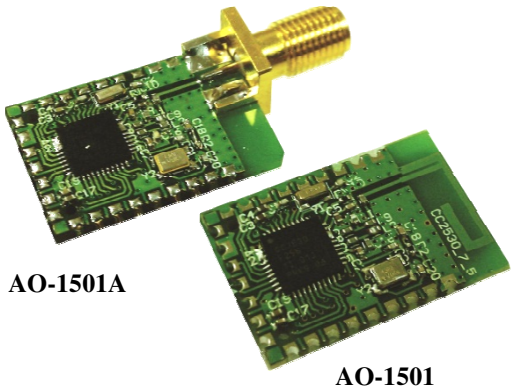
AO-1501
ZigBee Transceiver Module



Features

- Reliable wireless transceiver module.
- Compatible with Peer to Peer, Star, Tree, or Mesh network configurations.
- AO-1501 with on board PCB ANT with 150M range (LOS).
- AO-1501A with external Antenna.
- -97dBm sensitivity at the receiver.

Applications

- Wireless sensor network (WSN).
- Smart meter.
- RF remote control.
- 2.4 GHz IEEE 802.15.4 network.
- Home and building automation.
- Industrial control and surveillance.
- Set top box (STB).
- Smart energy.
- Wireless RS232 / RS485 / RS422

Description

AO-1501/A ZigBee Transceiver Module, which uses the latest TI CC2530 ZigBee chip, is designed for IEEE 802.15.4, ZigBee, ZigBee RF4CE, and smart energy applications. This module integrated high efficiency RF transceiver, 8051 MCU, 8 KB RAM, 32/64/128/256 KB flash memory, and other functional elements to work with various peripheral devices.

Ordering Information

PART NUMBER	INPUT/OUTPUT	SIGNAL DETECT	VOLTAGE	TEMPERATURE
AO-1501	DC/DC	TTL	3.3V	-40°C to 85 °C
AO-1501A	DC/DC	TTL	3.3V	-40°C to 85 °C

Absolute Maximum Ratings

PARAMETER	SYMBOL	MIN	MAX	UNITS	NOTE
Storage Temperature	T_S	–40	85	°C	
Supply Voltage	*Vcc*	-0.3	3.9	V	
Input Voltage	V_{IN}	2	*3.6*	V	
Operating Current	I_{OP}	---	40	mA	
Input RF level	RF_L	---	10	dBm	

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNITS	NOTE
Operating ambient temperature range	T_A	-40	85	°C	
Supply Voltage	*Vcc*	-0.3	3.9	V	
Operating Input Voltage	V_{IN}	2	3.6	V	
Operating Current	$I_{TX} + I_{RX}$	---	69.2	mA	

Electrical Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNITS	NOTE
I_{core} Core current consumption	PM0 DC Current	---	5.0	8.9	mA	
	PM1 DC Current	---	0.2	0.3	mA	
	PM2 DC Current	---	0.3	1	uA	
	32-MHz XOSC running, radio in RX mode at -100-dBm input power, no peripherals active, CPU idle	---	24.1	29.6	mA	
	32-MHz XOSC running, radio in TX mode, 4.5-dBm output power, no peripherals active, CPU idle	---	35.4	39.6	mA	
Peripheral Current Consumption						
ADC	When converting	---	1.2	---	mA	
Flash	Erase	---	1	---	mA	
	Burst write peak current	---	6	---	mA	
Wake-up and Timing						
Power mode 1 → active	Digital regulator on, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of 16-MHz RCOSC	---	4	---	µs	
Power mode 2 or 3 → active	Digital regulator off, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of regulator and 16-MHz RCOSC	---	0.1	---	ms	
Active → TX or RX	Initially running on 16-MHz RCOSC, with 32-MHz XOSC off	---	0.5	---	ms	
	With 32-MHz XOSC initially on			192	µs	
RX/TX and TX/RX turnaround				192	µs	

Radio Part					
RF frequency range	Programmable in 1-MHz steps, 5 MHz between channels	2394	---	2507	MHz
Radio baud rate	As defined by [1]	---	250	---	kbps
Radio chip rate	As defined by [1]	---	2	---	MChip/s
Wireless Distance		---	---	150	m
Communication Part					
UART Baud Rate		---	9600	---	bps

[1] AO-1503 reference design is suitable for systems targeting compliance with EN 300 328, EN 300 440, FCC CFR47 Part 15 and ARIB STD-T-66.

RF Transmitter Electrical Characteristics

V_{IN}= 3.0 V to 3.6 V, T_C = -40 °C to 85 °C, f_c = 2394 MHz to 2507 MHz

PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNITS	NOTE
Nominal output power	Delivered to a single-ended 50-Ω load through a balun using maximum-recommended output-power setting requires minimum –3 dBm	0	4.5	8	dBm	
Programmable output power 32 dB range	When converting	---	32	---	dB	
Optimum load impedance			69 + j29		Ω	

RF Receiver Electrical Characteristics

V_{IN}= 3.0 V to 3.6 V, T_C = -40 °C to 85 °C, f_c = 2394 MHz to 2507 MHz

PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNITS	NOTE
Receiver sensitivity	PER = 1%	---	-97	-92	dBm	
Saturation (maximum input level)	PER = 1%	---	---	10	dBm	
Frequency error tolerance	requires minimum 80 ppm		±150		ppm	
Symbol rate error tolerance	requires minimum 80 ppm		±1000		ppm	

Debug Interface Characteristics

TA = –40°C to 85°C, VDD = 2 V to 3.6 V, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNITS	NOTE
Debug clock frequency	fclk_dbg		---	---	12	MHz	(see Figure 1)
Allowed high pulse on clock	t1		35	---	---	ns	(see Figure 1)
Allowed low pulse on clock	t2		35	---	---	ns	(see Figure 1)
EXT_RESET_N low to first falling edge on debug clock	t3		167	---	---	ns	(see Figure 2)
Falling edge on clock to EXT_RESET_N high	t4		83	---	---	ns	(see Figure 2)
EXT_RESET_N high to first debug command	t5		83	---	---	ns	(see Figure 2)
Debug data setup	t6		2	---	---	ns	(see Figure 3)
Debug data hold	t7		4	---	---	ns	(see Figure 3)
Clock-to-data delay	t8	Load = 10 pF	---	---	30	ns	(see Figure 3)

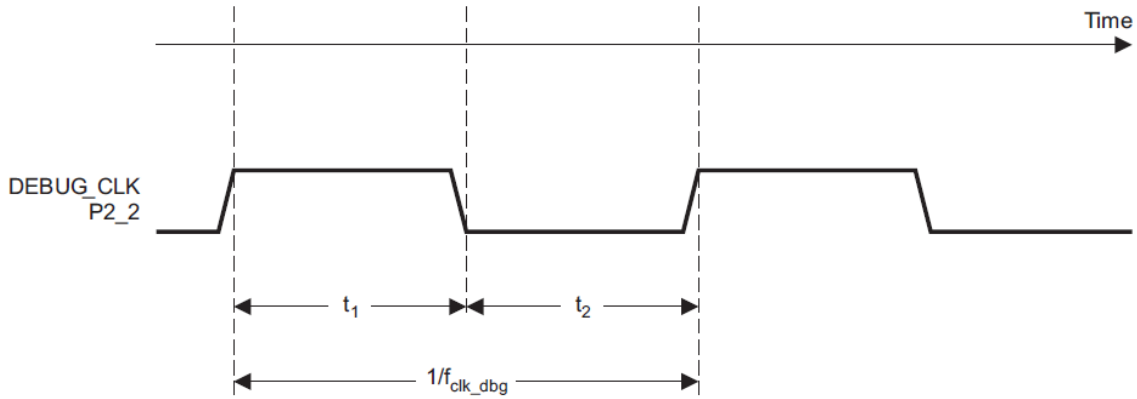


Figure 1 **Debug Clock – Basic Timing**

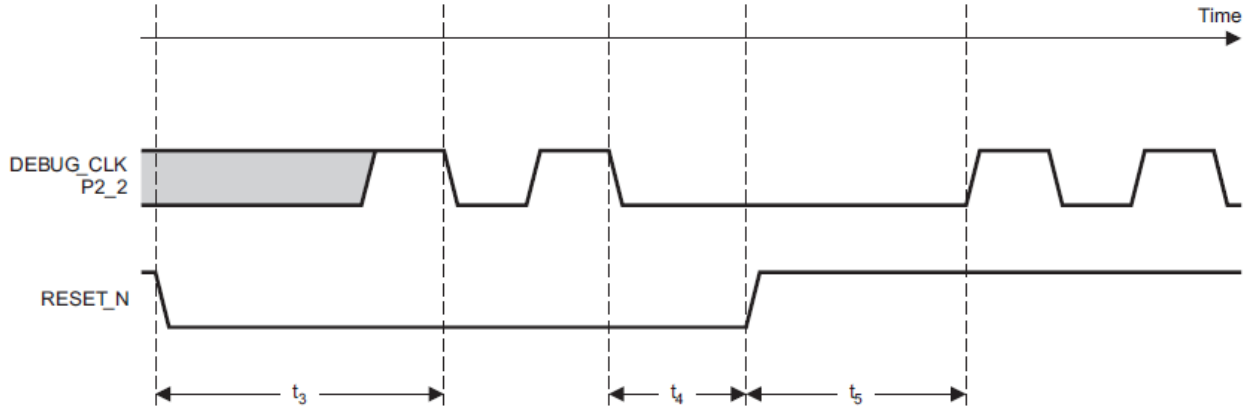


Figure 2 **Data Setup and Hold Timing**

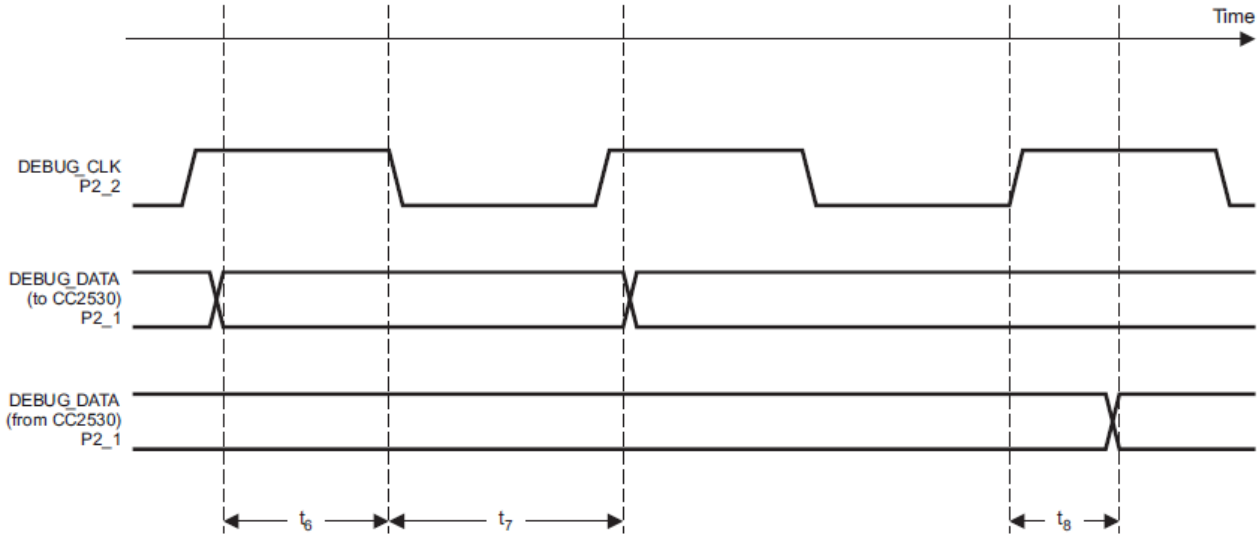
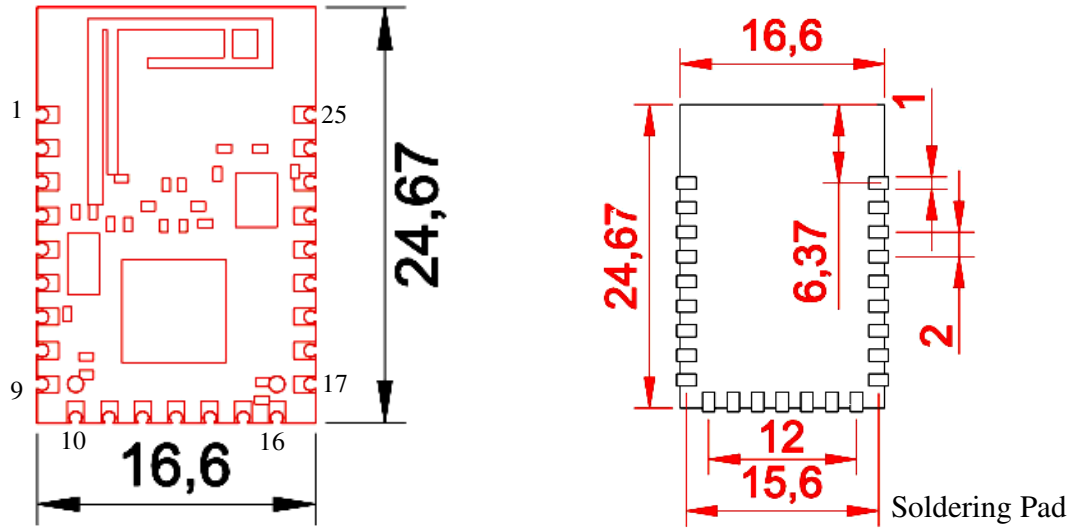


Figure 3 **Debug Enable Timing**

DC Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNITS	NOTE
Logic-0 input voltage		---	---	0.5	V	
Logic-1 input voltage		2.5	---	---	V	
Logic-0 input current	Input equals 0 V	-50	---	50	nA	
Logic-1 input current	Input equals VDD	-50	---	50	nA	
I/O-pin pullup and pulldown resistors		---	20	---	kΩ	
Logic-0 output voltage, 4-mA pins	Output load 4 mA	---	---	0.5	V	
Logic-1 output voltage, 4-mA pins	Output load 4 mA	2.4	---	---	V	
Logic-0 output voltage, 20-mA pins	Output load 20 mA	---	---	0.5	V	
Logic-1 output voltage, 20-mA pins	Output load 20 mA	2.4	---	---	V	

Dimensions



Unit: mm

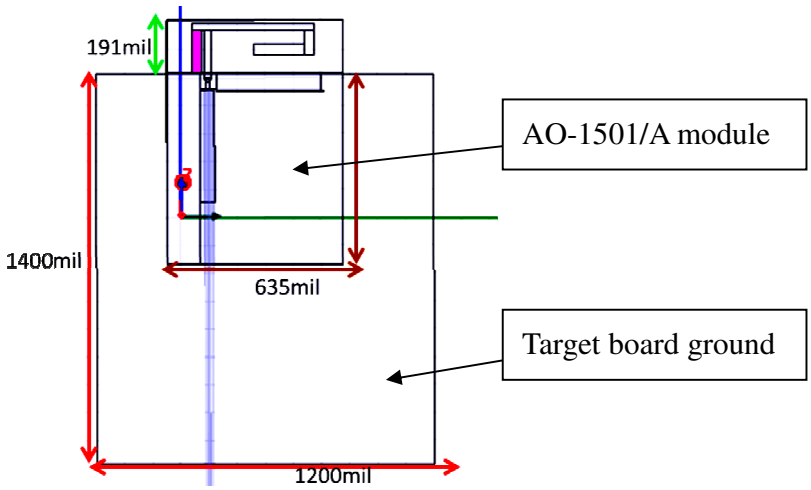
Pad Pin Assignment

Pin	Signal Name	Pin	Signal Name	Pin	Signal Name
1	*GND*	13	*P12*	25	*GND*
2	*GND*	14	*P11*		
3	*Reset*	15	*P03*		
4	*P22(DC, Debug Clock)*	16	*P02*		
5	*P21(DD, Debug Data)*	17	*P01*		
6	*P17*	18	*P07*		
7	*P16*	19	*P06*		
8	*P15*	20	*P05*		
9	*P14*	21	*P04*		
10	*VDD*	22	*P01*		
11	*GND*	23	*P00*		
12	*P13*	24	*VDD*		

Application Notes

1. Note that around the antenna on the PCB board can not exist any circuit layer including the front and back board.
2. When AO-1501 module is mounted to the target board, need to match the target board design to achieve a better antenna performance. The matching condition is as the follows.

Target board ground size	1200x1400mil
Module PCB ground size	625x910mil
Module PCB thickness	1.6mm
Target board thickness	1.0mm



3. The comparison of ideal and measured data

	Ideal Data	Measured Data
Center Frequency	2.45GHz	2.45GHz
S11(2.45GHz)	<-10dB	-29.679dB < -10dB
BW(on Board Antenna)	180MHz	100MHz