1 DESCRIPTION

The MT5815 is a System on Chip (SoC) for magnetic induction based wireless power transmitter solutions. It is fully compliant with the latest Wireless Power Consortium (WPC) Qi v1.2.4 specification, with support of both Baseline Power Profile (BPP) and Extended Power Profile (EPP).

The MT5815 provides powerful, flexible, feature rich yet compact wireless power transmitter solutions. It integrates everything except power MOSFET's and a few passive components.

These include high voltage Buck, LDO's, three pairs of N-MOSFET's drivers (to support two coils applications), multiple channels of unique Analog Front End (AFE) for ASK demodulation, FOD and Q factor detection, powerful and unique DSP for demodulation and FOD, generic 12 bit ADC and DAC, current sensing and Over Voltage, Over Current and Under Voltage Protection (OVP, OCP, UVP), oscillators and PLL with support of external crystal for high accuracy clock and extremely low power deep sleep mode, plenty of channels of PWM for individual control of each power MOSFET's for flexible dead time control and phase shift generation, power adaptor interface detection and control with support of QC 2.0/3.0, USB PD, SCP, FCP and AFC, etc. As the control and configuration center as well as data processor, MT5815 integrates an ARM Cortex M0 processor with a spacious 64KByte eFlash memory and 4KByte SRAM, as well as various serial interfaces (I2C, UART, GPIO's, etc.), offering powerful processing capabilities and customized features. With a single MT5815, one can implement any single coil or dual coil transmitters defined in WPC specification; by adding one tiny companion driver chip (MT5812), one can implement a 4 coil transmitter or two independent transmitters.

2 FEATURES

- Wide input voltage, ranging from 3.5V to 20V, and up to 40W of power transfer
- Compliant with latest WPC Qi specification v1.2.4 and beyond, supporting proprietary protocols.
- Embedded 32-bit ARM M0 processor with 64KB eFlash and 4 KB SRAM
- Supports fast charging power adaptors of different protocols, including USB PD, QC2.0/3.0, FCP and SCP, and AFC
- Integrated three pairs of N-MOSFET drivers for single and dual coil applications
- Integrated Buck convertor and LDO's for internal power supplies
- Integrated current sensing function for current measurement and current mode demodulation
- Multiple channels of AFE+DSP for ASK demodulation in voltage and current modes
- Low operating current and extremely low standby current in deep sleeping mode
- Internal 32K and 60M oscillators and PLL with support of external crystal for Apple mode fixed frequency operation
- Supports SWD, I2C, UART and JLink Interface with plenty of GPIO's
- Dual VDD_IO pins for flexible I/O levels
- Over-voltage/current/temperature protection
- Input under voltage detection and lockout function
- Available in 6mm x 6mm QFN48 package

3 APPLICATIONS

- WPC compliant wireless power transmitters for smart phones and wearable devices
- Medical, home appliance and industrial applications
- Car and other vehicle accessories
- Other wireless power applications

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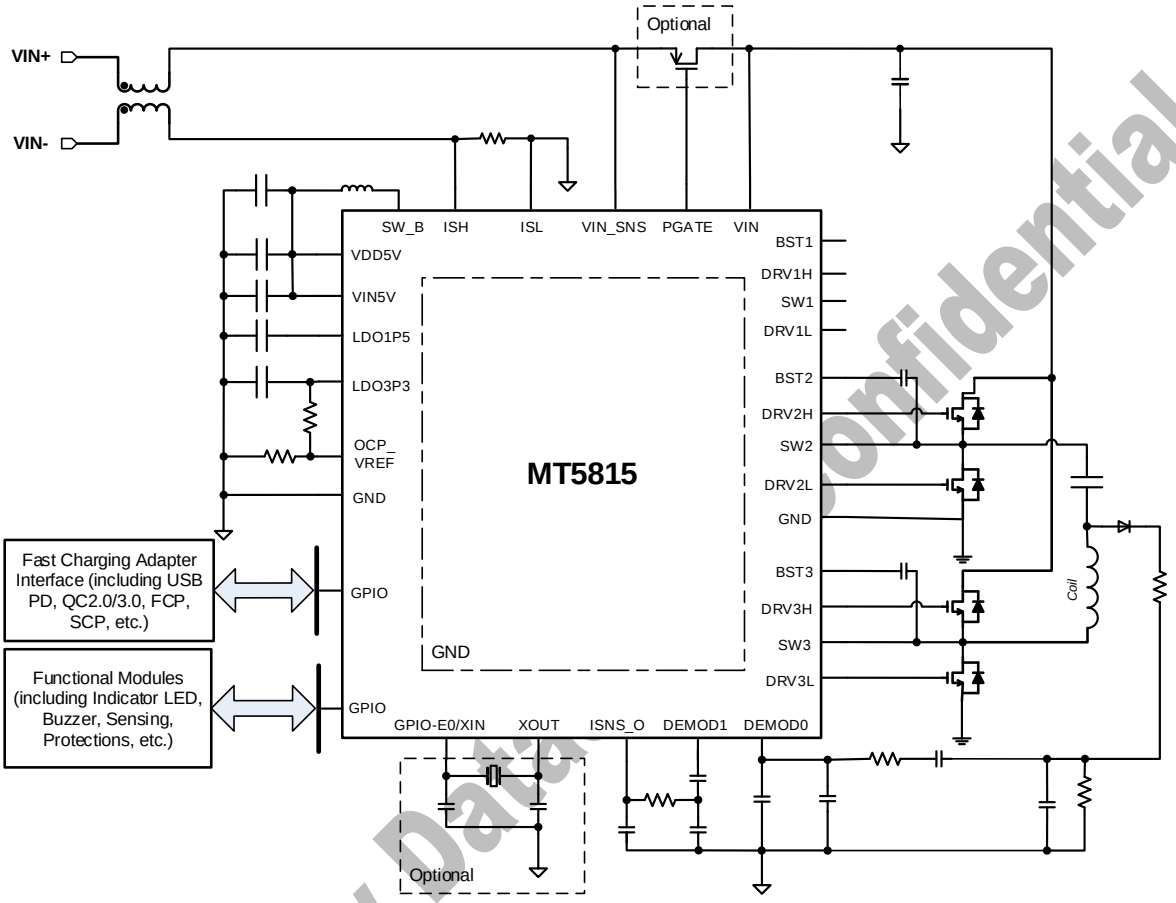
4 TYPICAL APPLICATION CIRCUIT

Single Coil Application



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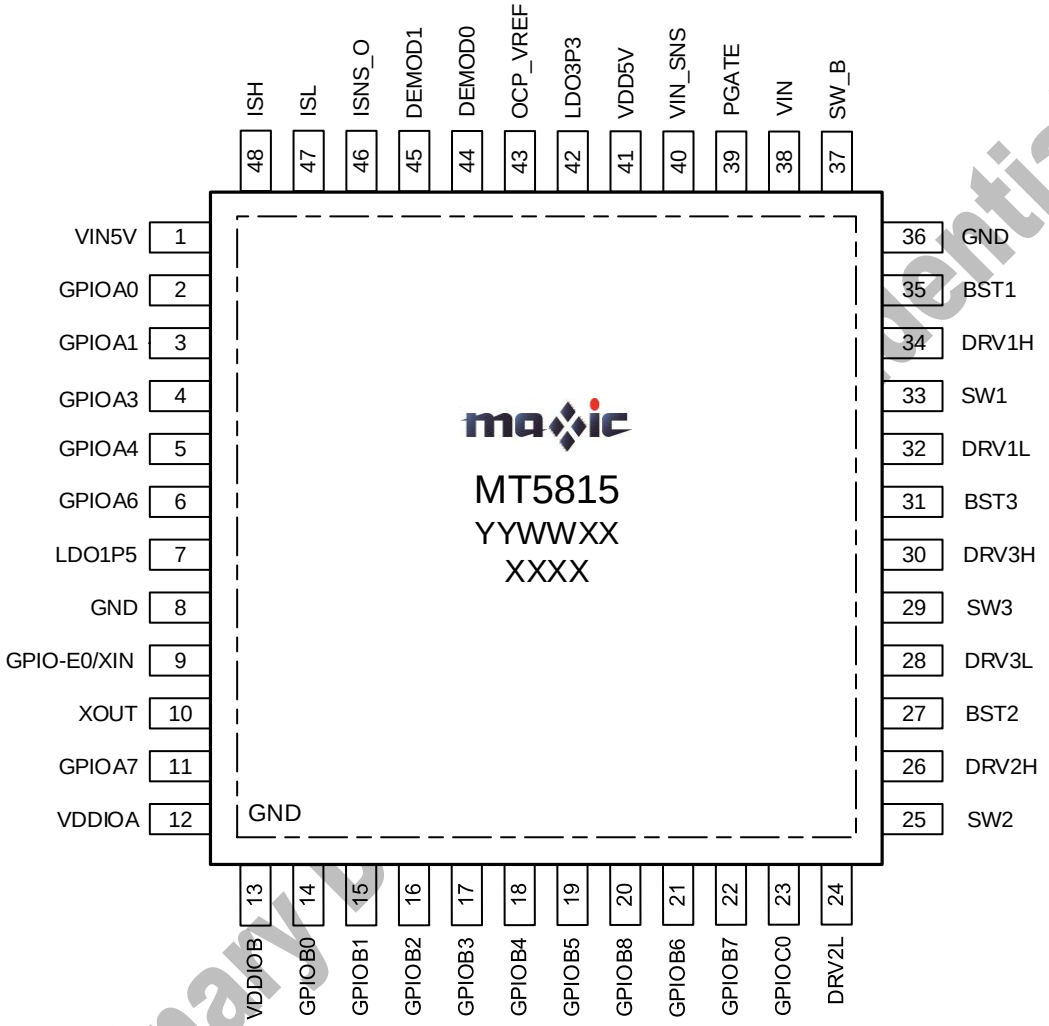
5 PIN CONFIGURATIONS AND FUNCTION

5.1 Pin Configurations



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5.2 Pin Functions

Pin Name	Pin No.	Type	Default Function	Description
VIN5V	1	PWR	VIN5V	+5V input voltage pin, connect 4.7uF capacitor.
VDD5V	41	PWR	VDD5V	BUCK converter's output, 100mA souring capability, connect 10uF and 0.1uF capacitor to GND.
LDO1P5	7	PWR	LDO1P5	Internal 1.5V LDO's output, connect 1uF capacitor to GND.
VDDIOA	12	PWR	VDDIOA	Power supply for GPIO group A, connect 1.8V/3.3V/5V power, and connect 1uF capacitor to GND.
VDDIOB	13	PWR	VDDIOB	Power supply for GPIO group B, connect 1.8V/3.3V/5V power, and connect 1uF capacitor to GND.
VIN	38	PWR	VIN	Power Supply Input.
LDO3P3	42	PWR	LDO3P3	Internal 3.3V LDO's output, connect 1uF capacitor to GND.
GPIOA0	2	I/O	CCID	Can be configured as GPIO/TRXD/CCID/FCP/DAC/ADC1
GPIOA1	3	I/O	DM	Can be configured as GPIO/SWCK/SDA/TXD/DM/FCP/DAC/ADC2
GPIOA3	4	I/O	DP	Can be configured as GPIO/SWDIO/SCL/TRXD/DP/DAC/ADC4
GPIOA4	5	I/O	Vin_sns	Can be configured as GPIO/SCL2/TRXD2/ADC5
GPIOA6	6	I/O	ISNS_O	Can be configured as GPIO/SDA2/TXD2/ADC7
GPIOA7	11	I/O	Vbrg_sns	Can be configured as GPIO/SDA2/TXD2/ADC9
GPIOB0	14	I/O	SCL	Can be configured as GPIO/SCL3/TRXD3/PWM/ADC12
GPIOB1	15	I/O	SDA	Can be configured as GPIO/SDA3/TXD3/PWM/ADC13
GPIOB2	16	I/O	Vcoil_sns	Can be configured as GPIO/SCS/PWM/ADC14
GPIOB3	17	I/O	OTP	Can be configured as GPIO/MOSI/SCL3/ADC15
GPIOB4	18	I/O	Buzzer	Can be configured as GPIO/SCP/PWM/ADC16
GPIOB5	19	I/O	Q_factor	Can be configured as GPIO/MISO/SDA3/ADC17
GPIOB8	20	I/O	GPIO	Can be configured as GPIO/PWM
GPIOB6	21	I/O	LED1	Can be configured as GPIO/LED/SCS/PWM
GPIOB7	22	I/O	LED2	Can be configured as GPIO/LED/SCP/PWM
GPIOC0	23	I/O	GPIO	GPIO
GPIO-E0/XIN	9	I/O	XIN	Clock input pin, can be configured as external XTAL OSC(8~24MHz) /GPIO
XOUT	10	I/O	XOUT	Clock output pin, can be configured as external XTAL OSC(8~24MHz) /GPIO
DRV2L	24	PWM	DRV2L	Output-Drive pin for low side power MOSFET in the 2nd switch pair.
SW2	25	PWM	SW2	Switching node in the 2nd switch pair.
DRV2H	26	PWM	DRV2H	Output-Drive pin for high side power MOSFET in the 2nd switch pair.
BST2	27	ANA	BST2	Bootstrap cap in the 2nd switch pair, connect 10nF capacitor to SW2.
DRV3L	28	PWM	DRV3L	Output-Drive pin for low side power MOSFET in the 3rd switch pair.

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Pin Name	Pin No.	Type	Default Function	Description
SW3	29	PWM	SW3	Switching node in the 3rd switch pair.
DRV3H	30	PWM	DRV3H	Output-Drive pin for high side power MOSFET in the 3rd switch pair.
BST3	31	ANA	BST3	Bootstrap cap in the 3rd switch pair, connect 10nF capacitor to SW3.
DRV1L	32	PWM	DRV1L	Output-Drive pin for low side power MOSFET in the 1st switch pair.
SW1	33	PWM	SW1	Switching node in the 1st switch pair.
DRV1H	34	PWM	DRV1H	Output-Drive pin for high side power MOSFET in the 1st switch pair.
BST1	35	ANA	BST1	Bootstrap cap in the 1st switch pair, connect 10nF capacitor to SW1.
SW_B	37	ANA	SW_B	Switching node of internal BUCK converter.
PGATE	39	ANA	PGATE	Gate control signal for external Over Voltage Protection P-MOSFET.
VIN_SNS	40	ANA	VIN_SNS	Input Voltage Sense.
OCP_VREF	43	ANA	OCP_VREF	Setting coil current OCP triggering threshold.
DEMOD0	44	ANA	DEMOD0	Demodulation channel 0 input pin.
DEMOD1	45	ANA	DEMOD1	Demodulation channel 1 input pin.
ISNS_O	46	ANA	ISNS_O	Input current sense voltage output.
ISL	47	ANA	ISL	Negative input of current sense
ISH	48	ANA	ISH	Positive input of current sense
GND	8, 36, GND	GND	GND	Power Ground.

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6. SPECIFICATIONS

6.1 Absolute Maximum Ratings

VIN_SNS, PGATE	30V
VIN, SW_B, SW1, SW2, SW3	24V
BST1, DRV1H	SW1+6V
BST2, DRV2H	SW2+6V
BST3, DRV3H	SW3+6V
VDD5V, VIN5V, VDDIOA, VDDIOB, GPIO_groupA, GPIO_groupB, GPIOC0, GPIO-E0/XIN, XOUT, DRV1L, DRV2L, DRV3L, OCP_VREF, DEMOD0, DEMOD1, ISNS_O	6V
LDO3P3	3.9V
LDO1P5	1.8V
ISL, ISH, GND	±0.3V
Storage Temperature	-55°C to 150°C
Operating Junction Temperature Range, TJ	-40°C to 125°C
Maximum Soldering Temperature (Reflow, Pb-Free, soldering, 10s)	260°C

6.2 ESD Ratings

Test Model	Pins	Ratings
HBM	All pins	±2000V
CDM	All pins	±500V

6.3 Recommended Operating Conditions

Operating Voltage (Vin)	3.5V ~ 20V
Operating Current (Iin)	0 ~ 2A
Operating Temperature (Environment)	-40°C ~ 85°C

6.4 Thermal Information (Package Thermal Data)

Junction to ambient ($R_{\theta JA}$)	36°C/W

Notes:

(1) 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 conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to absolute–maximum–rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

(3) ESD testing is performed according to the respective JESD22 JEDEC standard. 6.1 Absolute Maximum Ratings.

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6.5 Electrical Characteristics

(Test conditions: V_{IN}=5.5V, T_A=25°C unless otherwise stated.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
Vin	Input power supply		3.5	5	20	V
UVLO	Under voltage lockout			2.5		V
UVLO_HYS	Under Voltage Lockout Hysteresis			0.3		V
Idc	DC operation input current			TBD		mA
Iq	Quiescent input current			1		mA
Isleep	Sleep mode input current			TBD		uA
LDO						
LDO3P3_Vout	Output voltage	Cout=1uF; VIN=5V	3.25	3.3	3.35	V
LDO3P3_Iout	Load current		150			mA
LDO1P5	1.5V LDO Regulator	Cout=1uF; VIN=5V	1.42	1.5	1.57	V
BUCK Convertor						
Vout	Output voltage	Cout=10uF; L=4.7uH	4.95	5	5.05	V
Iout	Load current		100			mA
Current Sense Programming Ability						
Vsns_offset	Current sense output offset programming step	ISL=ISH, Measure ISNS_O PIN		1.6/1.2/ 0.9/0.6		V
Gain	Current sense gain programming step			20/30/40/ 50		
DEMOD						
Vdem_cm	Demodulation input common mode voltage programming step	Programmable. Default=0.6V		0.6/0.9 /1.2		V
ADC						
Vin_adc	ADC input range			0~2.4		V
N_adc	Number of bits of ADC			12		bit
N_ch	Number of input channels			16		N
DNL				±1		LSB
S_adc	ADC sampling rate			100		KSPS
DAC						
Vdac	DAC output range			0~2.4		V
N_dac	Number of bits of DAC			10		bit
S_dac	DAC code update speed			2		MSPS
CLOCK						
F_osc32k	Low speed oscillator			32		KHz
F_osc60M	60M oscillator			60		MHz

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
MOSFET Drivers						
Tl_on_off	Low-side Gate Driver Rise and Fall Times	C_{LOAD}= 3nF; 10% to 90%, 90% to 10%		50		ns
Th_on_off	High-side Gate Driver Rise and Fall Times	C_{LOAD}= 3nF; 10% to 90%, 90% to 10%		50		ns
GPIO						
VIH	Input high voltage		0.7* VDDIO			V
VIL	Input low voltage				0.3* VDDIO	V
VOH	Output high voltage	I=8mA	0.8* VDDIO			V
VOL	Output low voltage	I=8mA			0.2* VDDIO	V
I_lkg	leakage current			1		uA
DP and DM						
VDPsrc	Voltage source on DP			0.6		V
VDP3p3	3.3V source on DP			3.3		V
IDPsrc	DP current source			10		uA
IDPsink	DP sink current			100		uA
IDMsink	DM sink current			100		uA
RDMdown	DM pull down resistor			20		KΩ
IDPlkg	DP leakage current	DP/DM open		1		uA
IDMlkg	DM leakage current	DP/DM open		1		uA
Thermal Shut Down						
T_thermal_r	Thermal shut down rising threshold			140		°C
T_thermal_f	Thermal shut down falling threshold			120		°C

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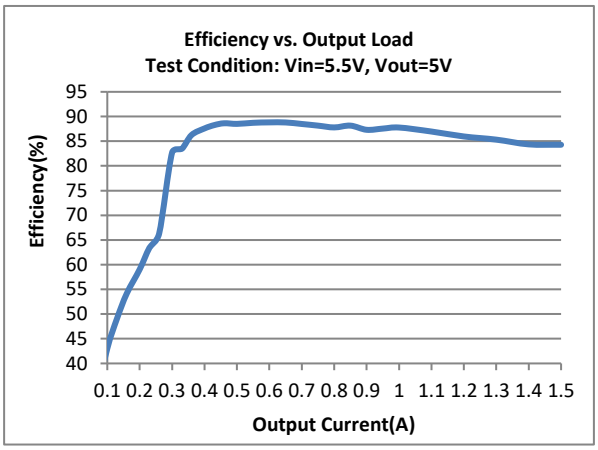
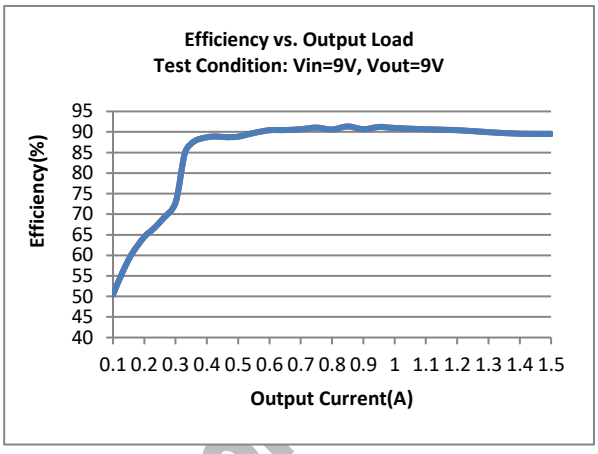
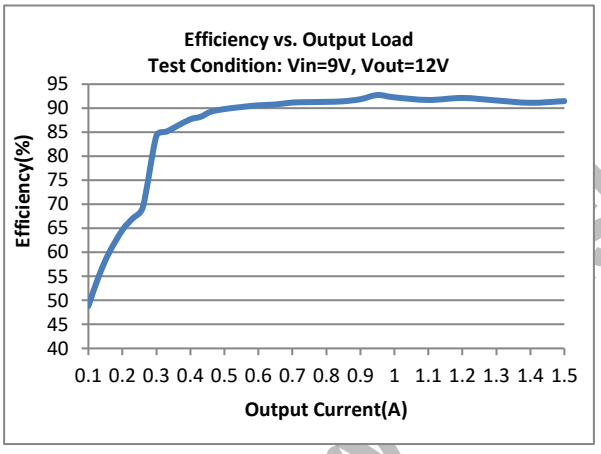
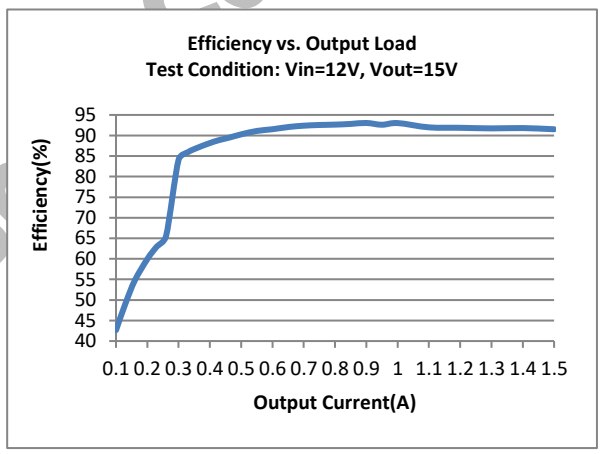
6.6 Typical Operating Characteristics

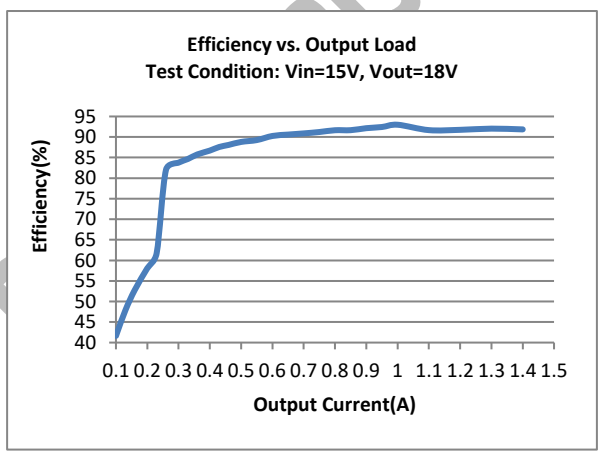
The following performance characteristics were taken using MT5815 wireless power transmitter and MT5715 wireless power receiver at T_A=25°C, unless otherwise noted.

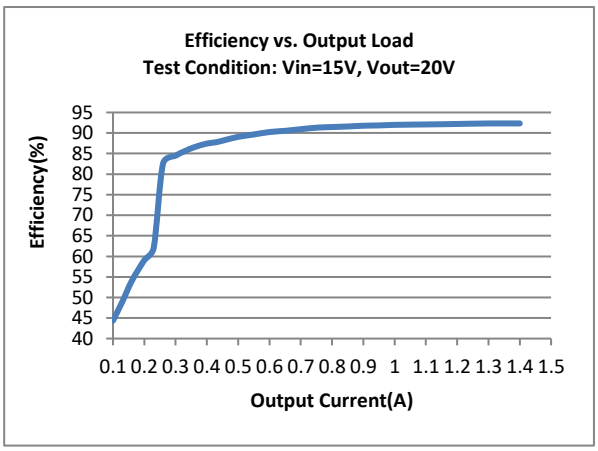












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7 DETAILED DESCRIPTIONS

7.1 Overview

MT5815 is an SoC for wireless power transmitter solutions. It integrates all major functional blocks of any WPC single coil or dual coil, BPP or EPP transmitters. These include DC to AC inverter block (clock oscillator, PLL, PWM generators, MOSFET drivers), communication block (ASK demodulation AFE and DSP, FSK modulation and 8 MHz to 24 MHz crystal support (for accurate operating and modulated frequencies), fast charging power adaptor detection and control block (Quick Charge 2.0/3.0, USB Power Deliver, FCP and SCP, AFC and other proprietary protocols), internal power supply block (high input voltage buck and analog, I/O and core LDO's), Q factor detection and FOD block, miscellaneous function block (band gap and bias, temperature sensing, ADC, DAC, current sensing, low frequency oscillator, CRC, encryption, etc.), exceptional condition protection block (input over voltage protection, input over current protection, input under voltage protection, coil over current protection, over temperature protection, etc.), serial interface block (UART, I2C master and slave, SWD, JLink, GPIO's), and an embedded processor block (32 bit ARM Cortex M0, 64Kbyte eFlash, 4Kbyte SRAM, fully programmable operating clock, AHB and APB, DMA's and peripherals, advanced timers and watchdog timers, etc.). With the abundant hardware functional blocks and the powerful M0 and the spacious eFlash memory, we allow our customers to implement differentiated functions and features on their own, based on the basic building blocks and libraries provided by us. MT5815 represents the state of art wireless power transmitter SoC solution and set an industry bench mark for high integration, rich feature set, extraordinary performance, extreme flexibility and low cost.

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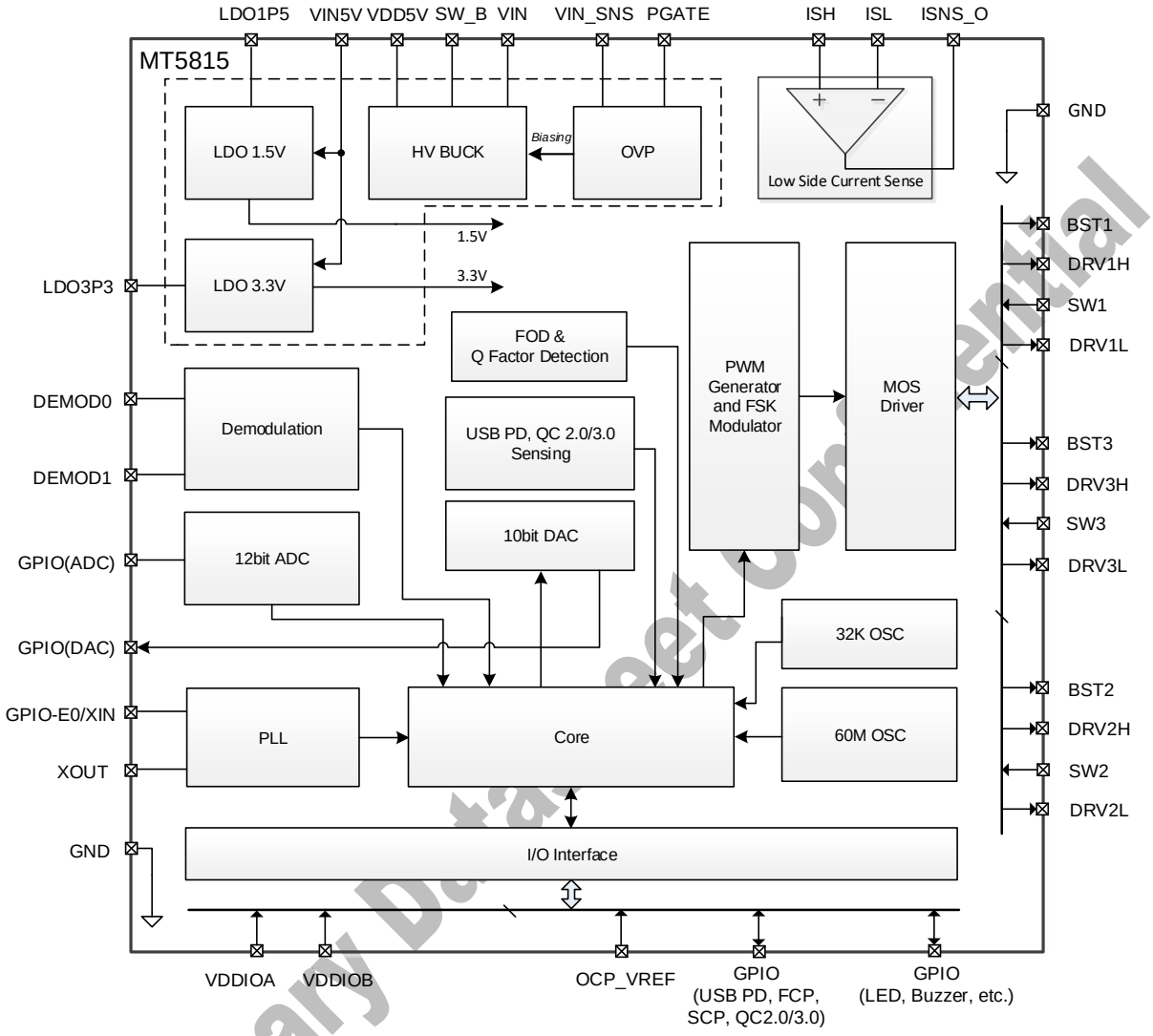
7.2 Functional Block Diagram



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7.3 Theory of Operation

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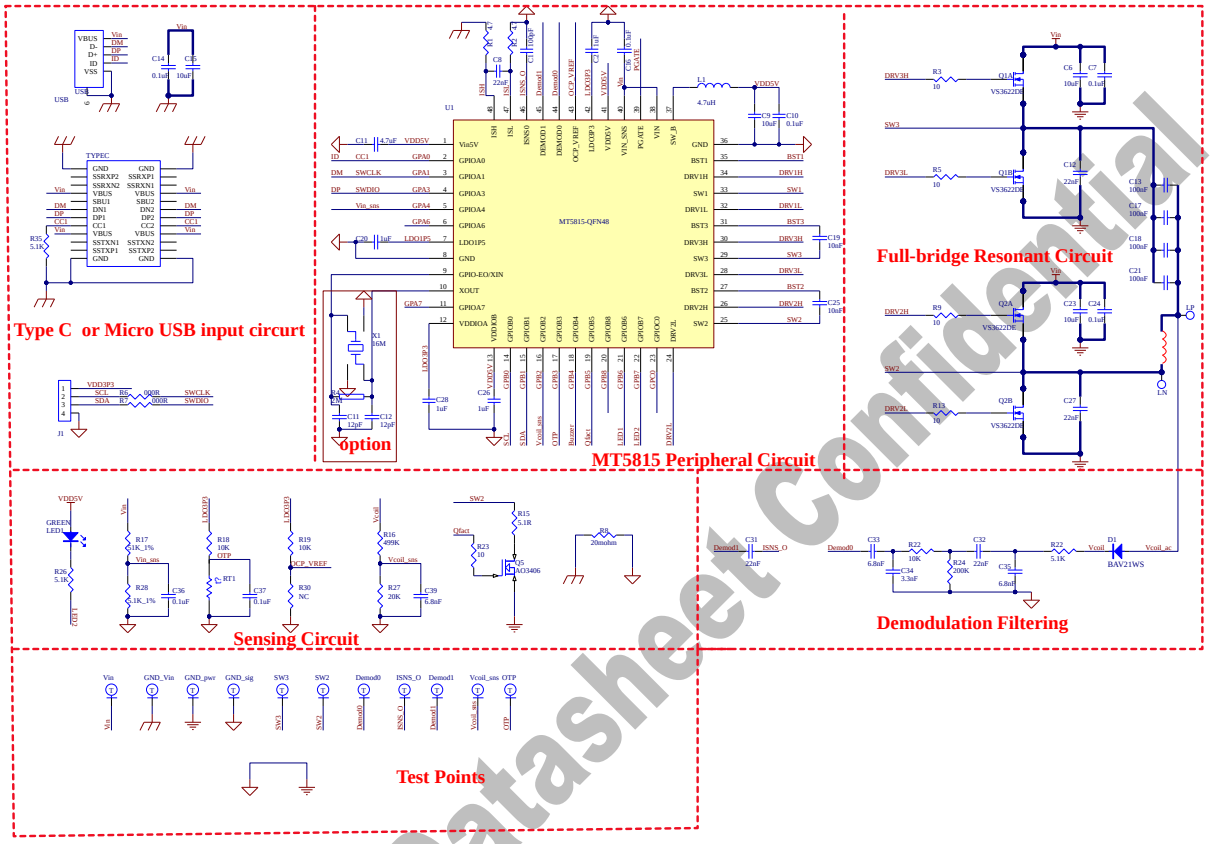
8 APPLICATIONS AND IMPLEMENTIONS

8.1 Reference schematic



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8.2 BOM

#	Reference	Value	Description	Footprint	Quantity
1	C6, C23, C9, C15	10uF/16V	CAP.CERAM.SMD,±10%,X7	0805	4
2	C11	4.7uF/10V	CAP.CERAM.SMD,±10%,X7	0603	1
3	C2, C26, C28, C20	1uF/10V	CAP.CERAM.SMD,±10%,X7	0402	4
4	C10, C16, C36, C37, C24, C7, C14	0.1uF/16V	CAP.CERAM.SMD,±10%,X7	0402	7
5	C13, C17, C18, C21	100nF/50V	CAP.CERAM.SMD,±10%,NP	1206	4
6	C12, C27, C31, C32, C8	22nF/16V	CAP.CERAM.SMD,±10%,X7	0402	5
7	C19, C25	10nF/16V	CAP.CERAM.SMD,±10%,X7	0402	2
8	C32, C33, C35, C39	6.8nF/10V	CAP.CERAM.SMD,±10%,X7	0402	4
9	C34	3.3nF/10V	CAP.CERAM.SMD,±10%,X7	0402	1
10	C1	100PF/10V	CAP.CERAM.SMD,±10%,X7	0402	1
11	R8	20mΩ	RES.SMD ±1% 1/4W	1206	1
12	R1, R2	4.7Ω	RES.SMD ±5%,1/16W	0402	2
13	R3, R5, R9, R13, R23	10Ω	RES.SMD ±5%, 1/16W	0402	5

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#	Reference	Value	Description	Footprint	Quantity
14	R15	5.1Ω	RES.SMD ±5% 1/8W	0805	1
15	R22, R28, R26, R35	5.1K	RES.SMD ±1% 1/16W	0402	4
16	R18, R19, R22	10K	RES.SMD ±5% 1/16W	0402	3
17	R27	20K	RES.SMD ±5% 1/16W	0402	1
18	R17	51K	RES.SMD ±1% 1/16W	0402	1
19	R24	200K	RES.SMD ±5% 1/16W	0402	1
20	R16	499K	RES.SMD ±1% 1/16W	0402	1
21	L1	4.7uH	IDC.SMD ±10% 100mA	0603	1
22	D1	BAV21WS	Diode.SMD 250V,250mA	SOT-323	1
23	LED1	LED	GREEN	SOD-523	1
24	Q1, Q2,	VS3622DE	Dual FET Rdson=14mΩ@Vgs=4.5V	DFN33	2
25	Q5	AO3406	Vds=30V, ID=3.6A	SOT-23-SM	1
26	Micro USB or Type C USB				1
27	U1	MT5815		QFN48-4M	1
				Total	60

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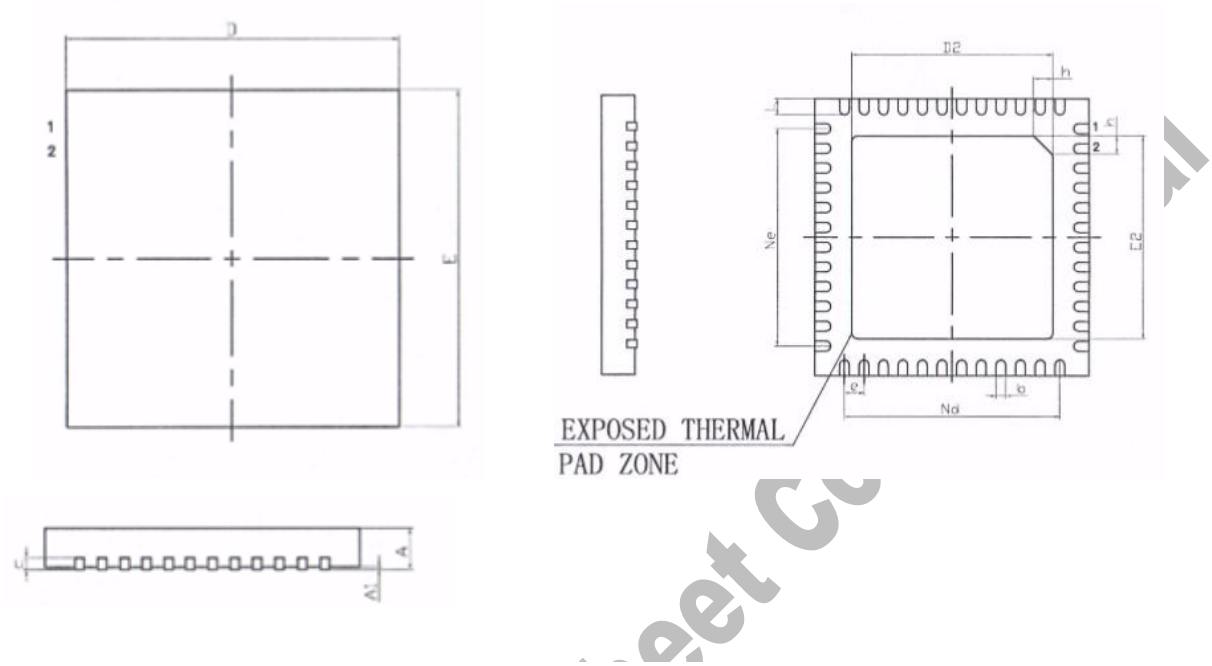
9 DETAILED PACKAGING INFORMATIONS

QFN48 Package Outline and Dimensions



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.23
D	5.90	6.00	6.10
D2	4.10	4.20	4.30
e	0.40BSC		
Ne	4.40BSC		
Nd	4.40BSC		
E	5.90	6.00	6.102.7
E2	4.10	4.20	4.30
L	0.35	0.40	0.45
b1	0.69		0.79
h	0.30	0.35	0.40

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10 ORDERING INFORMATION

Part No.	Package Type	Package Information	Package Quantity	Ambient Temperature	Chip Mark
MT5815Q	QFN48	6 x 6 mm QFN48	3000	-40°C~+85°C	MT5815 YYWWXX XXXX

11 REVISION HISTORY

Revision	Date	Description
0.5	2018-12-17	Initial release.

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