1 KEY FEATURES

- Wide input voltage range from 3.5V to 12V
- Less than 15W of power transfer
- Compliant with latest WPC Qi specification v1.2.4 with proprietary protocol support
- Embedded 32-bit ARM M0® processor with 16KB eFlash and 4 KB SRAM
- QC2.0/QC3.0, FCP/SCP support
- Integrated three pairs of N-MOSFET drivers (support for single coil applications only)
- Integrated high voltage Buck converter to reduce transmitter's power consumption in high voltage input cases
- Integrated 3.3V LDO for internal and I/O power supplies
- Integrated 1.5V LDO for core power supply
- Precise low-side current sensing function for FOD and current mode demodulation
- 4 channels demodulation AFE for voltage and current mode demodulation
- 16 channels dedicated DSP for robust ASK demodulation
- Dedicate FSK modulation hardware with programmable modulation depth
- 2 high performance PWM generation modules with 6 channels PWM output for each module, both with programmable dead time control
- Integrated 32KHz oscillator for ultra-low power sleeping mode
- Integrated Watchdog for sleeping power monitor and wake-up
- Integrated 60MHz programmable oscillator for system and PWM generation
- Supports 8~24MHz XTAL
- Integrated 440~660MHz programmable PLL for high performance PWM generation
- Build-in 10bit ADC for voltage, current and temperature measurement
- Build-in 10bit DAC with output buffer
- Low operating current and extremely low standby current in deep sleeping mode
- Supports SWD debug mode
- Supports I2C, UART and SPI 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

2 APPLICATIONS

- WPC compliant wireless power transmitters for smart phones and wearable devices
- Other wireless power applications

3 DESCRIPTION

The MT5811 is a highly integrated, high performance 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 both Baseline Power Profile (BPP) and Extended Power Profile (EPP) support. The integrated large size e-FLASH enables flexible customer function support.

The MT5811 integrates high voltage Buck, two LDO's, three pairs of N-MOSFET's drivers, four channels of ASK demodulation Analog Front End (AFE), 16 channels of ASK demodulation DSP. The embedded precise low-side current sensing, generic 10 bit ADC and DAC enable high performance FOD and Q factor detection.

It supports over voltage, over current, under voltage protection and over temperature protection (OVP, OCP, UVP, OTP) for safe operation.

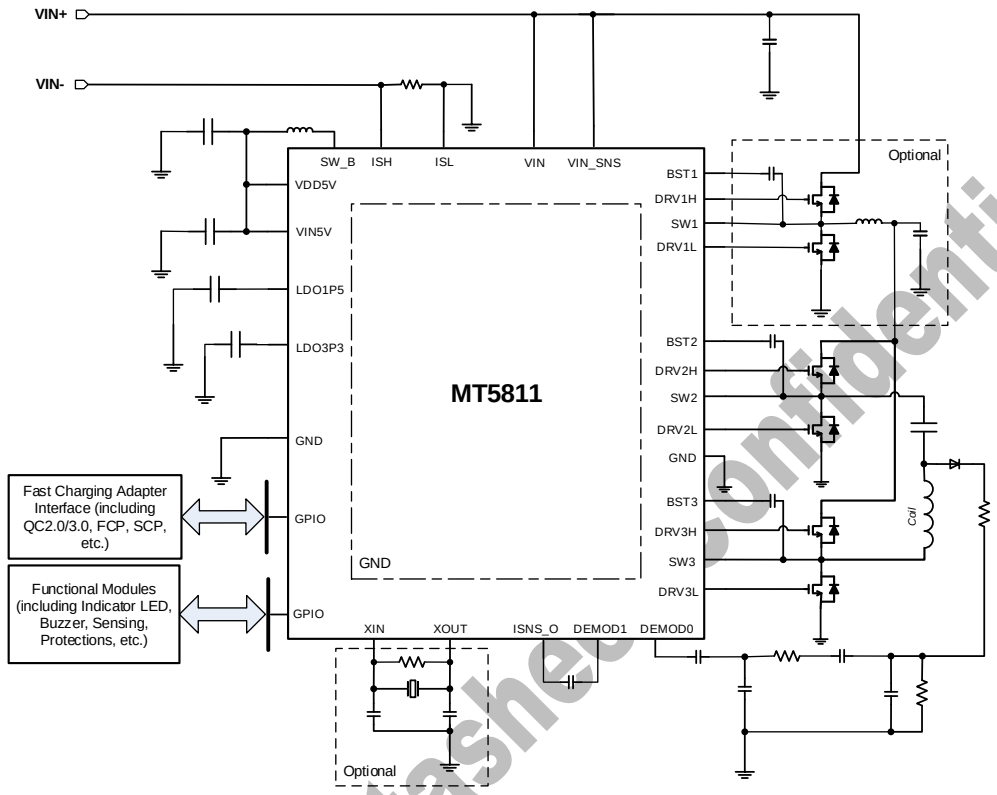
The MT5811 integrates separated high frequency and low frequency oscillators for low power and low cost application. The internal high frequency PLL with support of external crystal is designed for high accuracy clock and PWM signal generation. The high flexible I/O configuration enables multi-coil application with optimized standalone MOSFET driver (MT5603). The MT5811 is able to provide flexible dead time control and phase shift generation to improve EMI performance.

The MT5811 supports multi-protocol power adaptor interface detection and control with support of QC 2.0/3.0, SCP, FCP, etc.

The MT5811 integrates an ARM Cortex M0 processor with 16KB eFlash memory and various serial interfaces (I2C, UART, GPIO's, etc.), offering powerful processing capabilities and code space. The reference application is available with standard firmware. With the support of library (released separately), customers can easily develop the customized features.

4 TYPICAL APPLICATION CIRCUIT

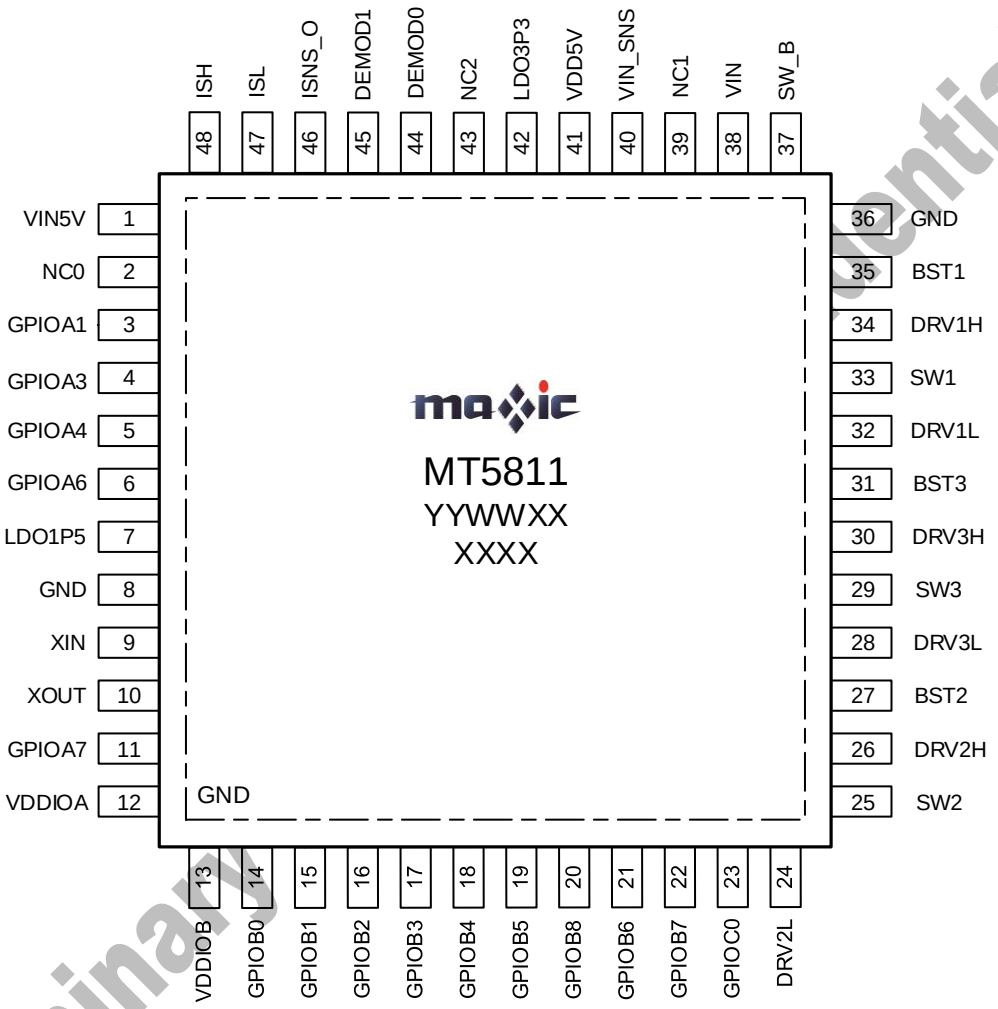
Single Coil Application



5 PIN CONFIGURATIONS AND FUNCTION

5.1 Pin Configurations

Top View



5.2 Pin Functions

Pin Name	Pin No.	Type	Description
VIN5V	1	PWR	+5V input voltage pin, connect 4.7uF capacitor.
VDD5V	41	PWR	BUCK converter's output, 100mA souring capability, connect 10uF and 0.1uF capacitor to GND.
LDO1P5	7	PWR	Internal 1.5V LDO's output, connect 1uF capacitor to GND.
VDDIOA	12	PWR	Power supply for GPIO group A, connect 1.8V/3.3V/5V power, and connect 1uF capacitor to GND.
VDDIOB	13	PWR	Power supply for GPIO group B, connect 1.8V/3.3V/5V power, and connect 1uF capacitor to GND.
VIN	38	PWR	Power Supply Input.
LDO3P3	42	PWR	Internal 3.3V LDO's output, connect 1uF capacitor to GND.
GPIOA1	3	I/O	Can be configured as GPIO/SWCK/SDA/TXD/DM/FCP/DAC/ADC2
GPIOA3	4	I/O	Can be configured as GPIO/SWDIO/SCL/TRXD/DP/DAC/ADC4
GPIOA4	5	I/O	Can be configured as GPIO/SCL2/TRXD2/ADC5
GPIOA6	6	I/O	Can be configured as GPIO/SDA2/TXD2/ADC7
GPIOA7	11	I/O	Can be configured as GPIO/SDA2/TXD2/ADC9
GPIOB0	14	I/O	Can be configured as GPIO/SCL3/TRXD3/PWM/ADC12
GPIOB1	15	I/O	Can be configured as GPIO/SDA3/TXD3/PWM/ADC13
GPIOB2	16	I/O	Can be configured as GPIO/SCS/PWM/ADC14
GPIOB3	17	I/O	Can be configured as GPIO/MOSI/SCL3/ADC15
GPIOB4	18	I/O	Can be configured as GPIO/SCP/PWM/ADC16
GPIOB5	19	I/O	Can be configured as GPIO/MISO/SDA3/ADC17
GPIOB8	20	I/O	Can be configured as GPIO/PWM
GPIOB6	21	I/O	Can be configured as GPIO/LED/SCS/PWM
GPIOB7	22	I/O	Can be configured as GPIO/LED/SCP/PWM
GPIOC0	23	I/O	GPIO
XIN	9	I/O	Clock input pin, can be configured as external XTAL OSC(8~24MHz) /GPIO
XOUT	10	I/O	Clock output pin, can be configured as external XTAL OSC(8~24MHz) /GPIO
DRV2L	24	PWM	Output-Drive pin for low side power MOSFET in the 2nd switch pair.
SW2	25	PWM	Switching node in the 2nd switch pair.
DRV2H	26	PWM	Output-Drive pin for high side power MOSFET in the 2nd switch pair.
BST2	27	ANA	Bootstrap cap in the 2nd switch pair, connect 10nF capacitor to SW2.
DRV3L	28	PWM	Output-Drive pin for low side power MOSFET in the 3rd switch pair.
SW3	29	PWM	Switching node in the 3rd switch pair.
DRV3H	30	PWM	Output-Drive pin for high side power MOSFET in the 3rd switch pair.

Pin Name	Pin No.	Type	Description
BST3	31	ANA	Bootstrap cap in the 3rd switch pair, connect 10nF capacitor to SW3.
DRV1L	32	PWM	Output-Drive pin for low side power MOSFET in the 1st switch pair.
SW1	33	PWM	Switching node in the 1st switch pair.
DRV1H	34	PWM	Output-Drive pin for high side power MOSFET in the 1st switch pair.
BST1	35	ANA	Bootstrap cap in the 1st switch pair, connect 10nF capacitor to SW1.
SW_B	37	ANA	Switching node of internal BUCK converter.
VIN_SNS	40	ANA	Input Voltage Sense.
DEMOD0	44	ANA	Demodulation channel 0 input pin.
DEMOD1	45	ANA	Demodulation channel 1 input pin.
ISNS_O	46	ANA	Input current sense voltage output.
ISL	47	ANA	Negative input of current sense
ISH	48	ANA	Positive input of current sense
NC0	2	NC	No connection. Must keep floating.
NC1	39	NC	No connection. Must keep floating.
NC2	43	NC	No connection. Must keep floating.
GND	8, 36, GND	GND	Power Ground.

5.3 I/O Pin Configuration

Pin Name	Bit[3:0] VALUE				
	0~3	4	5	6	7
GPIOA1	GPIO	swclk			
GPIOA2	GPIO				
GPIOA3	GPIO	swdio			
GPIOA4	GPIO	i2c_scl	uart_trxd		
GPIOA5	GPIO				
GPIOA6	GPIO	i2c_sda	uart_txd		
GPIOA7	GPIO	i2c_sda	uart_txd		
GPIOA8	GPIO	i2c_scl	uart_trxd		
GPIOA9	GPIO				
GPIOA10	GPIO				

I2C			
GPIOA4	scl_o	output from I2C0	
	scl_i	input to I2C0	(address = 0x4000_2030 bit[1:0] = 2'b00, default)
GPIOA6	sda_o	output from I2C0	
	sda_i	input to I2C0	(address = 0x4000_2030 bit[1:0] = 2'b00, default)
GPIOA7	sda_o	output from I2C0	
	sda_i	input to I2C0	(address = 0x4000_2030 bit[1:0] = 2'b00, default)
GPIOA8	scl_o	output from I2C0	
	scl_i	input to I2C0	(address = 0x4000_2030 bit[1:0] = 2'b00, default)
UART			
GPIOA4	uart_txd	output from UART0	(address = 0x4000_2030 bit[3:2] = 2'b00, default) //need set(address = 0x4000_1800 bit[5] //= 1'b1)
	uart_rxd	input to UART0	
GPIOA6	uart_txd	output from UART0	(address = 0x4000_2030 bit[3:2] = 2'b00, default) //need set(address = 0x4000_1800 bit[5] //= 1'b0) default
GPIOA7	uart_txd	output from UART0	(address = 0x4000_2030 bit[3:2] = 2'b00, default) //need set(address = 0x4000_1800 bit[5] //= 1'b0) default
GPIOA8	uart_txd	output from UART0	(address = 0x4000_2030 bit[3:2] = 2'b00, default) //need set(address = 0x4000_1800 bit[5] //= 1'b1)
	uart_rxd	input to UART0	

Pin Name	Bit[3:0] VALUE						
	0~3	4	5	8	9	A	B
GPIOB0	GPIO	GPIO	i2c_scl	uart_trxd	PWM1_1P	PWM1_1N	ATIM1_P
GPIOB1	GPIO	GPIO	i2c_sda	uart_txd	PWM1_1P	PWM1_1N	ATIM1_P
GPIOB2	GPIO	GPIO	spi_cs	LED1	PWM1_3P	PWM1_3N	ATIM3_P
GPIOB3	GPIO	GPIO	spi_sda	i2c_scl	PWM1_2P	PWM1_2N	ATIM2_P
GPIOB4	GPIO	GPIO	spi_sck	LED2	PWM1_3P	PWM1_3N	ATIM3_P
GPIOB5	GPIO	GPIO	spi_sda	i2c_sda	PWM1_2P	PWM1_2N	ATIM2_P
GPIOB6	GPIO	GPIO	spi_cs	LED1	PWM1_2P	PWM1_2N	ATIM2_P
GPIOB7	GPIO	GPIO	spi_sck	LED2	PWM1_2P	PWM1_2N	ATIM2_P
GPIOB8	GPIO	GPIO			PWM1_3P	PWM1_3N	ATIM3_P
GPIOB9	GPIO	GPIO			PWM1_2P	PWM1_2N	ATIM2_P

I2C			
GPIOB0	scl_o	output from I2C1	
	scl_i	input to I2C1	(address = 0x4000_2030 bit[1:0] = 2'b01)
GPIOB1	sda_o	output from I2C1	
	sda_i	input to I2C1	(address = 0x4000_2030 bit[1:0] = 2'b01)
GPIOB3	scl_o	output from I2C1	
	scl_i	input to I2C1	(address = 0x4000_2030 bit[1:0] = 2'b01)
GPIOB5	sda_o	output from I2C1	
	sda_i	input to I2C1	(address = 0x4000_2030 bit[1:0] = 2'b01)
UART			
GPIOB0	uart_txd	output from UART1	
	uart_rxd	input to UART1	(address = 0x4000_2030 bit[3:2] = 2'b01) //need set address = 0x4000_1A00 bit[2] = 1
GPIOB1	uart_txd	output from UART1	(address = 0x4000_2030 bit[3:2] = 2'b01) //need set address = 0x4000_1A00 bit[2] = 0 default

Pin Name	Bit[3:0] VALUE										
	0~3	4	5	6	7	8	9	A	B	C	D
GPIOC0	GPIO		PWM1_3P	PWM2_3P	ATIM3_P						
GPIOC1	GPIO					PWM1_1P	PWM1_1N	PWM2_1P	PWM2_1N	ATIM1_P	ATIM1_N
GPIOC2	GPIO					PWM1_1P	PWM1_1N	PWM1_2P	PWM1_2N	PWM2_1P	PWM2_1N
GPIOC3	GPIO	PWM2_2N	PWM1_2N	PWM1_1P	PWM1_1N	PWM1_2P	PWM1_2N	PWM2_1P	PWM2_1N	ATIM1_P	ATIM1_N
GPIOC4	GPIO	PWM1_2P	PWM1_2N	PWM1_3P	PWM1_3N	PWM2_2P	PWM2_2N	PWM2_3N	PWM_2_3P	ATIM2_N	ATIM2_P
GPIOC5	GPIO			PWM1_2P	PWM1_2N	PWM1_3P	PWM1_3N	PWM2_2P	PWM2_2N	ATIM2_P	ATIM2_N
GPIOC6	GPIO			PWM1_2P	PWM1_2N	PWM1_3P	PWM1_3N	PWM2_2P	PWM2_2N	ATIM2_P	ATIM2_N
GPIOC7	GPIO			PWM1_1P	PWM1_1N	PWM1_3P	PWM1_3N	PWM2_1P	PWM2_1N	ATIM3_P	ATIM3_N
GPIOC8	GPIO			PWM1_1P	PWM1_1N	PWM1_3P	PWM1_3N	PWM2_3P	PWM2_3N	ATIM3_P	ATIM3_N
GPIOC9	GPIO			PWM1_1P	PWM1_1N	PWM1_3P	PWM1_3N	PWM2_1P	PWM2_1N	ATIM3_P	ATIM3_N
GPIOC10	GPIO	PWM1_1P	PWM1_1N	PWM1_3P	PWM1_3N	PWM2_1P	PWM2_1N	PWM2_3P	PWM2_3N	ATIM2_P	ATIM2_N
GPIOC11	GPIO			PWM1_2P	PWM1_2N	PWM1_3P	PWM1_3N	PWM2_2P	PWM2_2N	ATIM2_P	ATIM2_N

	Bit[3:0] VALUE			
Pin Name	0	1	2	3
GPIO	Hiz	input	output	inout

6 SPECIFICATIONS

6.1 Absolute Maximum Ratings

VIN_SNS, VIN	30V
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, XIN, XOUT, DRV1L, DRV2L, DRV3L, 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	±1500V
CDM	All pins	±500V

6.3 Recommended Operating Conditions

Operating Voltage (Vin)	3.5V ~ 12V
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.

6.5 Electrical Characteristics

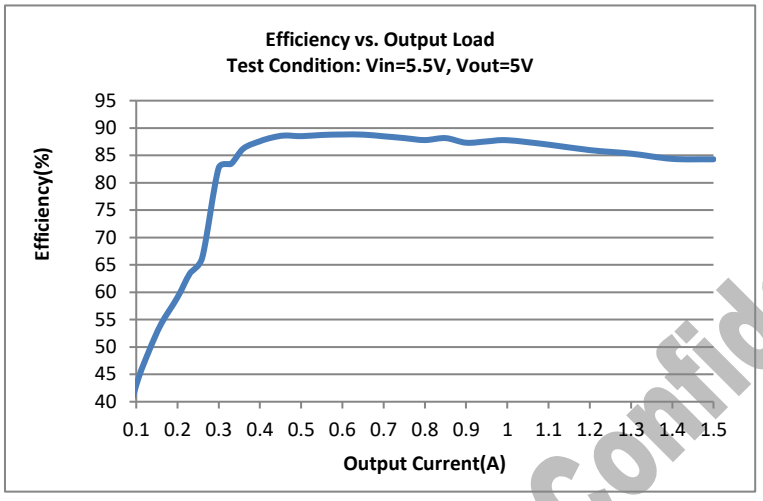
(Test conditions: V_{IN}=5.5V, T_A=25°C unless otherwise stated.)

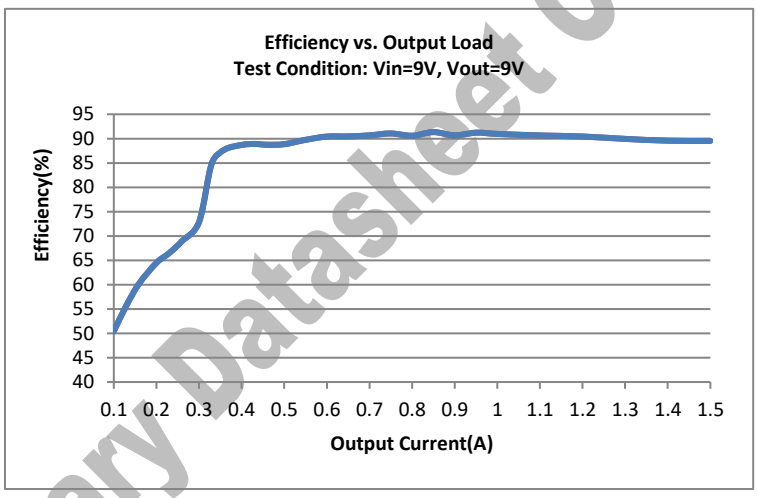
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
Vin	Input operating voltage range			3.5~12		V
UVLO	Under voltage lockout	Ramp from 0~5V.		2.5		V
UVLO_HYS	Under Voltage Lockout Hysteresis			0.3		V
Idc	DC operation input current			TBD		mA
Iq	Quiescent input current			1		mA
Isleep	Sleep mode input current			TBD		uA
LDO						
LDO3P3_Vout	Output voltage	Cout=1uF; VIN=5V	3.0	3.3	3.6	V
LDO3P3_Iout	Load current			50		mA
LDO1P5	1.5V LDO Regulator	Cout=1uF; VIN=5V	1.35	1.5	1.65	V
BUCK Converter						
Vout	Output voltage	Cout=10uF; L=4.7uH	4.5	5	5.5	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			10		bit
N_ch	Number of input channels			16		N
DNL	Differential Nonlinearity			±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		M
CLOCK						
F_osc32k	Low speed oscillator			32		KHz

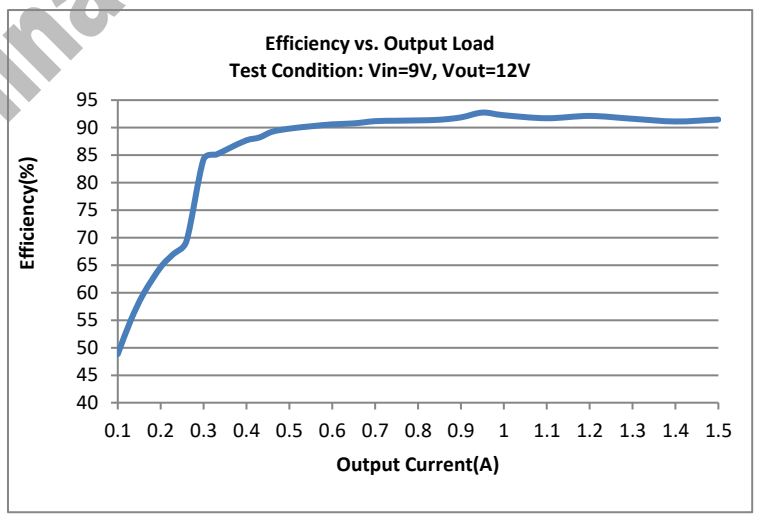
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
F_osc60M	60M oscillator			60		MHz
MOSFET Drivers						
Tl_on_off	Low-side Gate Driver Rise and Fall Times	C_{LOAD}= 3nF; 10% to 90%, 90% to 10%		50		ns
Th_on_off	High-side Gate Driver Rise and Fall Times	C_{LOAD}= 3nF; 10% to 90%, 90% to 10%		50		ns
GPIO						
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

6.6 Typical Operating Characteristics

The following performance characteristics were taken using MT5811 wireless power transmitter and MT5715 wireless power receiver at T_A=25°C, unless otherwise noted.







7 DETAILED DESCRIPTIONS

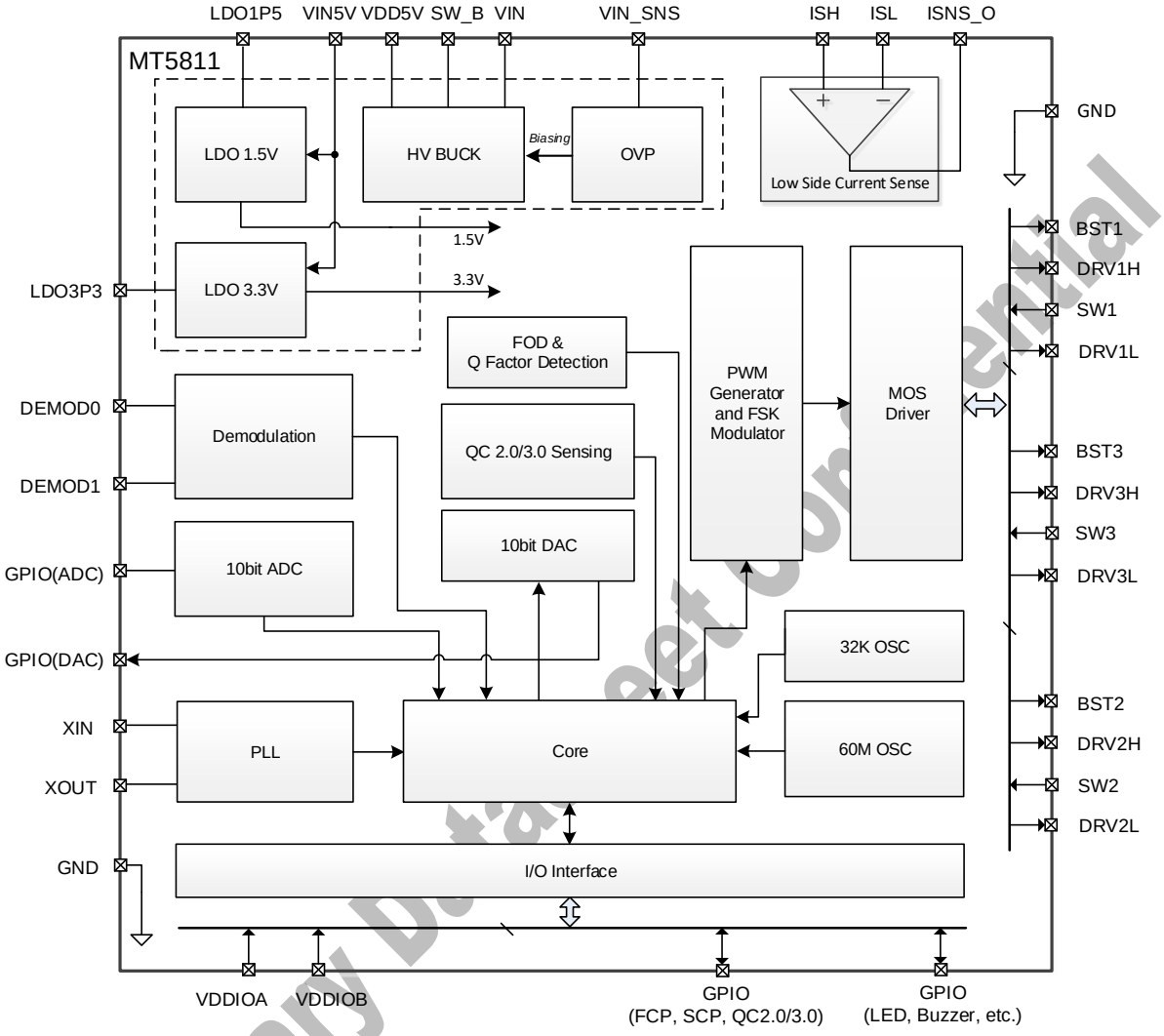
7.1 Overview

MT5811 is an SoC for wireless power transmitter solutions. It integrates all major functional blocks to ensure high flexibility, high performance and high reliability.

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.

MT5811 represents the state of art wireless power transmitter SoC solution and sets an industry bench mark for high integration, rich feature set, extraordinary performance, extreme flexibility and low cost.

7.2 Functional Block Diagram

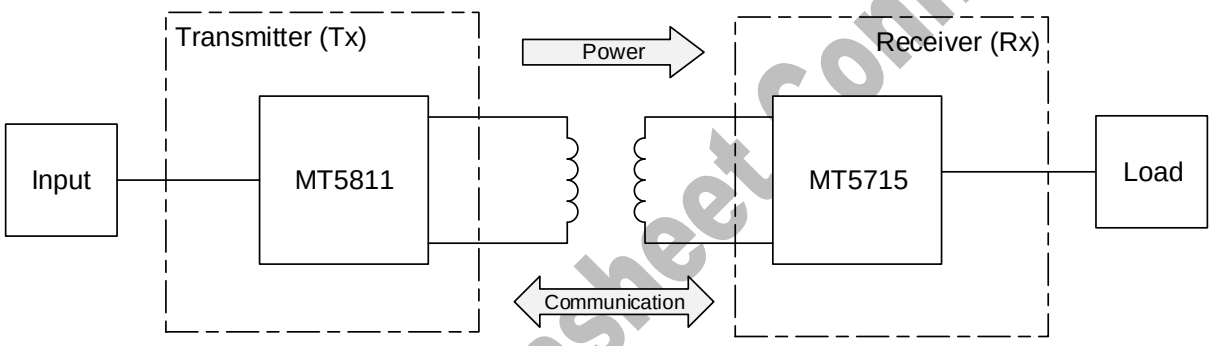


7.3 Theory of Operation

The wireless power system uses magnetic induction to transfer power from a power transmitter (Tx) to a power receiver (Rx).

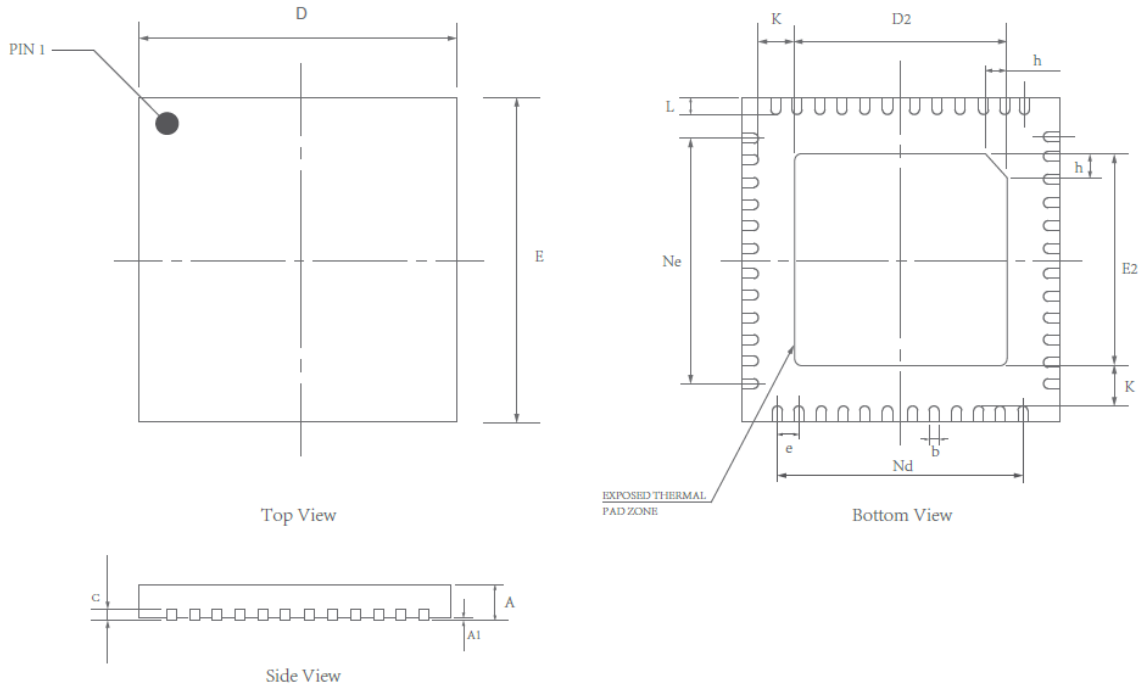
Before power transfer begins, the Rx and Tx communicate with each other to establish that the Rx is indeed capable of power receiving, whether it needs power transfer, how much power is required, etc. In short, the communication ensures an appropriate power transfer from the power transmitter to the power receiver.

When power transfer begins, the power transmitter runs an alternating electrical current through its coil(s), which generates an alternating magnetic field in accordance with Faraday's law. Varying electric field generates varying magnetic field; varying magnetic field generates varying electric field. Therefore, the power transfer is achieved.



8 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

9 ORDERING INFORMATION

Part No.	Package Type	Package Information	Package Quantity	Ambient Temperature	Chip Mark
MT5811	QFN48	6 x 6 mm QFN48	3000	-40°C~+85°C	MT5811 YYWWXX XXXX

10 REVISION HISTORY

Revision	Date	Description
1.0	2019-05-27	Initial release.

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