YC1078

High Performance Low Power BLE 5.2 SoC

Preliminary Datasheet

General Descriptions

The YC1078 is a high performance, low power System-on-Chip (SoC) integrating a Bluetooth® 5.2 compliant 2.4-GHz transceiver, 24 MHz proprietary 32 bit MCU with a RAM of 8 KB and a One-Time Programmable (OTP) memory of 2KB .

The YC1078 supports Bluetooth Basic Rate, Bluetooth Low Energy and Bluetooth 5.2 features including high-throughput 2 Mbps, Long Range and the Direction Finding. It can be paired through HCI interface with a more powerful MCU for applications requiring advanced wireless connectivity.

The fully-featured multiprotocol radio, +10 dBm output power, -99 dBm sensitivity and extended temperature range of -40 to 110°C makes it suitable for lighting applications.

The YC1078 features built-in USB, proprietary 32-bit MCU clocked at 24 MHz, integrated capless LDOs supporting 2.1-5.5V supply range, making it a perfect microcontroller for cost-sensitive applications such as mouse devices, toys and disposables.

Key Features

- MCU subsystems
  - 24 MHz 32-bit proprietary MCU for system control and PHY/link layer management
  - AES128 HW encryption
  - Serial wire debug
- Memories
  - 2 KB OTP with internal 6.5V charge pump
  - 8 KB data RAM
  - 4 KB RAM supporting retention mode
- Radio transceiver
  - BR/Bluetooth 5.2/Long Range
  - +10 dBm TX power in 1dB/steps
  - -99 dBm RX sensitivity @ BLE 1 Mbps
  - -96 dBm RX sensitivity @ BLE 2 Mbps
  - Integrated balun with single-ended output and direct connection to antenna
  - 6.3 mA RX system current @ BLE 1 Mbps -99 dBm sensitivity (3V ideal DC-DC converter)
  - 5.9 mA RX system current @ BLE 1 Mbps -97 dBm sensitivity (3V ideal DC-DC conveter)
  - 9.5 mA TX system current (3V ideal DC-DC converter, 0 dBm)
- Power management
  - Always-On (AON) supply: 2.1~ 5.5V
  - Main supply: 1.5 ~ 5.5V supporting external DCDC through a dedicated wakeup pin
  - Integrated LDOs requiring no external decoupling capacitors
  - 3.3V capless LDO
  - 1.3 µA in sleep mode (wake on RTC, no RAM retention)
  - 3 µA in sleep mode (wake on RTC, 4 KB RAM retention)
- Clock generation
  - Dedicated PLL to support 16M/24Mcrystals
  - Crystal trimming
  - 28 MHz RC oscillator for fast wakeup
  - Low jitter low power 32 KHz RC oscillator
- 9-channel 9-bit ADC
- Digital peripherals
  - Up to 14 GPIOs w/ functions fully multiplexed
  - 8 x PWMs up to 48 Mbps
  - Two-wire master (I^2C compatible) up to 600 kbps
  - 1 x UART(RTS/CTS) with HCI-H5 protocol up to 3.25 Mbps
  - 1 x SPI Master/Slave up to 24 Mbps
  - 1-axis Quadrature Decoder
  - 12 Mbps Full Speed USB 2.0
- Temperature range: -40°C to +110°C

Applications

- Mouse devices
- Toys
- Lightning applications
- Disposables
- Commercial and industrial applications requiring advanced connectivity

Key Benefits

- Best-in-class sensitivity and output power for RF-demanding applications
- BR for enhanced interoperability
- Lowest system cost for cost-oriented designs

Revision History

Version	Date	Owner	Note
0.1	2023/2/9		Initial version
0.2			
0.3			

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1 Block Diagram

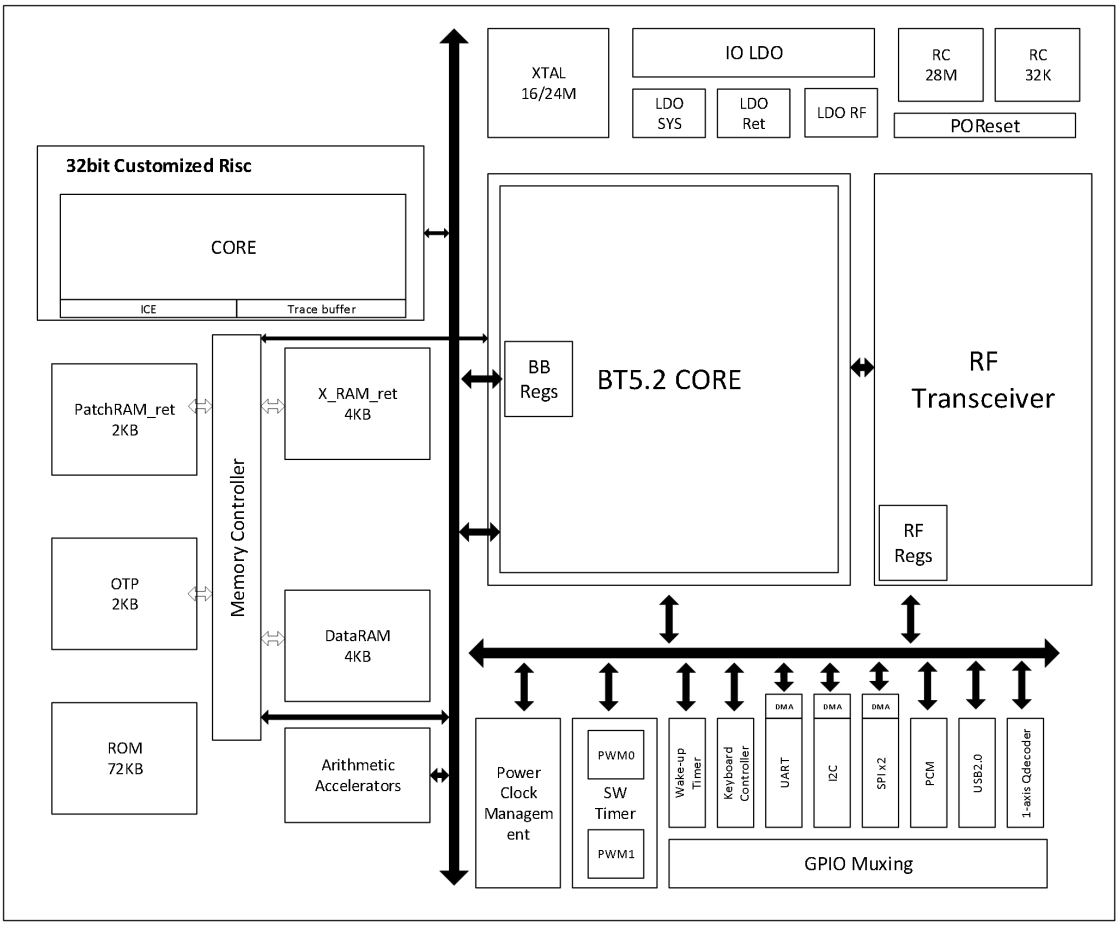


Figure 1- 1 Block diagram

2 Pinout Information

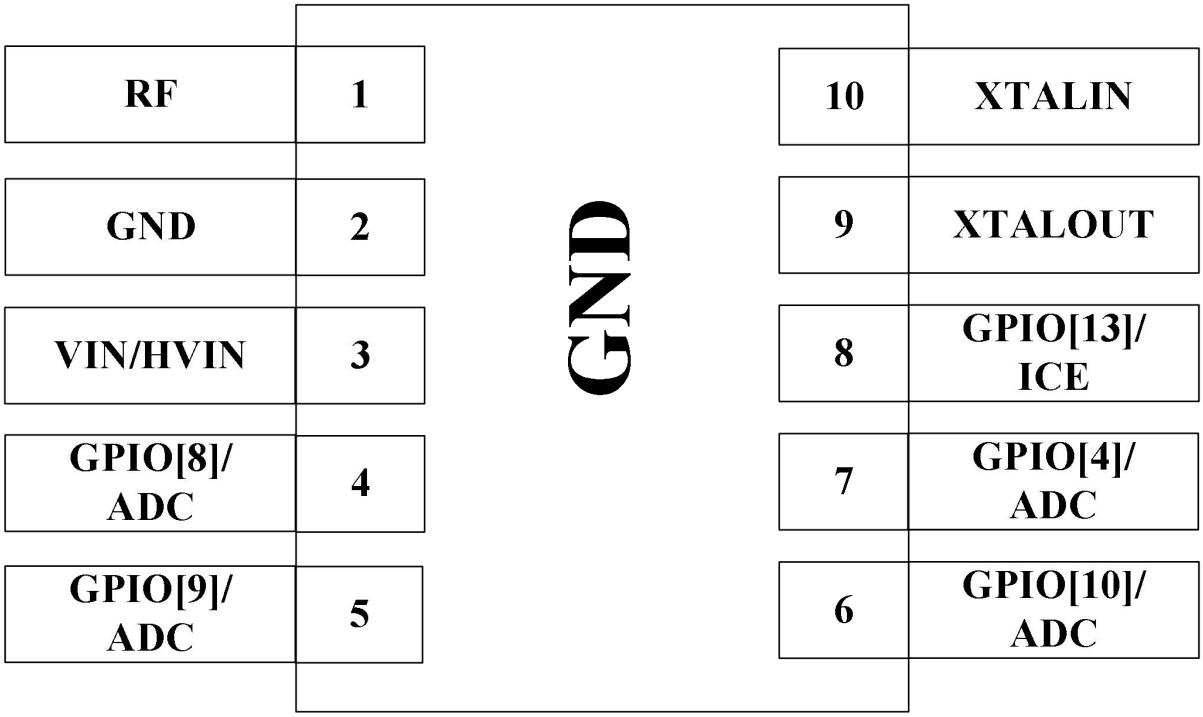


Figure 2- 1 Pinout top view (ESSOP10 package)

Abbreviations:

PWR: Power pin

AIO: Analog IO pin

DIO: Digital IO pin

RF: RF IO pin

Table 2- 1 Pinout Information

Pin Number SOP16	Type	Name	Description
1	RF	RF	Single-ended radio antenna connection
2	PWR	GND	Power Ground
3	PWR	HVIN/VIN	Main power input, 2.2~5.5V, 1μF bypass cap
4	DIO/AIO	GPIO8/ADC	General purpose I/O/SARADC input
5	DIO/AIO	GPIO9/ADC	General purpose I/O/SARADC input
6	DIO/AIO	GPIO10/ADC	General purpose I/O/SARADC input
7	DIO/AIO	GPIO4/ADC	General purpose I/O/SARADC input
8	DIO/AIO	GPIO13/ICE	General purpose I/O/debug port, Tx & Rx
9	AIO	XTALOUT	Connection for XTAL port
10	AIO	XTALIN	Connection for XTAL port/ external reference clock input

Note 1 : Drive capability of GPIO[13:2] internal pullup & pulldown resistance is 30K~50Kohm,Drive capability of VIO is up to 50mA. GPIO[1:0] internal pullup resistance is 1Kohm, Drive capability of VIO is 13mA.

Note 2 : GPIO[11] can not used as lpm wakeup source.

Note 3 : GPIO[13] is by default in pullup status as ice function after por. GPIO[13] will restore gpio function by setting ice_mode to 0.

Table 2- 2 GPIO Multiplexing

Pin Name	boot function	function-analog
GPIO[0]		
GPIO[1]		
GPIO[2]		
GPIO[3]		
GPIO[4]		saradc [0]
GPIO[5]		saradc [1]
GPIO[6]		saradc [2]
GPIO[7]		saradc [3]
GPIO[8]		
GPIO[9]		saradc [4]
GPIO[10]		saradc [5]
GPIO[11]		saradc [6]
GPIO[12]		saradc [7]
GPIO[13]	ICE	

3 Specifications

3.1 Recommended Operating Conditions

Table 3- 1 Recommended Operation Condition

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage for pin VBAT	V_{BAT}		1.6		5.5	V
Supply voltage for pin VDCDC	V_{DCDC}		1.5		5.5	V
Supply voltage for pin VIO	V_{IO}	VIO supplied by a host chip not VDD33	1.6		3.6	V
Ambient temperature	T_A		-40		110	°C

3.2 Power Consumption

Table 3- 2 Power Consumption Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit

Sleep						
Current through pin VIN	I_{VIN_SLEEP}	V_{VIN} = 3.3V		1.3		µA
	$I_{VIN\_SLEEP\_4KB\_RET}$			2		µA
Current of pin VIN with ideal DC-DC converter	I_{VDCDC_SLEEP}	V_{DCDC} = 1.2V		20.0		nA
RX mode 1 Mbps BLE @ -99 dBm sensitivity						
Current through pin VIN	I_{VIN_RX}	V_{VIN} = 3.3V	10	11.0	13	mA
Current of pin VIN with ideal DC-DC converter	I_{VDCDC_RX}	V_{VDCDC} = 1.2V	5.8	6.3	7.2	mA
RX mode 1 Mbps BLE @ -97 dBm sensitivity						
Current through pin VIN	I_{VIN_RX}	V_{VIN} = 3.3V	9.5	10.2	12.5	mA
Current through pin VDCDC	I_{VDCDC_RX}	V_{VDCDC} = 1.2V	5.6	5.9	7	mA
TX mode 0 dBm						
Current through pin VIN	I_{VIN_TX}	V_{VIN} = 3.3V	17.5	18.0	19.5	mA
Current of pin VIN with ideal DC-DC converter	I_{VDCDC_TX}	V_{VDCDC} = 1.2V	9.2	9.5	10.2	mA

3.3 Radio

All parameters are referred to chip port and measured on the condition of VIN = 3.3V if not stated otherwise.

Table 3- 3 Transmitter Specification

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	f_{TX}		2402		2480	MHz
Output power	P_{out}		-20.0		10	dBm
Power control step	P_{step}	For part-to-part power calibrations		1		dB
Spurious emissions (@ 4 dBm)	P_{spur}	30 MHz to 1000 MHz		-43.7		dBm
		1 GHz to 12.75 GHz		-31.0		dBm
		47 MHz to 74 MHz		-75		dBm
		87.5 MHz to 108 MHz		-75		dBm
		174 MHz to 230 MHz		-75		dBm
		470 MHz to 862 MHz		-44.0		dBm

Table 3- 4 Receiver Specification

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Frequency range	f_{RX}		2402		2480	MHz
Out-of-band blocking	OOB	30 MHz – 2000 MHz	-30			dBm
		2003 – 2399 MHz	-35			dBm
		2484 – 2997 MHz	-35			dBm
		3000 MHz – 12.75 GHz	-30			dBm
RX sensitivity	P_{SENS_BR}	0.1 % BER		-95		dBm
C/I co-channel	C/I_{CO_BR}	0.1 % BER		7		dB
C/I 1 MHz adjacent channel	C/I_{1_1M}	0.1 % BER		-9		dB

C/I 2 MHz adjacent channel	C/I_{2_1M}	0.1 % BER		-38		dB
C/I ⩾3 MHz adjacent channel	C/I_{3_1M}	0.1 % BER		-44		dB
C/I image channel	C/I_{im_1M}	0.1 % BER		-26		dB
1 Mbps BLE						
RX sensitivity	P_{SENS_1M}	30.8% PER		-99		dBm
C/I co-channel	C/I_{CO_1M}	30.8% PER		6		dB
C/I 1 MHz adjacent channel	C/I_{1_1M}	30.8% PER		-35		dB
C/I 2 MHz adjacent channel	C/I_{2_1M}	30.8% PER		-40		dB
C/I ⩾3 MHz adjacent channel	C/I_{3_1M}	30.8% PER		-45		dB
C/I image channel	C/I_{im_1M}	30.8% PER		-32		dB
C/I image channel + 1MHz	C/I_{im+1_1M}	30.8% PER		-44		dB
Maximum input signal level	$P_{IN\_MAX\_1M}$	30.8% PER		0.0		dBm
2 Mbps BLE						
RX sensitivity	P_{SENS_1M}	30.8% PER		-96		dBm
C/I co-channel	C/I_{CO_2M}	30.8% PER		5		dB
C/I 2 MHz adjacent channel	C/I_{2_2M}	30.8% PER		-37		dB
C/I 4 MHz adjacent channel	C/I_{4_2M}	30.8% PER		-41		dB
C/I ⩾6 MHz adjacent channel	C/I_{6_2M}	30.8% PER		-47		dB
C/I image channel	C/I_{im_2M}	30.8% PER		-32		dB
C/I image channel + 2MHz	C/I_{im+2_2M}	30.8% PER		-45		dB
Maximum input signal level	$P_{IN\_MAX\_2M}$	30.8% PER		0		dBm

3.4 24 MHz Crystal Oscillator

Table 3- 5 24 MHz Crystal Oscillator Characteristic

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Crystal frequency	f_{XTAL}		16	24		MHz
Crystal frequency tolerance	Δf_{XTAL}		-20		20	ppm
Load capacitance	$C_{L,INN}$	Programmable via registers		9	12	pF

3.5 LDO Characteristics

Table 3- 6 LDO Specification

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input voltage range	V_{IN}				5.5	V
Output voltage	V_{OUT_SLEEP}	I_{LOAD}=20 mA, when input voltage below 3.3V, output equals input		3.35		V
	V_{OUT_ACTIVE}	I_{LOAD}=100 µA, when input voltage below 3.3V, output equals input		3.35		V
Maximum load current	I_{LOAD}	Active mode			100	mA
Output load capacitance	C_L		0		1	µF

Quiescent current	I_{Q_SLEEP}	doze mode		50		nA
	I_{Q_ACTIVE}	active mode		150		μA

3.6 Reset Characteristics

Reset voltage is monitored on pin VBAT_HIGH.

Table 3- 7 Reset Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Reset voltage threshold	V_{POR}	rising edge	1.55	1.70	2.2	V
	V_{PDR}	falling edge	1.50	1.65	2.15	V
POR stretch time	T_{POR}			20.00		mS
PDR stretch time	T_{PDR}			20		μS

4 Application Schematic

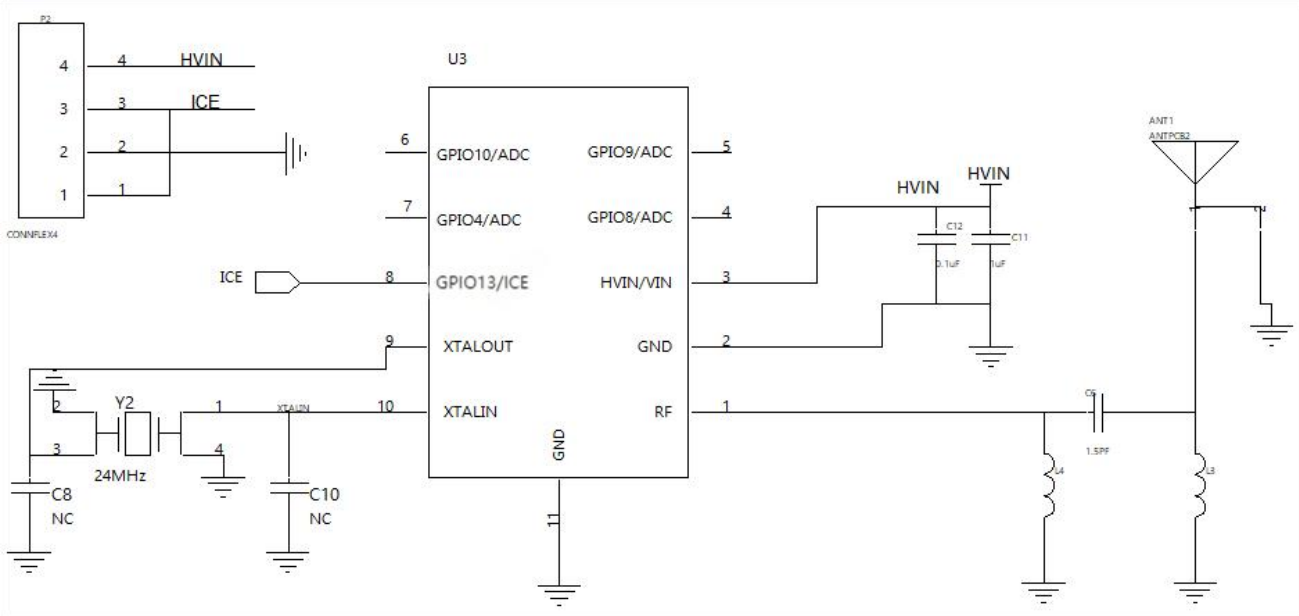
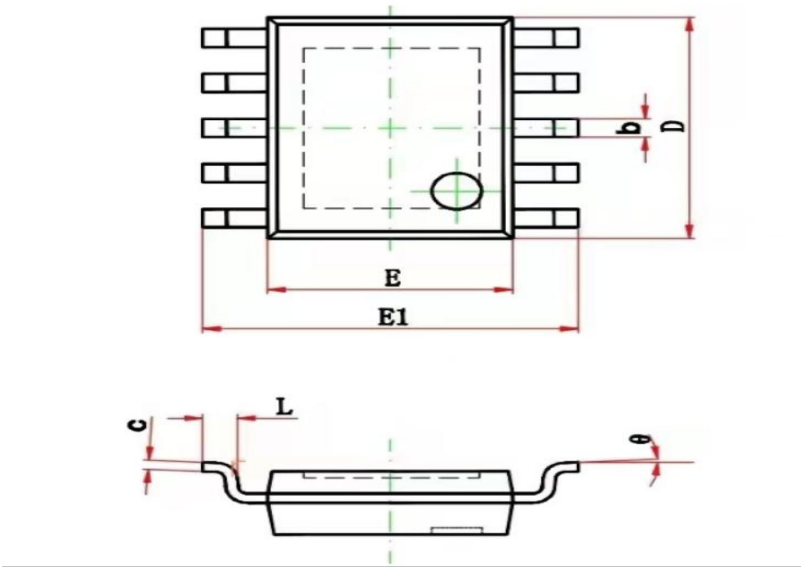
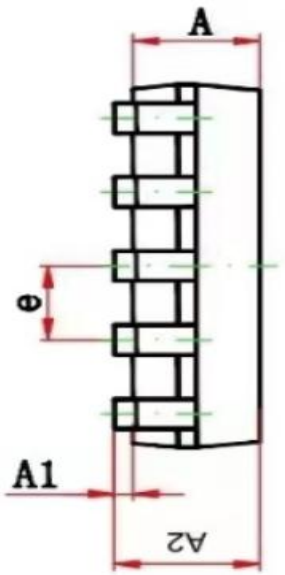


Figure 4- 1 Typical application: ESSOP 10-pin

5 Package Information

ESSOP10 (130*83)
PACKAGE OUTLINE DIMENSIONS





COMMON DIMENSIONS CUNITS MEASURE=MILLIMETER			
SYMBOL	MIN	NOM	MAX
A	1. 350	1. 450	1. 550
A1	0. 0	0. 04	0. 08
A2	1. 350	1. 49	1. 630
b	0. 325	0. 350	0. 375
c	0. 180	0.20	0.22
D	4. 700	4. 90	5. 100
E	3. 800	3. 90	4. 000
E1	5. 800	6. 000	6. 200
e	1. 000(BSC)		
L	0. 400	0.60	0.80
θ	0°		8°

Figure 5- 1 ESOP10 package dimensions