SENSE} =10mΩ, DAC_CC = 0.6V		1.6		A
		R_{SENSE} =10mΩ, DAC_CC = 0.4V		1		A
Input Under-voltage Lockout Protection						
Input Under-Voltage Lockout Threshold	V_{UVLO}			4.7		V
Input Under-Voltage Lockout Hysteresis	V_{UVHYS}		0.53	0.64	0.71	V
Output Under-voltage Lockout						
Output Under-voltage Protection	V_{UVLO}			V_{OUT}*60%		V
Output Over-voltage Protection						
Over-Voltage Protection	V_{OVP}			V_{OUT}*120%		V
Over-Temperature Protection						
Thermal Shutdown	T_{SD}	Increasing Temperature		140		°C
Thermal Shutdown Hysteresis	T_{SD_HYS}	Decreasing temperature		30		°C
Digital Output Pins						
Digital Output High Voltage	V_{OH}	Maximum Sink Current = 12mA	0.8 × V_{DD}			V
Digital Output Low Voltage	V_{OL}	Maximum Sink Current = 12mA			0.1 × V_{DD}	V

Functional Block Diagram

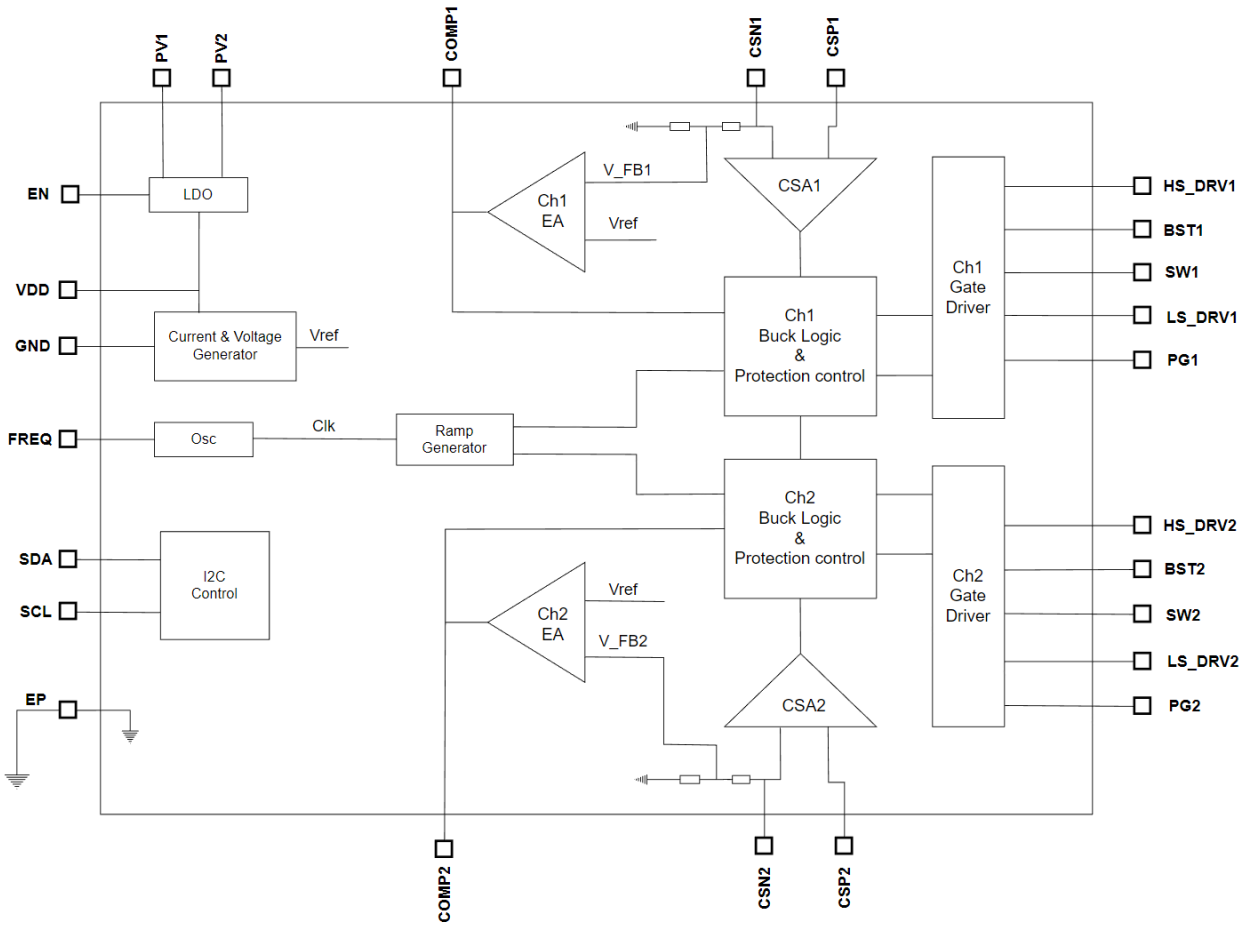


Fig. 3 - Functional Block Diagram

Application Information

Input Protection

If the input voltage is smaller than Input UVLO, both buck channels stop the gate driver, reset and enter hiccup mode. It returns to Normal when the faults are cleared.

Output Protection

The Output Under-voltage Lockout threshold and the Output Over-voltage Protection are set at V_{OUT}*60% and V_{OUT}*120%. Once Output UVLO or OVP is triggered, the specific channel stops the gate driver, reset and enters hiccup mode.

Soft Start

HT3000 series employs an internal soft start in the buck converter to prevent large inrush current and overshoots of V_{OUT}. The soft start time is 20ms in the design.

Frequency Selection

The switching frequency can be selected by applying different condition to the pin FREQ.

FREQ state	f_{sw} (kHz)
Z	150
L	250
H (Tied to VDD)	350

The efficiency of the conversion depends on the switching FET. Usually, the efficiency is higher at lower frequency because of lower switching loss.

Efficiency and External FET R_{dson}

The accuracy of the output voltage and the conversion efficiency is highly affected by the R_{dson} of the external FET. The lower the R_{dson} the higher the efficiency and voltage accuracy.

Constant Voltage / Constant Current Mode

HT3328 has the capability to operate in either CV (constant voltage) mode or CC (constant current) mode, with a smooth transition from CV to CC (See Fig.4). When in CV mode, it regulates the output voltage. Once the output current limit threshold is reached, HT3328 switches to CC mode. In CC mode, the output voltage decreases while the output current remains clamped at the predefined values. The current limit can be determined using the following equation.

$$I_{out(\max)} = \frac{33mV}{R_{sense}}$$

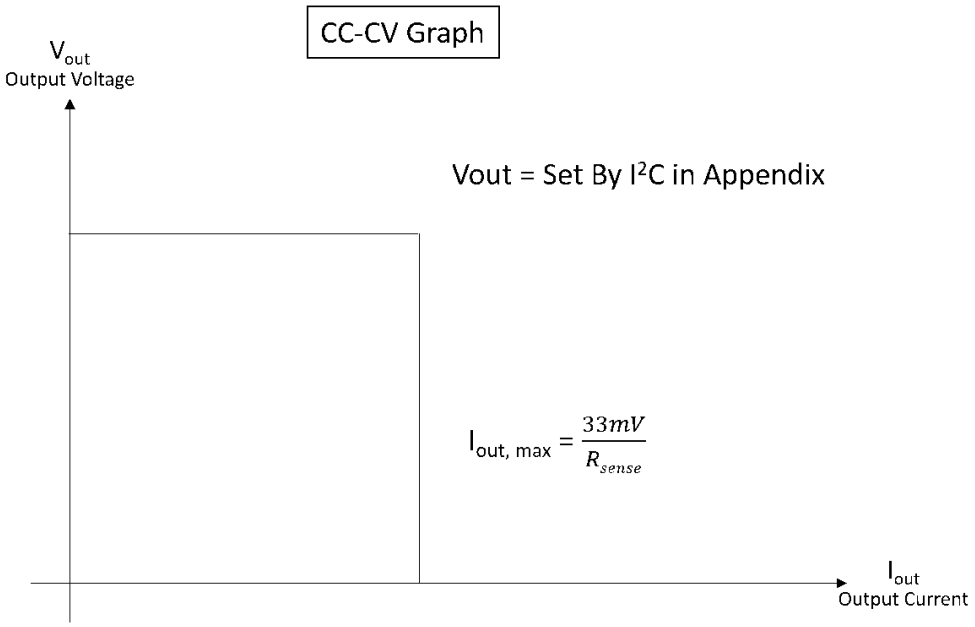


Fig.4 - CC-CV graph

Typical Application Schematic

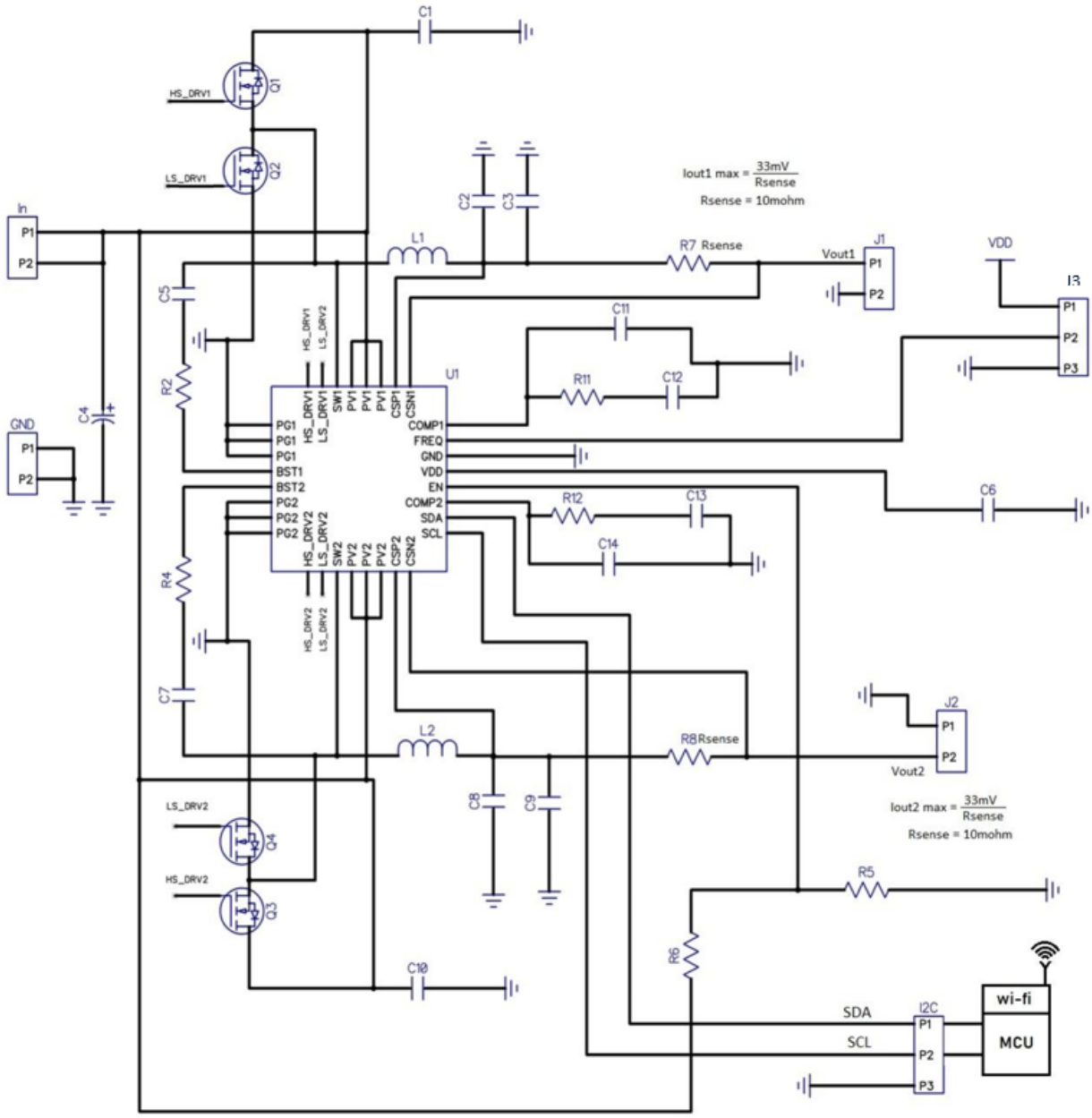
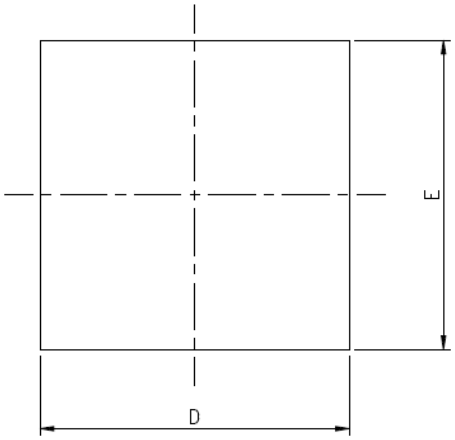


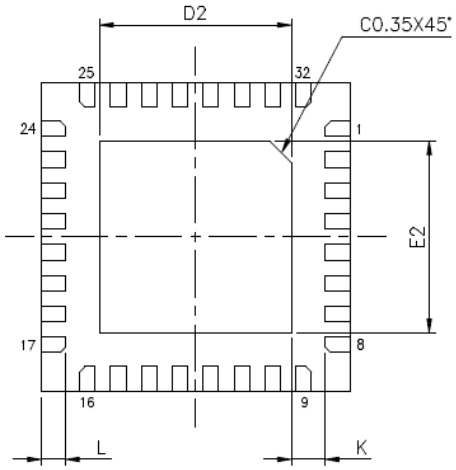
Fig. 5 - HT3328 Simplified Schematic

Package Outline and Dimensions

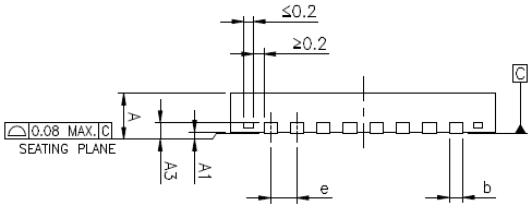
32-pin QFN (5mm x 5mm, 0.5mm pitch)



Top View



Bottom



Side View

	PACKAGE TYPE					
JEDEC OUTLINE	MO-220			MO-220		
PKG CODE	WQFN(X532)			VQFN(Y532)		
SYMBOLS	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.80	0.85	0.90
A1	0.00	0.02	0.05	0.00	0.02	0.05
A3	0.203 REF.			0.203 REF.		
b	0.18	0.25	0.30	0.18	0.25	0.30
D	5.00 BSC			5.00 BSC		
E	5.00 BSC			5.00 BSC		
e	0.50 BSC			0.50 BSC		
L	0.35	0.40	0.45	0.35	0.40	0.45
K	0.20	—	—	0.20	—	—

NOTES :
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Appendix

The hex data values for programmable constant voltage (CV). The lowest value of CV (output voltage) may go down to 1.2V, depending on applications. The step size is 100mV.

I2C Data (Hex)	CV (V)	I2C Data (Hex)	CV (V)	I2C Data (Hex)	CV (V)	I2C Data (Hex)	CV (V)	I2C Data (Hex)	CV (V)	I2C Data (Hex)	CV (V)
20	3.2	40	6.4	60	9.6	80	12.8	A0	16.0	C0	19.2
21	3.3	41	6.5	61	9.7	81	12.9	A1	16.1	C1	19.3
22	3.4	42	6.6	62	9.8	82	13.0	A2	16.2	C2	19.4
23	3.5	43	6.7	63	9.9	83	13.1	A3	16.3	C3	19.5
24	3.6	44	6.8	64	10.0	84	13.2	A4	16.4	C4	19.6
25	3.7	45	6.9	65	10.1	85	13.3	A5	16.5	C5	19.7
26	3.8	46	7.0	66	10.2	86	13.4	A6	16.6	C6	19.8
27	3.9	47	7.1	67	10.3	87	13.5	A7	16.7	C7	19.9
28	4.0	48	7.2	68	10.4	88	13.6	A8	16.8	C8	20.0
29	4.1	49	7.3	69	10.5	89	13.7	A9	16.9	C9	20.1
2A	4.2	4A	7.4	6A	10.6	8A	13.8	AA	17.0	CA	20.2
2B	4.3	4B	7.5	6B	10.7	8B	13.9	AB	17.1	CB	20.3
2C	4.4	4C	7.6	6C	10.8	8C	14.0	AC	17.2	CC	20.4
2D	4.5	4D	7.7	6D	10.9	8D	14.1	AD	17.3	CD	20.5
2E	4.6	4E	7.8	6E	11.0	8E	14.2	AE	17.4	CE	20.6
2F	4.7	4F	7.9	6F	11.1	8F	14.3	AF	17.5	CF	20.7
30	4.8	50	8.0	70	11.2	90	14.4	B0	17.6	D0	20.8
31	4.9	51	8.1	71	11.3	91	14.5	B1	17.7	D1	20.9
32	5.0	52	8.2	72	11.4	92	14.6	B2	17.8	D2	21.0
33	5.1	53	8.3	73	11.5	93	14.7	B3	17.9		
34	5.2	54	8.4	74	11.6	94	14.8	B4	18.0		
35	5.3	55	8.5	75	11.7	95	14.9	B5	18.1		
36	5.4	56	8.6	76	11.8	96	15.0	B6	18.2		
37	5.5	57	8.7	77	11.9	97	15.1	B7	18.3		
38	5.6	58	8.8	78	12.0	98	15.2	B8	18.4		
39	5.7	59	8.9	79	12.1	99	15.3	B9	18.5		
3A	5.8	5A	9.0	7A	12.2	9A	15.4	BA	18.6		
3B	5.9	5B	9.1	7B	12.3	9B	15.5	BB	18.7		
3C	6.0	5C	9.2	7C	12.4	9C	15.6	BC	18.8		
3D	6.1	5D	9.3	7D	12.5	9D	15.7	BD	18.9		
3E	6.2	5E	9.4	7E	12.6	9E	15.8	BE	19.0		
3F	6.3	5F	9.5	7F	12.7	9F	15.9	BF	19.1		

The hex data values for programmable current limit (CC). The step size is 100mA.R_{sense}=10mΩ

I2C Data (Hex)	CC (A)	I2C Data (Hex)	CC (A)	I2C Data (Hex)	CC (A)	I2C Data (Hex)	CC (A)	I2C Data (Hex)	CC (A)	I2C Data (Hex)	CC (A)
0	-	7	0.7	E	1.4	15	2.1	1C	2.8	23	3.5
1	0.1	8	0.8	F	1.5	16	2.2	1D	2.9	24	3.6
2	0.2	9	0.9	10	1.6	17	2.3	1E	3.0	25	3.7
3	0.3	A	1.0	11	1.7	18	2.4	1F	3.1	26	3.8
4	0.4	B	1.1	12	1.8	19	2.5	20	3.2	27	3.9
5	0.5	C	1.2	13	1.9	1A	2.6	21	3.3	28	4.0
6	0.6	D	1.3	14	2.0	1B	2.7	22	3.4		

IOT POWER

HT3000 Series

Smart Home Connection
At Your Fingertips

芯高科技 HIGH TECH TECHNOLOGY LIMITED

Hong Kong Office
Tel: (852) 36195375
Email: sales@hightt.com
URL: https://hightt.com
Address:
Unit 713, 7/F, 12W, 12 Science Park West Avenue,
Hong Kong Science Park, Shatin, Hong Kong

微信 WeChat