

Z8X天线规格书

- 该报告是为了更好支持协作客户所做的详细过程及总结。
- 该报告中所有产品射频性能的思路与方法，均为沃莱特针对该产品定制开发。
- 在未获得沃莱特许可下，该研发报告请勿散播给第三方，感恩您的理解与支持。

版本	时间	主要事项	客户结论
V1	2024/11/22	新项目调试	

Z8X Antenna Specification Document

- The report is a detailed process and summary to better support the collaboration customers.
- All RF performance concepts and methodologies for the products in this report were customized by Woleite for these specific products.
- This R&D report must not be shared with third parties without Wolei's authorization. We appreciate your understanding and support.

Version	time	The main points of this are as follows:	Customer Conclusion
V1	2024/11/22	New project debugging	

测试系统与设备（4*4*3.5 TEM24多探头测试系统，3*3*2.5 MVG12多探头测试系统、Agilent5071系列网络分析仪、是德5063系列网络分析仪、 Agilent8960、RS-CMW500 ）



附：天线设计研发过程说明及介绍

阶段一	天线性能预先评估	根据不同项目特点建议客户最为恰当的评估方式，包括仿真评审，图档评审，手板评审等。天线评审作为天线研发非常重要的一个环节，在项目立项前期就导入进行，这对后期天线性能，可实现性有着非常重大的意义。
阶段二	天线无源性能测试	作为一个能量转换和传输的装置，其本质是无源器件，而表征其自身性能的参数就是无源参数。在无源调试阶段，主要调试天线本身的传输参数和辐射参数，关注的测试参数主要为阻抗、回损，效率和增益等。
阶段三	天线有源性能测试	在天线确认无源参数OK的情况下，最终使用效果还需要放进产品中进行性能的确认。在这个阶段，需要调试的是整个系统表现出来的综合性能，主要的关注参数为功率和灵敏度，这是量化天线发射和接收能力最直观的有源参数。
阶段四	无线用户体验感测试	对于所有无线形态的电子产品，其用户体验感是最终我们需要实现的目的，这也是用户的切身感受。所以我们前期的所有研发实际都是为了最终的这一个阶段在服务。

Test systems and equipment (4×4×3.5 TEM24 multi-probe testing system, 3×3×2.5 MVG12 multi-probe testing system, Agilent5071 series network analyzer, Keysight 5063 series network analyzer, Agilent 8960, RS-CMW500)



Appendix: Description and introduction of antenna design and development process

Phase 1	Pre-evaluation of antenna performance	The most appropriate evaluation methods are suggested to the customer according to the characteristics of different projects, including simulation review, drawing review, prototype review, etc. Antenna review is an important part of antenna R & D, which is introduced in the early stage of project establishment, and it is of great significance to the performance and feasibility of antenna in the later stage.
Phase 2	Antenna passive performance testing	As a device of energy conversion and transmission, it is a passive device, and the parameters characterizing its own performance are passive parameters. In the phase of passive debugging, the transmission parameters and radiation parameters of the antenna itself are mainly debugged, and the main test parameters are impedance, return loss, efficiency and gain.
Phase 3	Active performance test of antenna	When the antenna's passive parameters are confirmed as OK, the final performance must be tested in the product for validation. At this stage, the focus is on debugging the system's overall performance, with particular attention to power and sensitivity—these being the most intuitive active parameters for quantifying the antenna's transmission and reception capabilities.
Phase 4	Wireless user experience testing	For all the wireless electronic products, the user experience is the ultimate goal we need to achieve, which is also the user's personal feeling. So all the research and development in the early stage is actually for the final stage to serve.

研发报告常见天线参数释义			
所属类别（测量设备）	天线参数	释义	
天线无源参数（网络分析仪）	驻波比（VSWR）	电压驻波比指驻波波腹电压与波节电压幅度之比，又称为驻波系数、驻波比。驻波比等于1时，表示馈线和天线的阻抗完全匹配，此时高频能量全部被天线辐射出去，没有能量的反射损耗；驻波比为无穷大时，表示全反射，能量完全没有辐射出去。	$VSWR \leq 3$
	回波损耗（Return loss）	回波损耗是传输线端口的反射波功率与入射波功率之比，以对数形式来表示，单位是dB，一般是负值，其绝对值可以称为反射损耗。	$ RL \geq 6dB$
	阻抗圆图（SMITH CHART）	史密斯图（阻抗圆图）是一种在高频和超高频电路设计时有效地选择计算匹配阻抗的工具。	天线工作频段越靠近50欧姆点越佳
	天线效率（Effeciency）	天线效率是指天线辐射出去的功率（即有效的转换电磁波部分的功率）和输入到天线的有功功率之比。	非金属环境：Effeciency $\geq$ 35% 金属环境：Effeciency $\geq$ 20%
	天线增益（Gain）	天线增益是指在输入功率相等的条件下，实际天线与理想的辐射单元在空间同一点处所产生的信号的功率密度之比。它定量地描述一个天线把输入功率集中辐射的程度，关键参数微最大增益，而天线的平均增益即是效率。	根据工作频段及产品特点的不同而不同
	天线方向图（radiation pattern）	天线方向图是指在离天线一定距离处，辐射场的相对场强（归一化模值）随方向变化的图形，通常采用通过天线最大辐射方向上的两个相互垂直的平面方向图来表示。	根据实际使用体验感需求不同而不同

Category (Measurement Equipment)	Antenna parameters	Paraphrase	
Antenna passive parameters (network analyzer)	VSWR	The voltage standing wave ratio (VSWR) is defined as the ratio of the amplitude of the standing wave's node voltage to its node voltage, also known as the standing wave coefficient or VSWR. When VSWR equals 1, it indicates perfect impedance matching between the feeder and antenna, where all high-frequency energy is radiated without any reflection loss. Conversely, when VSWR approaches infinity, it signifies total reflection, with no energy being radiated.	$VSWR \leq 3$
	Return loss	The reflection loss is the ratio of the reflected wave power to the incident wave power at the transmission line port, expressed in logarithmic form, with the unit being dB. It is generally negative, and its absolute value is referred to as the reflection loss.	$ RL \geq 6\text{dB}$
	Smith chart	Smith diagram is a useful tool to calculate the matching impedance in the design of high frequency and ultra high frequency circuits.	The better the antenna working frequency band is close to the 50 ohm point
	Antenna efficiency	Antenna efficiency is the ratio of the power radiated by the antenna (i.e. the power of the effective converted electromagnetic wave) to the active power input to the antenna.	Non-metallic environment: Efficiency $\geq 35\%$ Metallic environment: Efficiency $\geq 20\%$
	Antenna gain	Antenna gain is the ratio of the power density of the signal produced by the actual antenna and the ideal radiation unit at the same point in space under the condition of equal input power. It quantitatively describes the degree of the input power concentrated and radiated by the antenna. The key parameter is the minimum gain, and the average gain of the antenna is the efficiency.	It varies according to the working frequency band and product features.
	Antenna radiation pattern	Antenna pattern is the graph of the relative field strength (normalized modulus) of the radiation field with the direction change at a certain distance from the antenna. It is usually expressed by two plane patterns that are perpendicular to each other on the direction of the antenna's maximum radiation.	It varies depending on the actual user experience requirements.

有源主板传导参数（综合测试仪+屏蔽箱）	发射功率TX Power(主板传导)	主板传导发射功率是天线向空间辐射电磁波的源头，是衡量射频芯片发射能力的量化参数。传导测试又叫点测或者闭环测试，在主板上通常会有一个特定的位置作为校准端口，距离天线较近。需要注意的是，如果校准端口距离天线较远，那么最终传导到天线输入端口处的功率可能会与校准端口测量值差异较大。	CSM850/900： $\geq 32.5\text{dBm}$ DCS/PCS： $\geq 29\text{dBm}$ DCMA/TD-SCDMA： $\geq 23\text{dBm}$ WCDMA/LTE： $\geq 22.5\text{dBm}$ WIFI与BT根据具体制式和速率有所不同
	接收灵敏度RX Sensitivity(主板传导)	主板传导接收灵敏度是天线接收电磁波的极限状态，是衡量射频芯片在无外来干扰、无传输损耗情况下的量化参数。如果传导灵敏度低，那么整机OTA的接收灵敏度肯定不会高，其它注意事项同传导发射功率。	GSM/CDMA/TD/WCDMA： $\leq -109\text{dBm}$ LTE： $\leq -96\text{dBm}@10\text{MHz}$
天线有源参数	天线总辐射功率（TRP）	天线总辐射功率是指在3D微波暗室里面，利用暗室标准天线探头采集整机在360° 各个典型方向上的功率值，通过近场转远场以及球面积分，最终计算出该项目在空间中各个方向上的总辐射功率，理想情况下是和天线效率紧密相关的。	根据不同产品形态及客户要求而不同
	天线总接收灵敏度（TIS）	类似TRP，TIS同样是指在3D微波暗室里面，利用暗室标准天线探头采集整机在360° 各个典型方向上的接收灵敏度，通过近场转远场以及球面积分，最终计算出该项目在空间中各个方向上的总接收灵敏度，在立项的情况下，与效率也是正相关的关系。	根据不同产品形态及客户要求而不同

Conduction Parameters of Active Motherboard (Integrated Test Instrument+Shielded Box)	TX Power (conducted via motherboard)	Conduction transmission power, the fundamental metric for evaluating RF chip performance, represents the electromagnetic wave source radiated by the antenna into space. Conductive testing (also known as point testing or closed-loop testing) typically employs a calibration port positioned close to the antenna on the motherboard. It should be noted that when the calibration port is positioned farther from the antenna, the actual power delivered to the antenna's input port may significantly deviate from the measured values obtained at the calibration port.	CSM850/900: ≥ 32.5 dBm DCS/PCS: ≥ 29 dBm DCMA/TD-SCDMA: ≥ 23 dBm WCDMA/LTE: ≥ 22.5 dBm WIFI and BT differ in specific standards and speeds.
	RX Sensitivity (conduction on motherboard)	Conduction sensitivity is the maximum sensitivity of the antenna to receive electromagnetic waves, and it is a quantitative parameter to measure the RF chip under the condition of no external interference and no transmission loss. If the conduction sensitivity is low, the receiving sensitivity of the OTA will definitely not be high, and other matters needing attention are the same as the conduction transmission power.	GSM/CDMA/TD/WCDMA: ≤ -109 dBm LTE: ≤ -96 dBm@10MHz
Active antenna parameter	Total Radiated Power (TRP)	The total radiation power of the antenna is the power value of the whole machine in 360 ° typical directions in the 3D microwave anechoic chamber, which is collected by the anechoic chamber standard antenna probe. Through the near-field to far-field and the sphere area integral, the total radiation power of the project in the space is finally calculated. In the ideal condition, it is closely related to the antenna efficiency.	It varies depending on the product type and customer requirements.
	Total Integrated Sensitivity (TIS)	Similar to TRP, TIS measures the receiver sensitivity of the entire system across all 360° directions in a 3D microwave anechoic chamber using standard probe antennas. Through near-field to far-field conversion and spherical integration, it calculates the total spatial sensitivity in each direction. When the project is approved, this sensitivity shows a positive correlation with efficiency.	It varies depending on the product type and customer requirements.

Z8X天线测试V1

日期: 2024/11/22

本次报告主要目的: 新项目调试

本次报告主要结论: 实测效果ok, 佩戴走路, 跑步未见卡顿

天线	频段	材质	天线类型
BT	2400-2480MHz	导线	内置天线

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Z8X Antenna Test V1

date : 2024/11/22

The main purpose of this report is to:

New Project Debugging

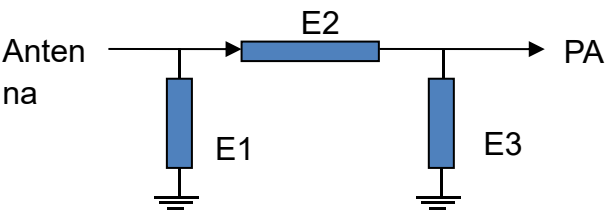
The main findings of the report are:

The measured performance is good. There is no lag when wearing it while walking or running.

Antenna	Frequency range	Material quality	Antenna Type
BT	2400-2480MHz	Lead	Integral Antenna

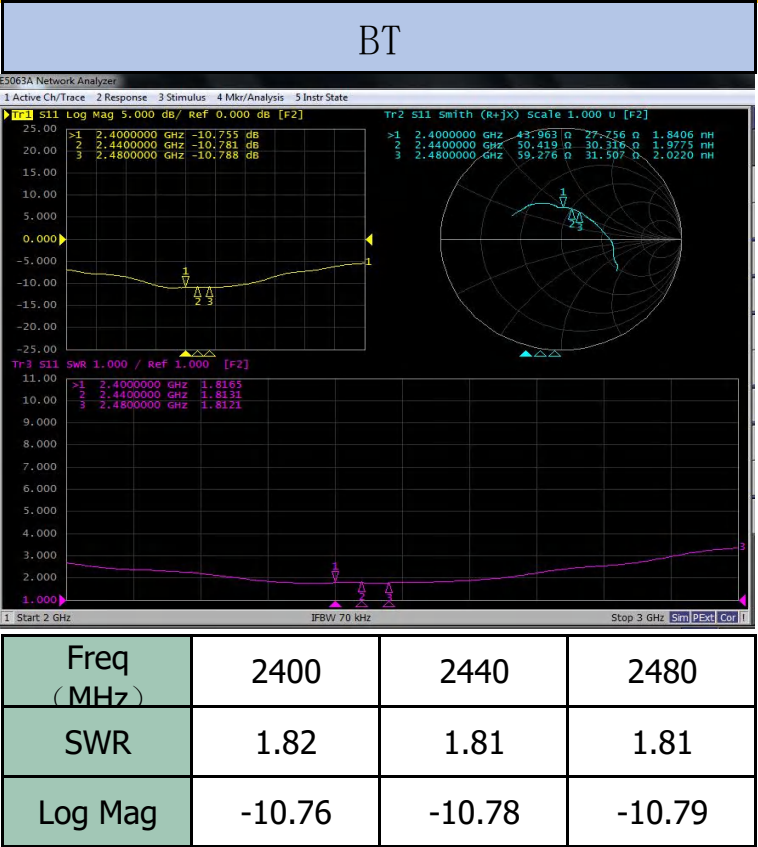
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天线端匹配电路：



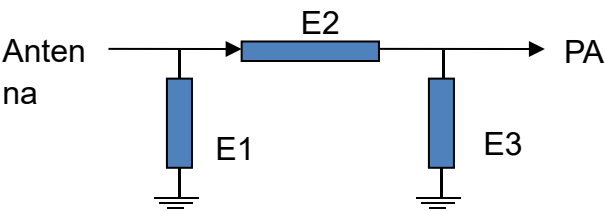
BT	
Element	
E1(0402)	
E2(0402)	0欧姆
E3(0402)	

天线无源S11参数测试：



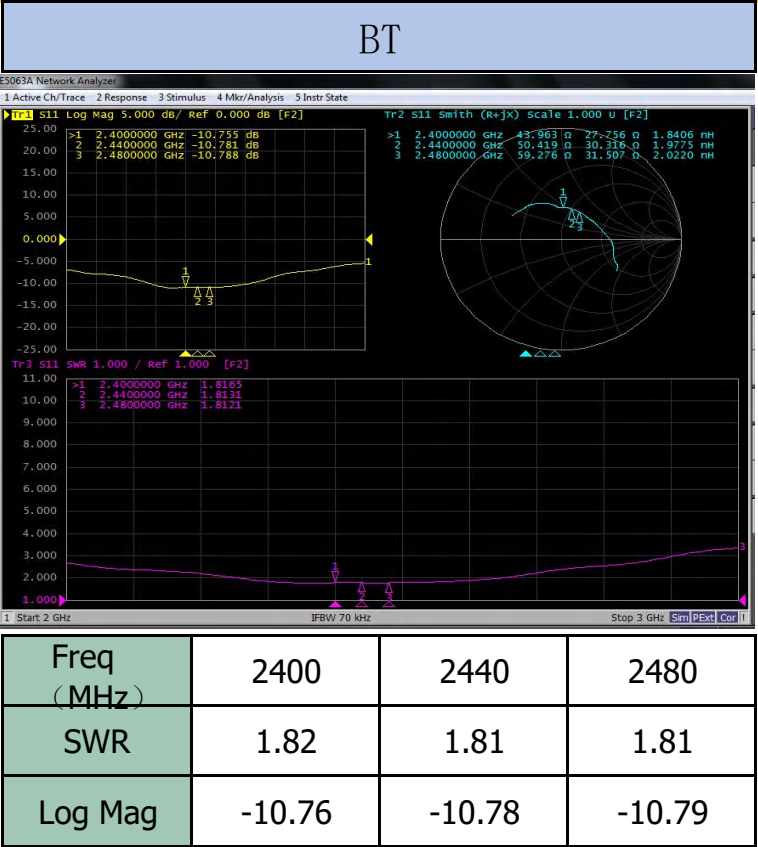
天线无源效率与增益测试：

Antenna terminal matching circuit:



BT	
Element	
E1(0402)	
E2(0402)	0 ohms
E3(0402)	

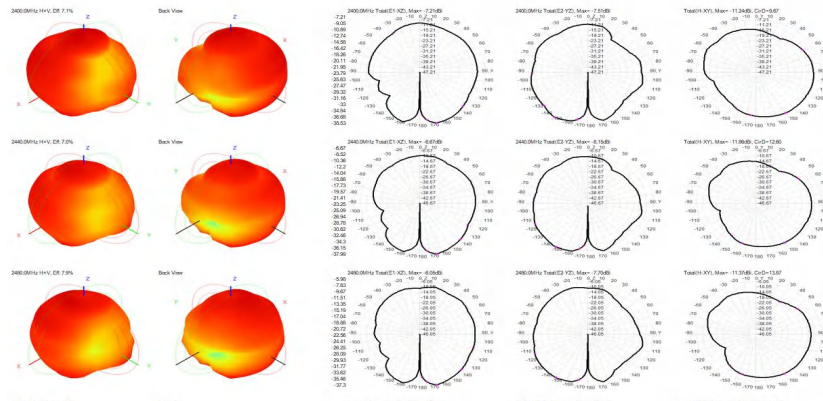
Passive S11 parameter test for the antenna:



Antenna passive efficiency and gain test:

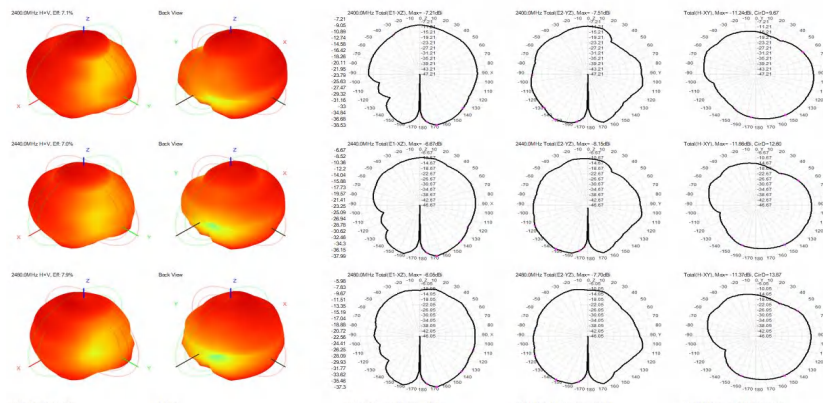
BT		
Frequency (MHz)	Gain (dBi)	Efficiency (%)
2400	-7.21	7.13
2410	-7.18	7.00
2420	-7.03	6.96
2430	-6.79	7.04
2440	-6.67	6.99
2450	-6.59	7.01
2460	-6.44	7.15
2470	-6.24	7.48
2480	-5.98	7.94
2490	-5.77	8.51
2500	-5.50	7.23

天线无源辐射方向图:

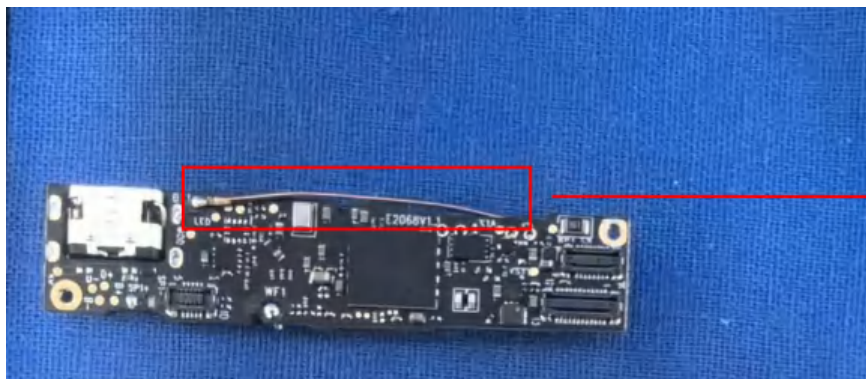


BT		
Frequency (MHz)	Gain (dBi)	Efficiency (%)
2400	-7.21	7.13
2410	-7.18	7.00
2420	-7.03	6.96
2430	-6.79	7.04
2440	-6.67	6.99
2450	-6.59	7.01
2460	-6.44	7.15
2470	-6.24	7.48
2480	-5.98	7.94
2490	-5.77	8.51
2500	-5.50	7.23

Antenna passive radiation pattern:

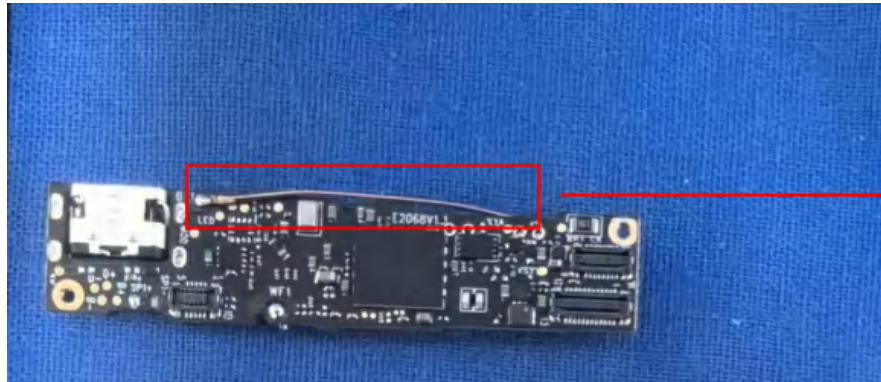


天线位置与匹配图片：



BT ANT

Antenna location and matching image:



BT ANT

天线尺寸图



Antenna dimension diagram

