Bluetooth Low Energy Single Mode SoC

FEATURES

- BLE 5.0 Compliance
- Support Bluetooth Master/Slave
- Single Power Supply 2.0V~3.63V
- The Build In firmware includes:
  - Logical Link Control and Adaptation Protocol (L2CAP)
  - Security Manager (SM)
  - Attribute Protocol (ATT)
  - Generic Attribute Profile (GATT)
  - Generic Access Profile (GAP)
  - Advanced Encryption Standard (AES-128)
- Clock Interface support 32MHz/32KHz
  - 32 MHz Crystal in system domain
  - Internal 32KHz RC Oscillator in RTC domain
- Integrated DC2DC
- Integrated LDO regulator for low noise
- Integrated 32Bit Micro-processor
- Integrated 256Kbyte flash
- Integrated Watchdog/Power on reset
- Integrated Timers
- Integrated RAM/Retention RAM
  - 32K RAM in system domain
  - 2K Retention RAM in RTC domain
- Support 19 GPIOs with interrupt function
- Support 1 IIC master,1 SPI master,6 PWM
- Support 4Row*4Col Keys Scan Matrix
- Support 1 UART port
- -93 dBm High performance receiver sensitivity
- Follow Bluetooth Class 3 grade : Max +3 dBm transmit output power
- Support Class 1/2 through external PA/LNA
- Single wire antenna: no RF matching or RX/TX switching required
- Extreme Low power
  - Deep Sleep Mode: 20nA@3.3V
  - Sleep Mode: 3.8uA@3.3V
  - Idle Mode: 1mA@3.3V
  - RX Active: 10mA@3.3V
  - TX Active: 10mA@3.3V (0dBm output power)
- QFN 4x4 32Pin Package
- Operating Temperature: -40 -- 105ºC

ORDERING INFORMATION

Part Number	Temp Range	Package
77422 **LN**	-40ºC to105ºC	QFN32 4x4mm

GENERAL DESCRIPTION

77422 is a highly integrated Bluetooth 5.0 low energy single mode device. It integrates a high-performance RF transceiver, baseband, 32Bit Risc Microprocessor, rich interface resource, qualified protocol stack and customized profile to support BLE application.

77422 enable low power connectivity and basic data transfer for applications limited by the power consumption. It has four power modes: Deep Sleep/Sleep/Idle/Active. 77422 firmware includes one boot-loader which support firmware upgrade by UART or wireless. It features L2CAP/SM/ATT/GATT/GAP and application profiles such as Health thermometer, Heart Rate, Blood Pressure, Human Interface Device.

77422 integrates 32Kbyte RAM in system domain to support application case. 2Kbyte Low leakage retention RAM is used to store sensitive data and connection information in Sleep mode.

77422 integrates 256Kbyte flash.

77422 build in DCDC, LDO, Watchdog, POR, ADC to decrease BOM cost.

provides users with reference designs and development kits, and fully supports system development with speed and efficiency. Low-cost solution, excellent performance and rapid integration allow our customers the opportunity to seize market share.

APPLICATIONS

- Keyboard/Mouse/Remote Control Human Interface Devices
- Fitness Device
- Mobile Phone Accessories
- Consumer Electronics
- Health Care and Medical Remote Monitoring
- Smart ID reader
- Automated Meter Reading
- Wireless Sensor Networks
- Lighting and HVAC Control
- Ibeacon Station
- Proximity and out of Range Detection

FUNCTIONAL BLOCK DIAGRAM
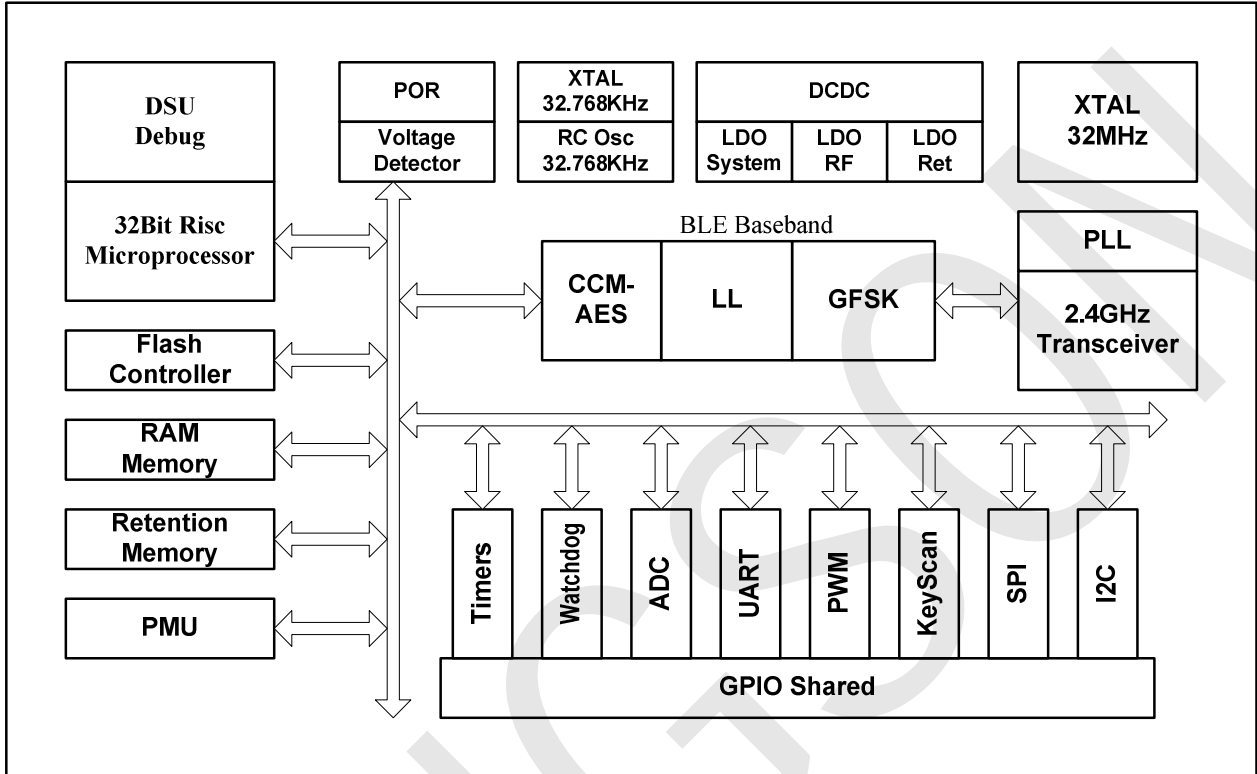
PIN ASSIGNMENTS AND DEFINITIONS

Note 1: IO Type and Pull up/Pull down

Term	Description	Term	Description
I	Input	GND	Ground
O	Output	PU	Internal pull up
I/O	Input and output	PD	Internal pull down
Power	Power source		

Table1.1 IO Type

Note 2: Operation Mode Definition

Test Mode Pin	Mode Description	Comments
High	ATE Scan-Chain Mode	Enable ATE Test
Low	Normal Mode	Internal Pull Down, Enable Normal working mode. Connect to Ground or Let it floating if no using.

Table1.2 Operation Mode Definition

Note 3: Shared Digital IO Mapping

| GPIO	Key Scan	ADC Input	PWM	UART1	DSU	I2C Master	SPI Master	External PA Enable
gpio0	Out0						SCLK	
gpio1	Out1						MOSI	
gpio2	Out2						MISO	
gpio3	Out3						SCS	
gpio4	IN0							
gpio5	IN1							
gpio6	IN2							
gpio7	IN3							PATX
gpio8		ADC0	PWM0			SCL		
gpio9		ADC1	PWM1			SDA		
gpio10		ADC2	PWM2		DRX			
gpio11		ADC3	PWM3		DTX			
gpio12			PWM4	URX1				
gpio13			PWM5	UTX1				

Table1.3 Shared Digital IO Mapping

Note 4:

If don't use the key scan function, please let the GPIO5 floating. Because it's Latch-up test only support to -50mA.

QFN32

Pin Assignments
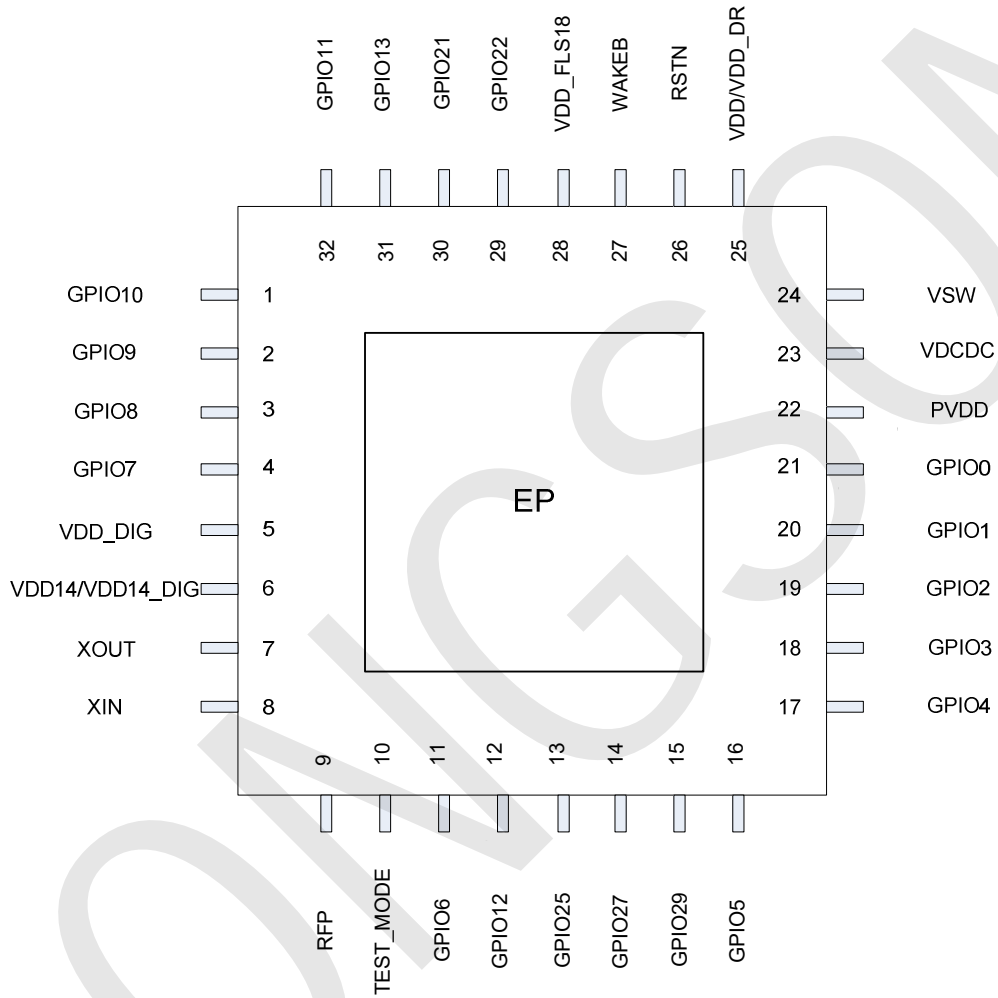
Pin Definitions

Pin	Name	Type	Drive	Description
1	GPIO10/ADC2/PWM2/DRX	Digital I/O (Note1)	4mA	GPIO10/ADC2/PWM2/DSURX(Note3)
2	GPIO9/ADC1/PWM1/SDA	Digital I/O	4mA	GPIO9/ADC1/PWM1/SDA
3	GPIO8/ADC0/PWM0/SCL	Digital I/O	4mA	GPIO8/ADC0/PWM0/SCL
4	GPIO7/KS_IN3/PATX	Digital I/O	4mA	GPIO7/KS_IN3/PATX
5	VDD_DIG	Power		Digital power, System LDO OUT 1.2V,1uF capacity to GND
6	VDD14/VDD14_DIG	Power		1.4V RF/Digital power supply, from VDCDC
7	XOUT	Analog		32MHz crystal output
8	XIN	Analog		32MHz crystal input
9	RFP	Analog		RFIO
10	TEST_MODE	Digital I		Scan mode, high active (Note2)
11	GPIO6/KS_IN2	Digital I/O	4mA	GPIO6/KS_IN2
12	GPIO12/PWM4/URX1	Digital I/O	4mA	GPIO12/PWM4/UART1_RX
13	GPIO25	Digital I/O	4mA	
14	GPIO27	Digital I/O	4mA	
15	GPIO29	Digital I/O	4mA	
16	GPIO5/KS_IN1	Digital I/O	4mA	GPIO5/KS_IN1 (Note4)
17	GPIO4/KS_IN0	Digital I/O	4mA	GPIO4/KS_IN0
18	GPIO3/KS_OUT3/XCS0	Digital I/O	4mA	GPIO3/KS_OUT3/XCS0
19	GPIO2/KS_OUT2/XMISO	Digital I/O	4mA	GPIO2/KS_OUT2/XMISO
20	GPIO1/KS_OUT1/XMOSI	Digital I/O	4mA	GPIO1/KS_OUT1/XMOSI
21	GPIO0/KS_OUT0/SPCLK	Digital I/O	4mA	GPIO0/KS_OUT0/SPCLK
22	PVDD	Power		3.3V test output,1uF capacity to GND
23	VDCDC	Power		DCDC Output，1.4V
24	VSW	Power		DCDC switch pin
25	VDD/VDD_DR	Power		Power supply (2.0V~3.63V)
26	RSTN	Analog I/O		Reset Test signal,1.2V level,1uF capacity to GND
27	WAKEB	Analog		Wake-up signal input. Active low. Tie WAKEB pin to low to disable the Deep_sleep mode
28	VDD_FLS18	Power		1.8V output, 1uF capacity to GND
29	GPIO22	Digital I/O	4mA	
30	GPIO21	Digital I/O	4mA	
31	GPIO13/PWM5/UTX1	Digtal I/O	4mA	GPIO13/PWM5/UART1_TX
32	GPIO11/ADC3/PWM3/DTX	Digital I/O	4mA	GPIO11/ADC3/PWM3/DSUTX
EP	EP			GND

77422 ARCHITECTURE OVERVIEW

77422 is a highly integrated Bluetooth 5.0 low energy single mode chip. It integrates a high-performance 2.4GHz RF transceiver, baseband, 32Bit Risc Microprocessor, rich interface resource, qualified protocol stack and customized profiles to support different BLE application.

77422 enable low power wireless connectivity and 1Mbps data transfer for applications limited by the power consumption. It has four power modes: Deep Sleep/Sleep/Idle/Active.

77422 has one powerful MCU which can be set to work at 32MHz frequency. It integrates 32Kbyte RAM in system domain to support a lot of application cases. 2Kbyte Low leakage retention RAM is used to store sensitive data and connection information in Sleep mode, so that the connection can be recovery as soon as possible.

77422 firmware includes one robust boot-loader which support firmware upgrade by UART or wireless online. It also features stable and qualified O2Micro^{TM} BLE protocol stack, implementing L2CAP/SM/ATT/GATT/GAP and application profiles such as Health thermometer, Heart Rate, Blood Pressure, Human Interface Device. We provide friendly SDK compile/debug/programming tools, Library, example profile source code to decrease customer product development period. 77422 has one 2.4GHz GFSK transceiver which is designed and optimized to operate in the worldwide ISM frequency band at 2.4~2.4835GHz. The transceiver implement receiver, transmit and frequency synthesizer. Receiver achieves -93dBm sensitivity with filters. Transmitter support typical BLE output power level Class1/2/3. RF synthesizer has 1MHz resolution to frequency hopping.

77422 feature one hardware engine which implement CRC, AES, CCM, Gauss Filter, Digital Modulation, Data whitening, Access code correlation blocks. The hardware function can be configured flexibly to meet BLE specification DTM test requirement.

77422 design 19 GPIOs, 6 PWMs, 1 SPI Master, 1 I2C Master, Key-Scan, 1 UART, 4 channels ADC shared interfaces to support different applications.

77422 build in DCDC, LDO, Watchdog, POR, LPO to decrease BOM cost.

We provide users with reference designs and development kits, and fully support system development with speed and efficiency. Low-cost solution, excellent performance and rapid integration allow our customers the opportunity to seize market share.

FUNCTIONAL DESCRIPTION

RF Section

RFP Port

77422 contains an integrated balun which provides a single-ended RF TX/RX port pin. No matching components are needed as the receive mode impedance is 50Ω and the transmitter has been deliver power in to a 50Ω load.

LNA

A high-performance LNA takes its input from the balanced port of the integrated balun. The lowest noise figure is the contributor to overall system sensitivity.

RSSI

The ADC samples RSSI voltage real-time and feedback to MCU. The front-end LNA gain is changed according to the measured RSSI value. This improves the dynamic range of receiver and improves performance in interference environments.

IQ Modulator

The transmitter features a direct carrier up-conversion to channel frequency during a transmit packet. The coming data stream is passed through Digital Gauss Filter. The modulation index is fixed to 0.5 accurately.

Power Amplifier

The internal PA has a maximum 0dBm output power and its output level can be fine adjusted. We can provide one PATX pin to connect external PA to get higher output power level.

PLL and Loop Filter

The entire Phase-Locked Loop (PLL) generating the local oscillator for the mixer is contained on-chip. A classic three-element RC PLL loop filter has been implemented on-chip. The reference frequency for the PLL is provided by an external reference source. The external reference source support 32MHz crystal.

Parameter	Condition	Min	Typ	Max	Unit
Nominal Frequency	Nominal frequency referenced to 25°C		32		MHz
Frequency tolerance			+/-20		ppm
Load capacitance			10		pF
Temperature range		-40		85	°C

Table1.4 RF Crystal Specification

Baseband Section
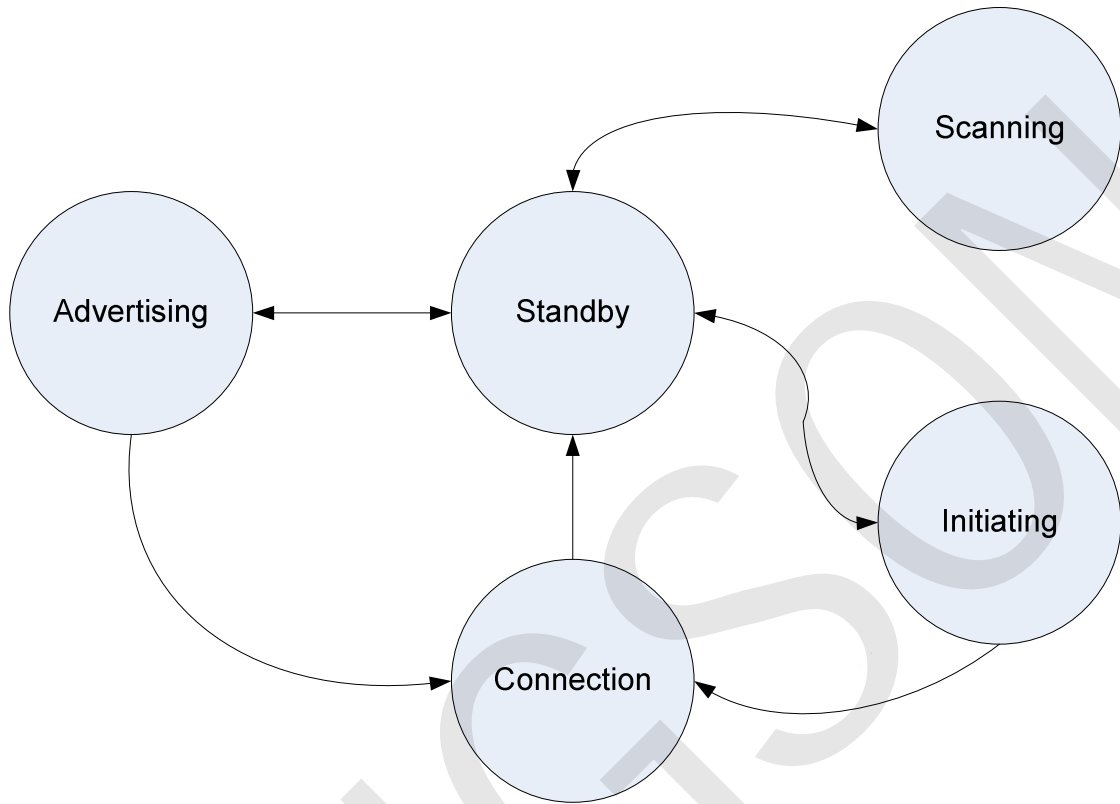
GFSK

Running in the 2.4GHz ISM band, Bluetooth employs frequency hopping techniques with the carrier modulated using Gaussian Frequency Shift Keying (GFSK).
A binary one is represented by a positive frequency deviation and a binary zero is represented by a negative frequency deviation. The modulated signal is then filtered using a filter with a Gaussian response curve to ensure the sidebands do not extend too far either side of the main carrier. By doing this the Bluetooth modulation achieves a bandwidth of 1 MHz with stringent filter requirements to prevent interference on other channels. For correct operation the level of BT is set to 0.5 and the modulation index must be between 0.45 and 0.55.

Link Layer

Based on RF/GFSK physical layer, Link Layer need implement connection, frequency hopping scheme, package resend, CRC, Channel shared, and so on. There are six possible Link Layer states of a BLE device.

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77422规格书

CCM

Cipher Block Chaining-Message Authentication Code Mode is an authenticated encryption algorithm designed to provide both authentication and confidentiality during data transfer. The CCM block generates an encrypted key stream, applies it to the input data using XOR operation, and generates 4byte MIC field in one operation. CCM will encrypt in time for transmission and decrypt after receiving bytes into memory from the air.
CCM integrated AES-128 calculation unit. AES-128 can be used for a range of cryptographic functions like hash generation, digital signatures, and key stream generation for encryption/decryption.

PMU Section

Power Mode

77422 has a complete power management unit. There are one high efficiency DCDC and separate low noise LDOs. They can be on/off controlled by smart firmware.
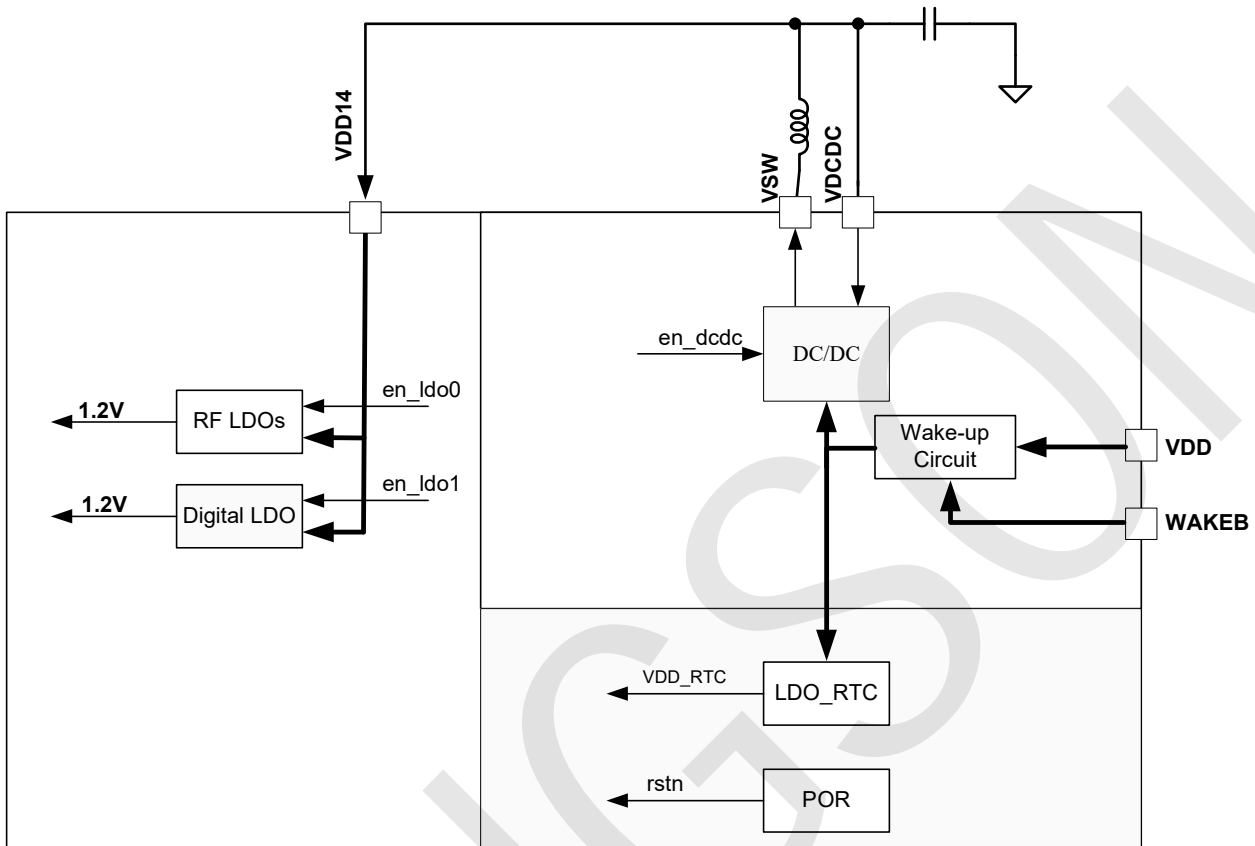
Power mode definition as follow:

Power Mode	System domain	RTC domain	Description
Active	On	On	RF TX/RX working; MCU running
Idle	On	On	RF TX/RX no working; MCU hung-up, Peripherals gated clock
Sleep	Off	On	System domain power off; Logic and memory in RTC running
Deep Sleep	Off	Off	System and RTC domain power off. Only Deep Sleep WakeB circuit working. About 4second Low pulse on WakeB pin will wake-up whole system

POR

77422 integrated one power on reset circuit in RTC domain. It monitors power supply input voltage, and generate reset signal once voltage fall lower than 1.5V threshold.
RSTN pin is the output of POR circuit, you can drive this pin low to force system recovery from any exception. Let is floating if no using.

MCU & Peripherals Section

MCU

This is a 32Bit processor conforming to the IEEE-1754(SPARC V8) architecture. It is designed for embedded applications with the following unit: separate instruction and data caches, hardware multiplier, divider, interrupt controller, debug unit with trace buffer.

32Kbyte RAM serves as data ram for intermediate variables and various data that the protocol required. Optionally, it can be used as extra memory space for the BLE TX and RX data structures. 32Kbyte RAM is enough to a lot of application cases.
2Kbyte low leakage ram is used to store various data of the Bluetooth protocol as well as the system's global variables and processor stack when the system goes into Sleep mode. Storage of this data ensures secure and quick configuration of the BLE Core after the system wakes up.
77422 also integrated 256kbyte flash. It supports to save customer's firmware and parameters. It exceeds 100,000 program and erase cycles.

Clocks

77422 has two clock inputs: RF Crystal input in System domain and internal 32.768KHz RC oscillator in RTC domain.

RF Crystal input

This crystal act as RF reference clock source and main CPU clock. It is necessary in the communication system. Its specification refers to PLL and Loop Filter.
RF oscillator circuit supports 32MHz frequency crystal. Baseband hardware engine works at fixed 16MHz. MCU and peripherals can work at 32MHz frequency.

RTC clock

77422 also build in one 32.768KHz RC oscillator for saving cost in BLE slave device, and there is one strategy to calibrate its frequency based on external RF crystal.

Watchdog

The watchdog timer is a 32-bit timer that can be used to detect an unexpected execution sequence caused by a software run-away and can generate a full system reset or a Maskable Interrupt.
Maskable Watchdog will freeze when the MCU is halted in Debug mode.

Timers

77422 contains nine timer modules that are software controlled, programmable and can be used for various tasks.

Timer Name	Width	Purpose	Clock source	Notes
Timer0	32Bit	In System timer	CPU Clock	In System
Timer1	32Bit	In System timer	CPU Clock	In System
Timer2	32Bit	No Reload Function Timer out will generate interrupt	CPU Clock	In System
Alarm Timer0	32Bit	Power on	32.768KHz Clock	In RTC
Alarm Timer1	32Bit	Power on	32.768KHz Clock	In RTC
Interval Timer	32Bit	CPU clock on	Baseband Clock or 32.768KHz Clock	In RTC
Supervision Timer	32Bit	No Reload Function Timer out will generate interrupt	Baseband Clock or 32.768KHz Clock	In RTC
TIFS Timer	16Bit	Switch between TX and RX	Baseband Clock	In System
Long Timer	32Bit	For Software task counter	32.768KHz Clock	In RTC

GPIO Ports

77422 integrates many general input/output ports in System power domain. ➢
Supports 19 GPIOs
➢   All 19 GPIOs support the IO function and interrupt function.
➢   Drive strength is 4mA.

PWM

77422 has six independent PWM outputs. Each PWM output can be disable/enable. Theirs duty cycle can be configured as below method.
High Level Time = MCU clock $\times$ N (N = 0 ~ 0XFFFF)
Low Level Time = MCU clock $\times$ F (F = 0 ~ 0XFFFF)

PWM will output fixed level if N or F is configured to 0.

UART

77422 Supports one UART devices. The UART interface has 128 bytes FIFO for TX and 64 bytes FIFO for RX. It will generate interrupt request when there is risk or event of FIFO underflow or overflow. For the RX, it will generate interrupt if found parity bit check error or stop bit check error.

The UART's main features are:

➢ Fully synchronous design
➢ Synchronous or Asynchronous Interface
➢ FIFO mode for transmit and receive sections

UART supports the following Baud rates: 115200bps, 57600bps, 38400bps, 19200bps, 9600bps, and 4800bps.

SPI Master

77422 design one SPI master interface with MOSI/MISO/SCLK/SCS. It has four pins for the SPI connection to external circuit. Depending on the requirements of the external circuit, OZ77422 can be configured to support either a four-wire or a three-wire SPI interface. This is shown in the following Figures.
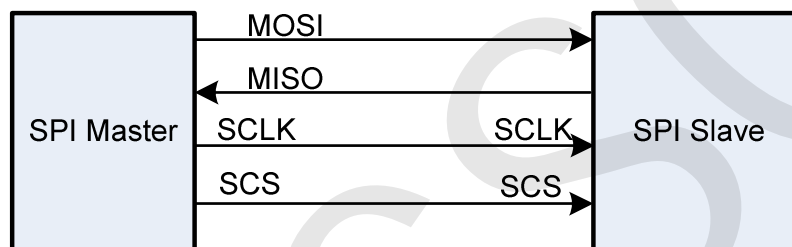

Figure2.1 SPI Connection with Four Line SPI Device
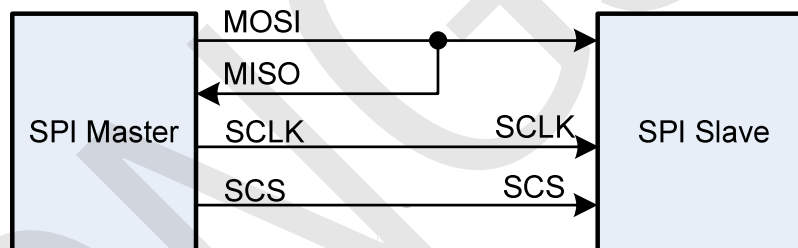

Figure2.2 SPI Connection with Three Line SPI Device

IIC Master

77422 IIC has the following features

➢ Supports 7/10 bits of address width.
➢ Supports three speed modes :100Kbps, 400Kbps, 2.9Mbps
➢ Supports manual and auto read/write

ADC

77422 integrated 12Bit SAR ADC that support multiple channels sampling. The ADC only support one-shot operation mode. A single conversion will be triggered by ADC_start signal. An ADC_eoc signal will go high at the end of each conversion.
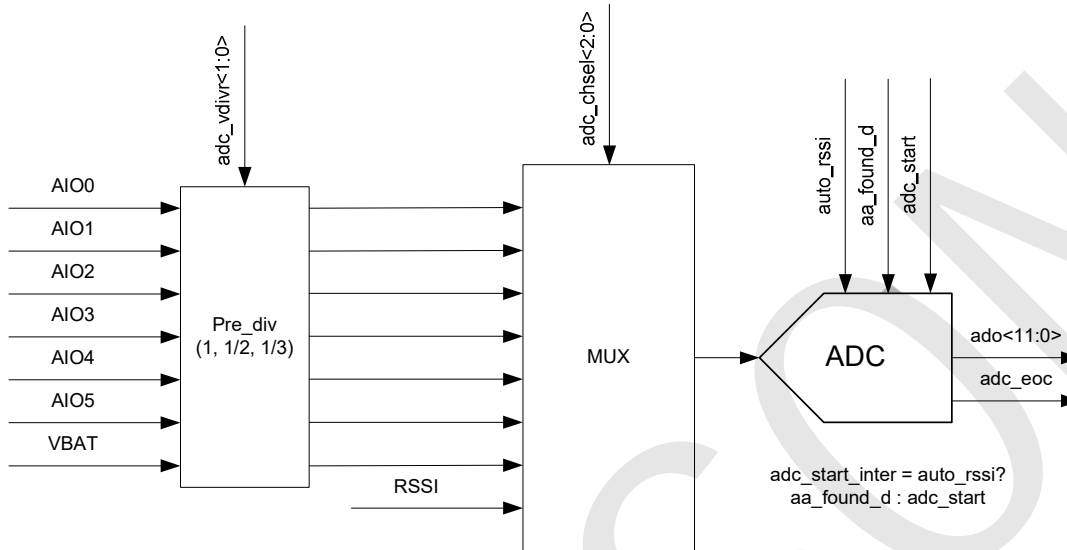
The ADC clock frequency is programmable as following table.

clk_adc_rate[2:0]	ADC working frequency
111	Reserve
110(default)	8MHz
101	4MHz
100	2MHz
011	1MHz
010	500kHz
001	250kHz
000	125kHz

ADC input channel can be selected as following table.

adc_chsel<2:0>	Input signal
000	RSSI
001	VBAT
010	AIO[0]
011	AIO[1]
100	AIO[2]
101	AIO[3]
110	AIO[4]
111	AIO[5]

Input voltage pre-divider is available for ADC channel 1~7. Voltage pre-divider ratio is programmable as following table.

adc_vdivr[1:0]	Input signal divider ratio
00	1/3
01	1/2
1x	1

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Absolute maximum ratings are short term stress ratings only. And functional operation of the device at these or any other conditions beyond those indicated in the recommended operating conditions is not implied. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

Symbol	Parameters	Note	Min	Max	Unit
VDD	Single Power Supply voltage	—	-0.3	+3.63	V
VI	Input Voltage	—	-0.5	+VDD +0.5	V
VO	Output Voltage	—	-0.5	+VDD +0.5	V
RFP max	LNA input power	—	—	+3	dBm
Topt	Operating temperature	—	−40	+85	°C
Tstg	Storage temperature range	—	−50	+150	°C
Tsldr	Solder reflow temperature	—		250	°C

Table2.1 Absolute maximum Ratings

Recommended Operating Conditions

Symbol	Parameters	Note	Min	Typ	Max
VDD	System Domain IO Supply voltage	—	2V	3.3V	3.63V
TA	Ambient Operating temperature	—	-40°C	—	+85°C

Table2.2 Recommended Operating Conditions

DC Characteristics

DC Electrical Characteristics (Digital IO Section)

Recommended Operating Conditions for 3.3V I/O application

Symbol	Parameters	Min	Typ	Max
VDD	IO Voltage VDD	2.97V	3.3V	3.63V
VIH	Input High Voltage	2.0V		VDD+0.3V
VIL	Input Low Voltage	-0.3V		0.8V
IL	Input Leakage Current			±10uA
VOL	Output low voltage			0.4V
VOH	Output High voltage	2.4V		
IOL	Low level output current @VOL=0.4V	4.0mA	6.2mA	7.8mA
IOH	High level output current @VOH=2.4V	4.6mA	9.8mA	15.4mA
RPU	Pull-up Resistor	33K	41K	62K
RPD	Pull-down Resistor	33K	42K	68K

Recommended Operating Conditions for 2.5V I/O application

Symbol	Parameters	Min	Typ	Max
VDD	IO Voltage VDD	2.25V	2.5V	2.75V
VIH	Input High Voltage	0.55*VDD		VDD+0.3V
VIL	Input Low Voltage	-0.3V		0.35*VDD
IL	Input Leakage Current			±10uA
VOL	Output low voltage			0.45V
VOH	Output High voltage	VDD-0.45V		
IOL	Low level output current @VOL=0.45V	2.2mA	4mA	5.6mA
IOH	High level output current	1.8mA	3mA	4.2mA

	@VOH=VDD-0.45V			
RPU	Pull-up Resistor	67K	93K	152K
RPD	Pull-down Resistor	64K	92K	170K

Table2.3 Digital IO DC Electrical Characteristics

DC Electrical Characteristics (Power Consumption)

Power Mode	VDD Current	Description
TX Active	10mA@3.3V	RF TX working; MCU running
RX Active	10mA@3.3V	RF RX working; MCU running
Idle	1mA@3.3V	RF TX/RX no working; MCU hung-up, Peripherals gated clock
Sleep	3.8uA@3.3V	System domain power off; Logic and memory in RTC running
Deep Sleep	20nA@3.3V	System and RTC domain power off. Only Deep Sleep WakeB circuit working. About 4second Low pulse on WakeB pin will wake-up whole system

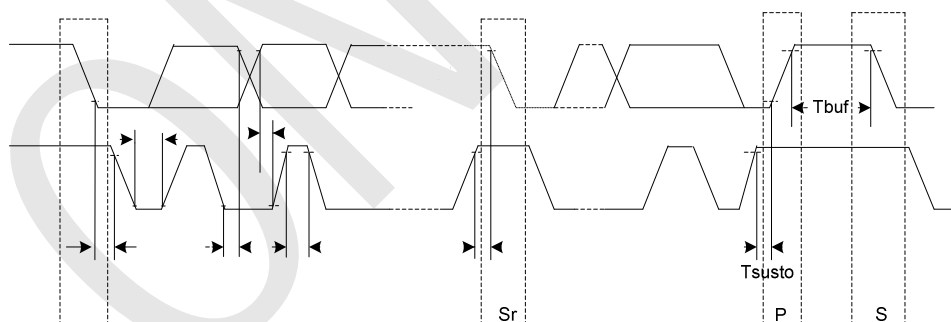**Table2.4 Power Consumption Characteristics**

AC Characteristics

AC Electrical Characteristics (Peripherals Section)

1. IIC Part

   Applicable over recommended operating range from TA=-40C to +85C, VDD=3.3V

Symbol	Standard Speed	Full Speed	High Speed
Thdsta	4us	1us	125ns
Tlow	6us	1.5us	187.5ns
Thigh	4.03125us	1.03125us	156.25ns
Tsusta	6.03125us	1.53125us	218.75ns
Thddat	4us	1us	125ns
Tsudat	2us	0.5us	62.5ns
Tsusto	4.03125us	1.03125us	156.25ns
Tbuf	18us	5us	5.25us
Prescale	16'hf	16'h3f	8'h1
Actual speed	99.6KHz	395KHz	2.9MHz

Table2.5 IIC AC Electrical Characteristics

2. SPI Part

   Applicable over recommended operating range from TA=-40C to +85C, VDD=3.3V
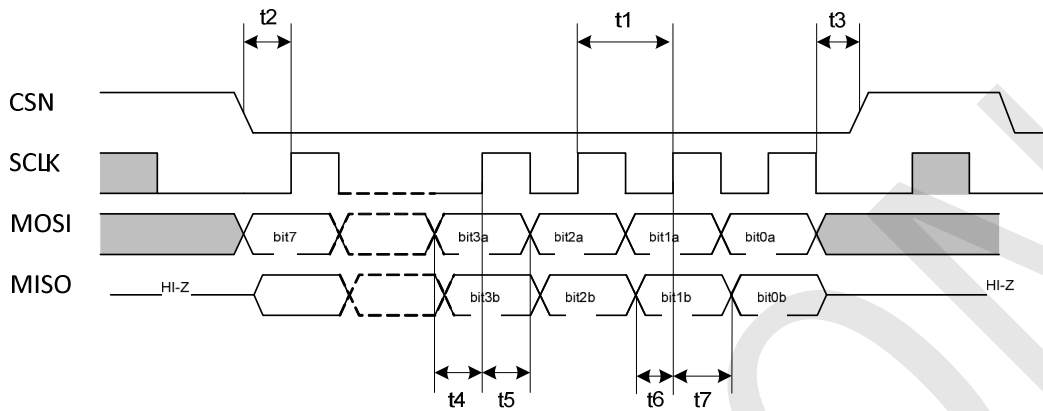
Figure2.1 Timing Diagram for a double 8-bit Register Read Operation

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
t1	SCLK period	125		15937.5	ns
	SCLK duty cycle		50%		
t2	CSN low to SCLK	62.5	Tsclk/2	7968.75	ns
t3	SCLK to CSN high	62.5	Tsclk/2	7968.75	ns
t4	MOSI early out	62.5	Tsclk/2	7968.75	ns
t5	MOSI late out	62.5	Tsclk/2	7968.75	ns
t6	MISO setup time	31.25	Tclk~ Tsclk/2	7968.75	ns
t7	MIOS hold time	0		15937.5	ns
	Operating frequency	0.062745		8	MHz

Table2.6 SPI AC Electrical Characteristics

3. ADC analogy input

Parameter	Specification	Notes
Input impedance	500Kohm	
Input mode	Single end input	
Conversion time	16 ADC working clocks	
INL	+/- 2 LSB	
Reference Voltage	Internal 1.2V	
Resolution	12Bit	

TYPICAL APPLICATION

Application Notes

RFP need not external matching components. Please connect PATX pin to your external power amplifier if you want to increase output power.

Key-scan interface support maximum 16 buttons, and also support two buttons push at the same time.

LDO de-coupling capacitor need be placed near power pin.

Recommend that the PCB land pattern is in accordance with IPC standard IPC-7351.

WAKEB pin need connect to ground if no using Deep Sleep Mode.
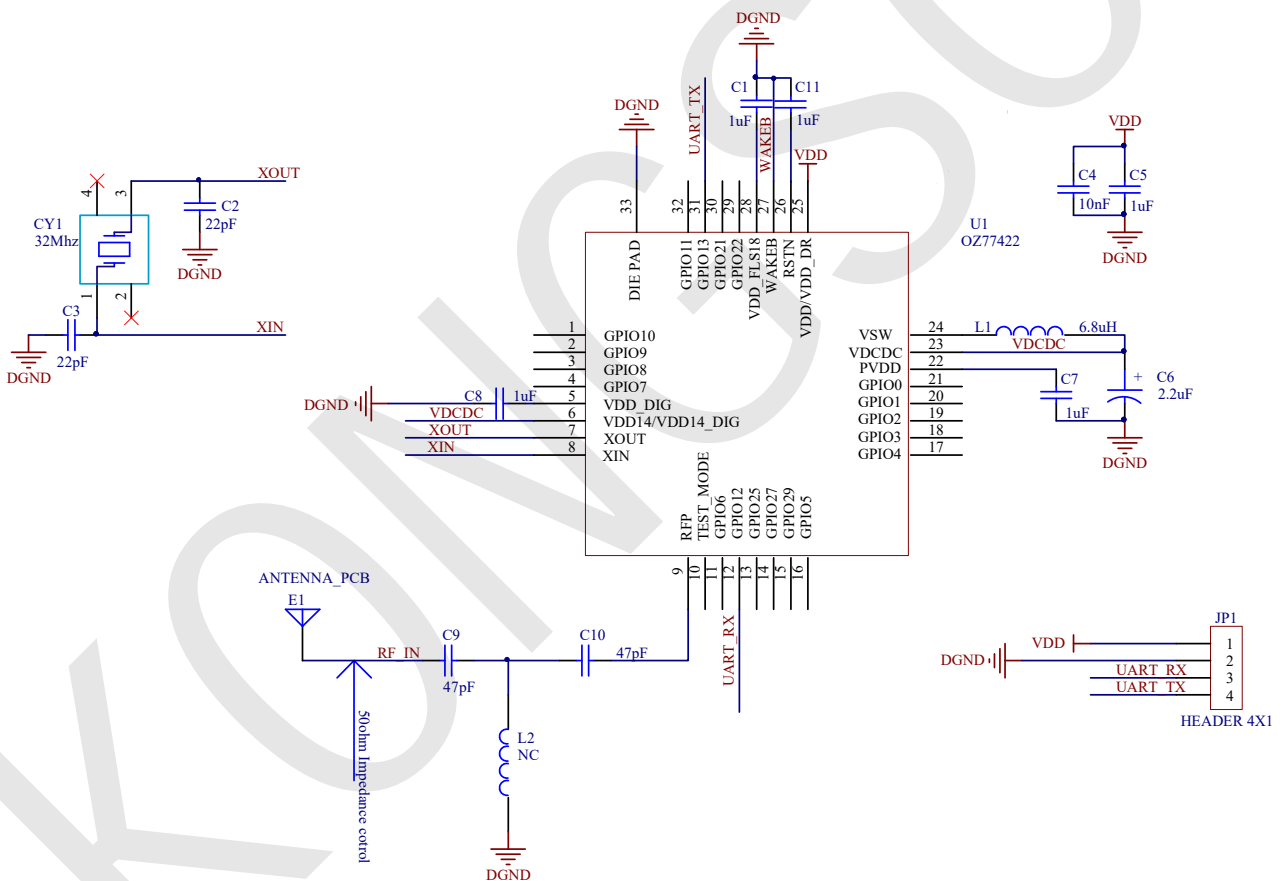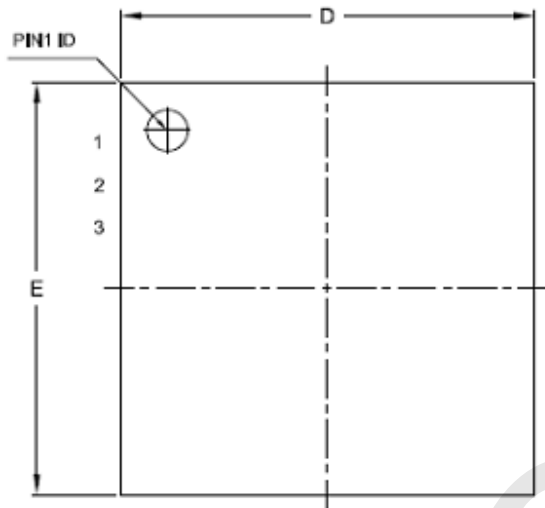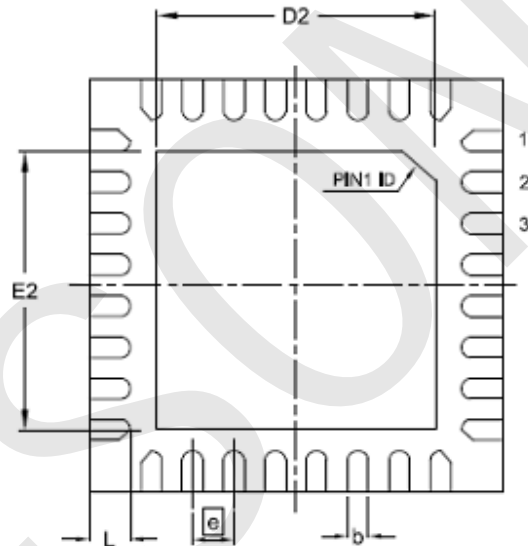
Reference Design Schematics

Figure3.1 77422 Application Reference Design
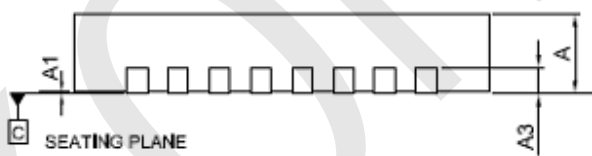
PACKAGE INFORMATION

32PIN QFN 4mmx4mm: OZ77422LN

TOP VIEW

BOTTOM VIEW

SEATING PLANE

Notes:
1. ALL DIMENSIONS ARE IN MILLIMETER
2. REFER TO JEDEC STD MO-220

SYMBOL	DIMENSION (MM)		
	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0	-	0.05
A3	0.203 REF		
b	0.15	0.20	0.25
D	3.90	4.00	4.10
E	3.90	4.00	4.10
D2	2.60	2.70	2.80
E2	2.60	2.70	2.80
e	0.40 BSC		
L	0.30	0.40	0.50

ABBREVIATION

Term	Definition
DSU	Debug server unit
RTC	Real time clock
IIC	Inter-Integrated Circuit Interface
CPU	Center process unit
PLL	Phase lock loop
LDO	Low voltage drop output
RISC	Reduced Instruction-Set Computer
LNA	Low noise amplifier
UART	Universal Asynchronous Receiver Transmitter
SPI	Serial peripheral interface
GPIO	General purpose input output
I/O	Input output
PMU	Power management unit
RF	Radio front
ADC	Analogue to digital converter
FIFO	First input first output