

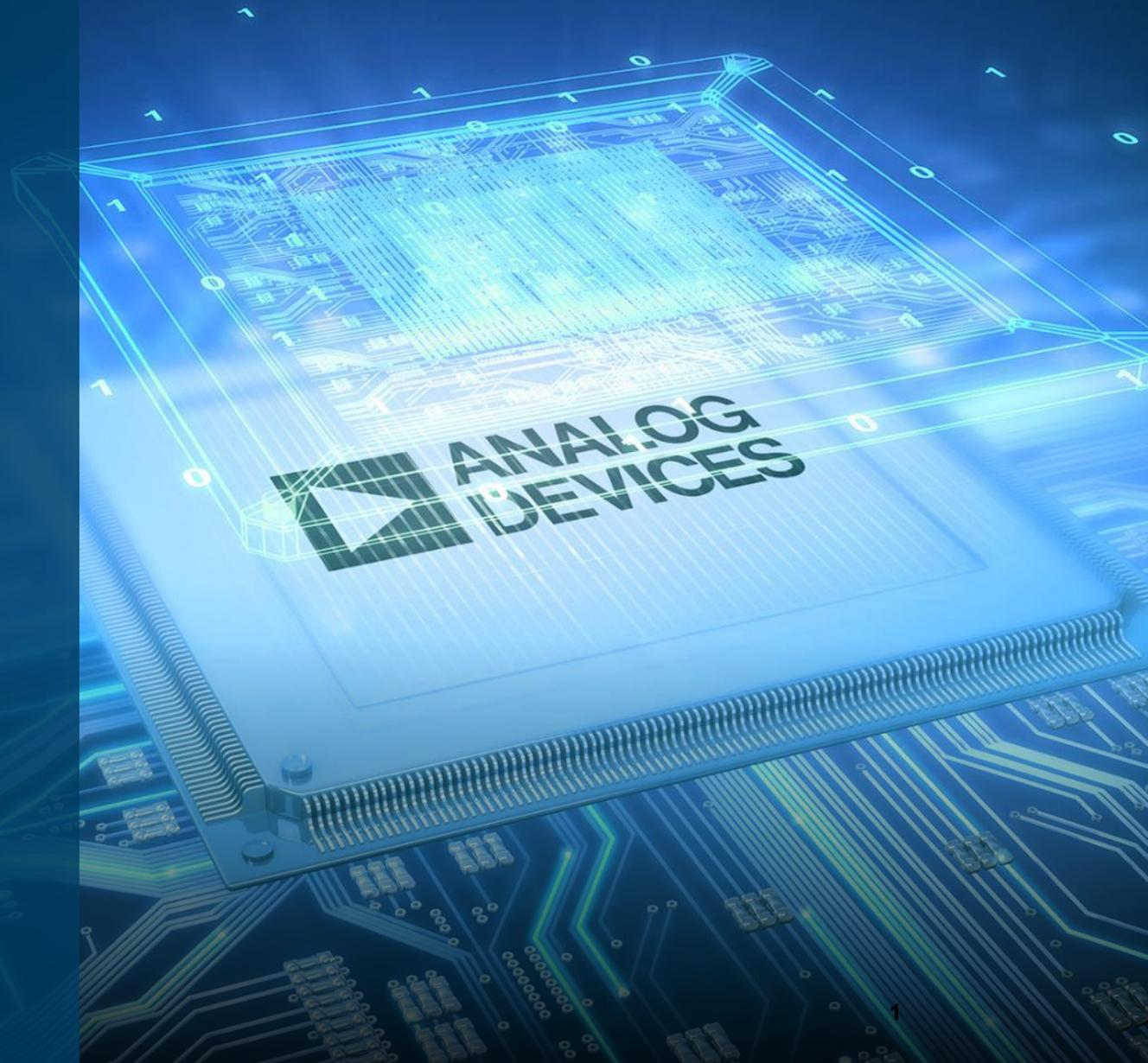


AHEAD OF WHAT'S POSSIBLE™

物联网设备的可靠连接

MICHAEL DALTON

产品营销



▶ 物联网连接

- 电池供电的物联网应用
- 连接要求
- 全球通用ISM频段一览

▶ 利用鲁棒的无线电设计应对RF挑战

- 拥堵的ISM频段
- 范围
- 工作环境影响 – 温度变化
- 器件老化效应



电池供电的物联网应用

医疗保健



智慧城市



智能农业



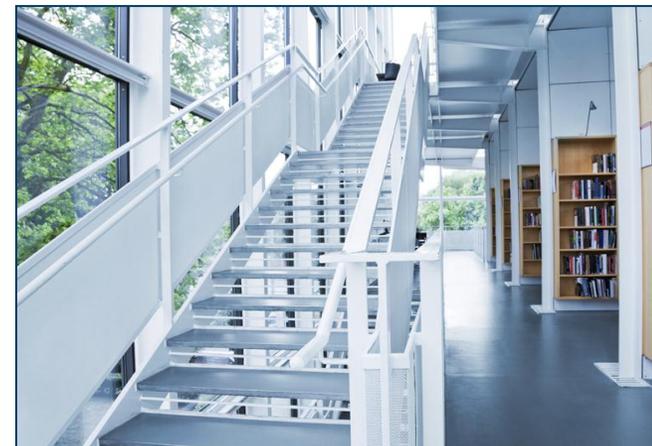
能源



工业4.0



互连建筑物



多种多样的应用要求

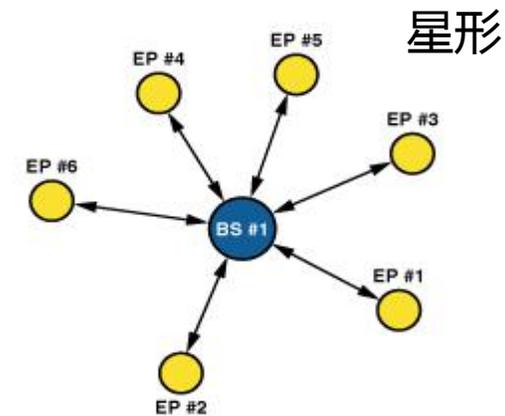
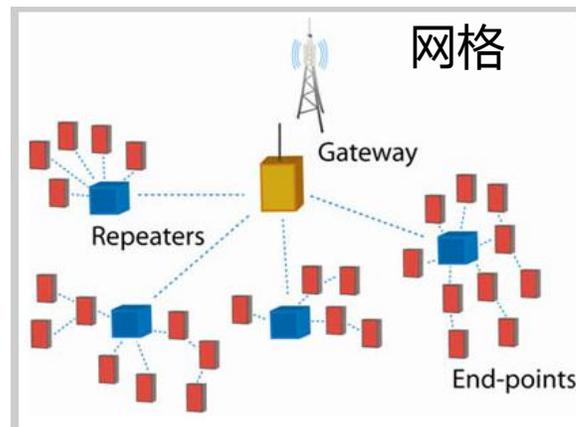
- ▶ 数据要求
- ▶ 互连节点数
- ▶ 节点的地理间距
- ▶ 任务关键型 – 您的数据如何重要？

协议

WirelessHART



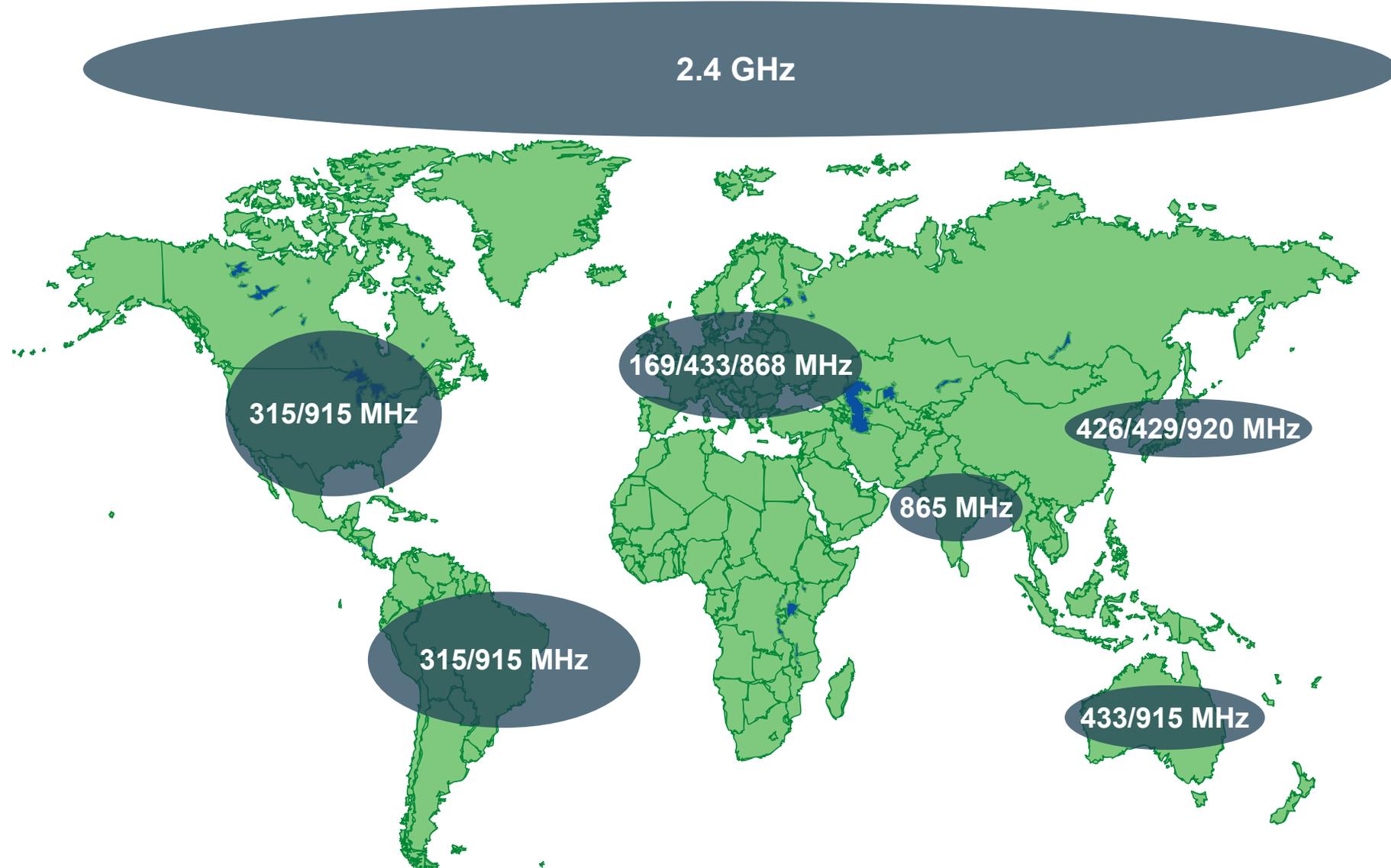
网络架构



频段

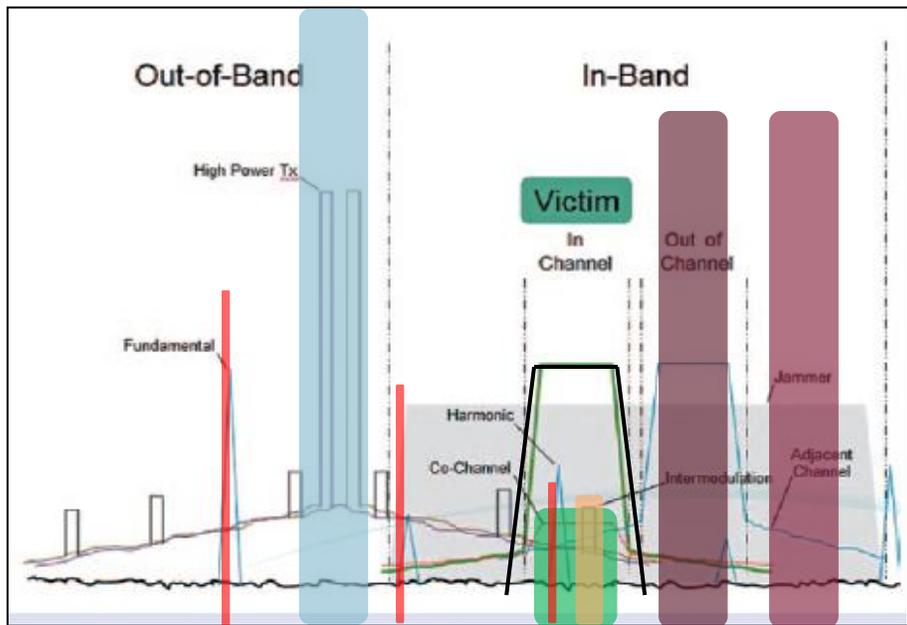
- 2.4 GHz
- Sub-GHz ISM频段
- Sub-GHz许可频段
- 蜂窝频段

全球通用ISM频段



物联网连接挑战

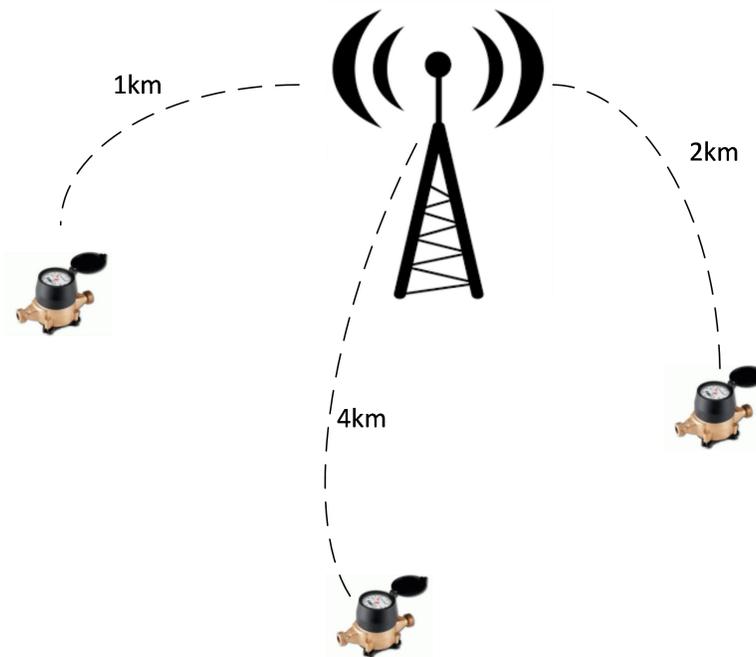
拥堵的ISM频段



季节变化



长距离

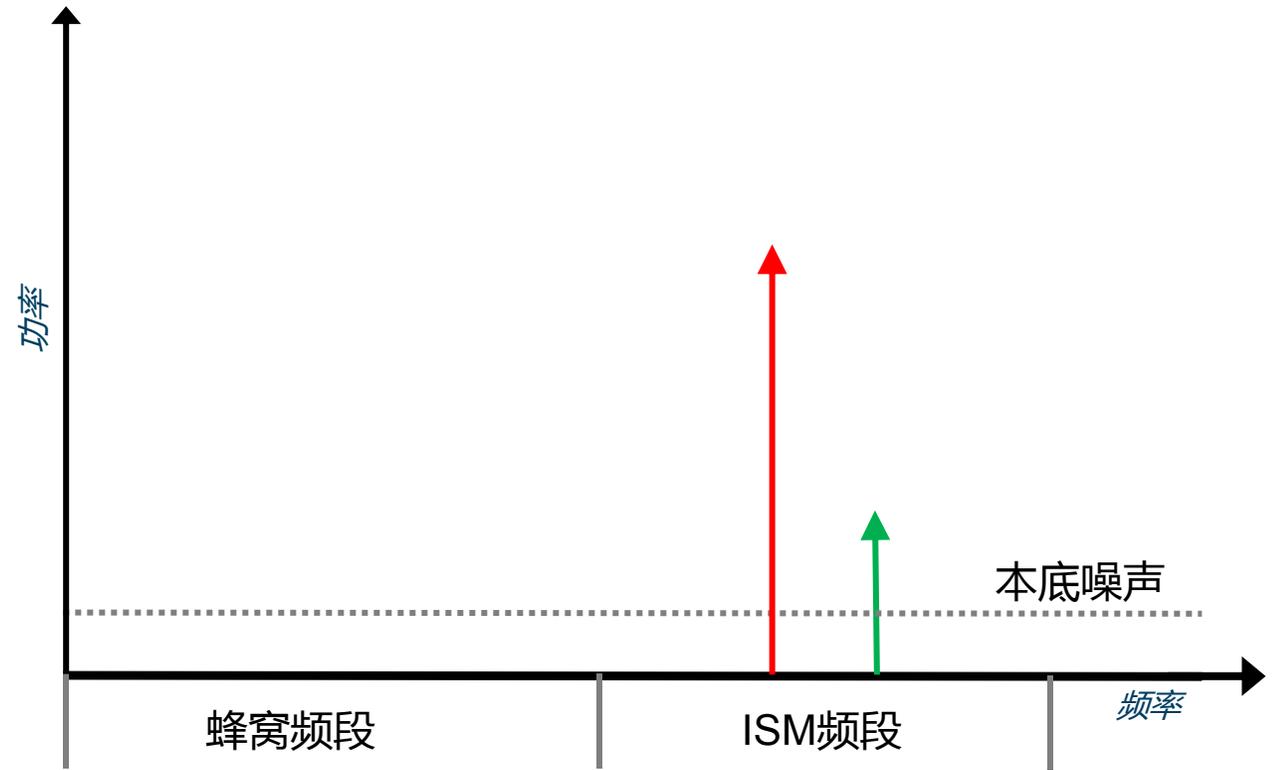
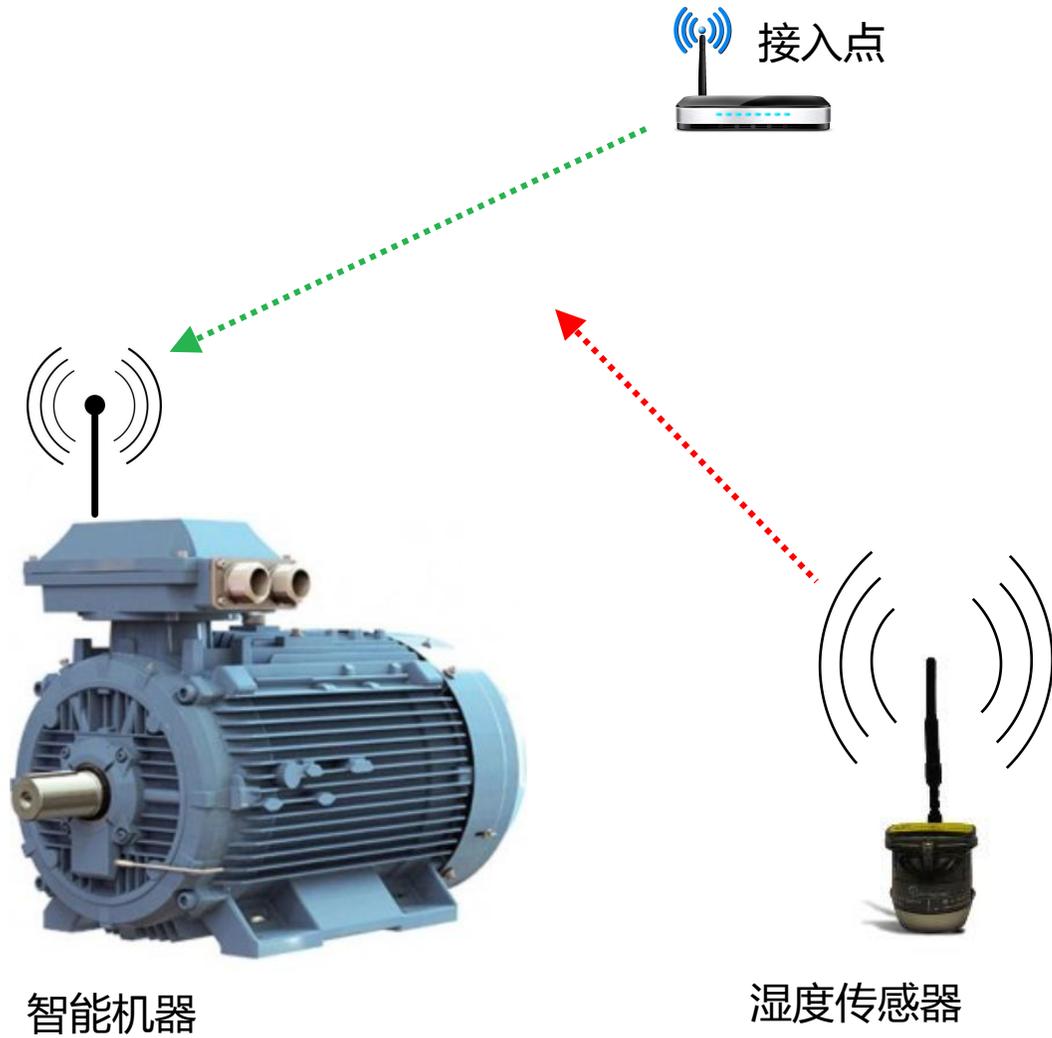


合规限制



拥堵的ISM频段

带内干扰

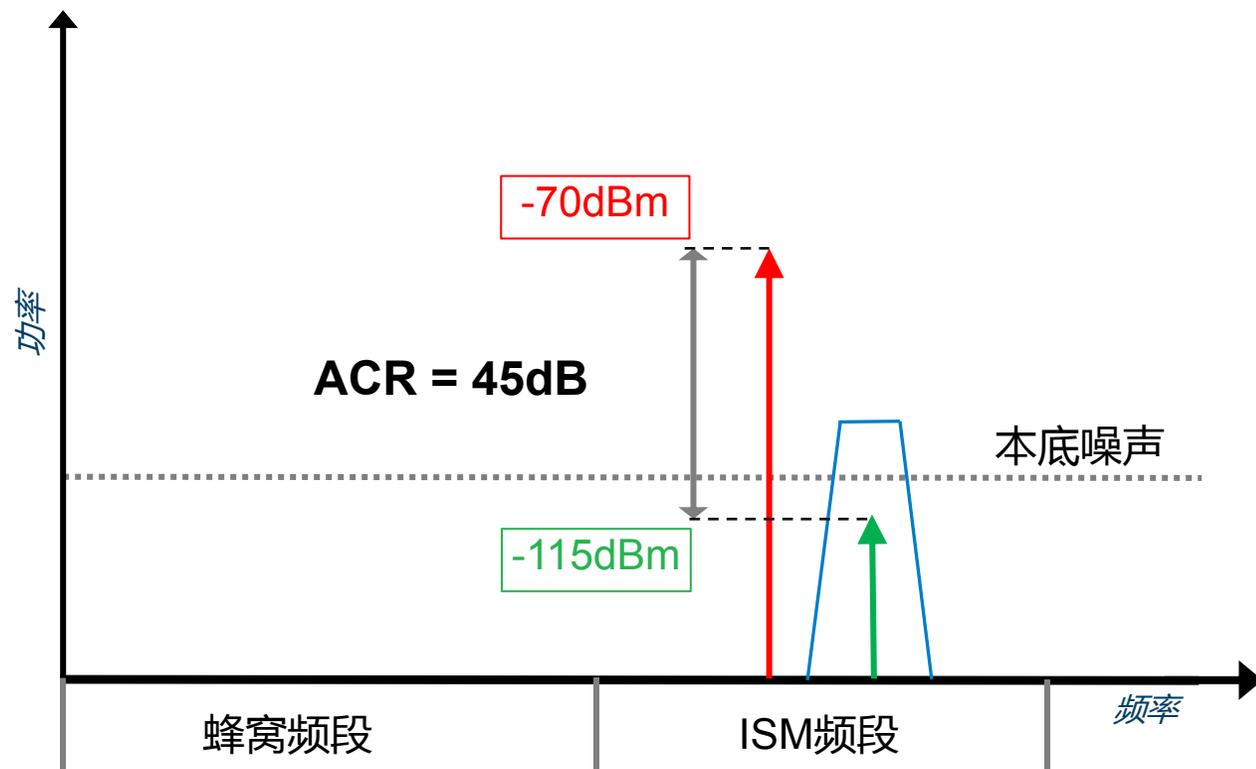


拥堵的ISM频段

邻道抑制规格(ACR)

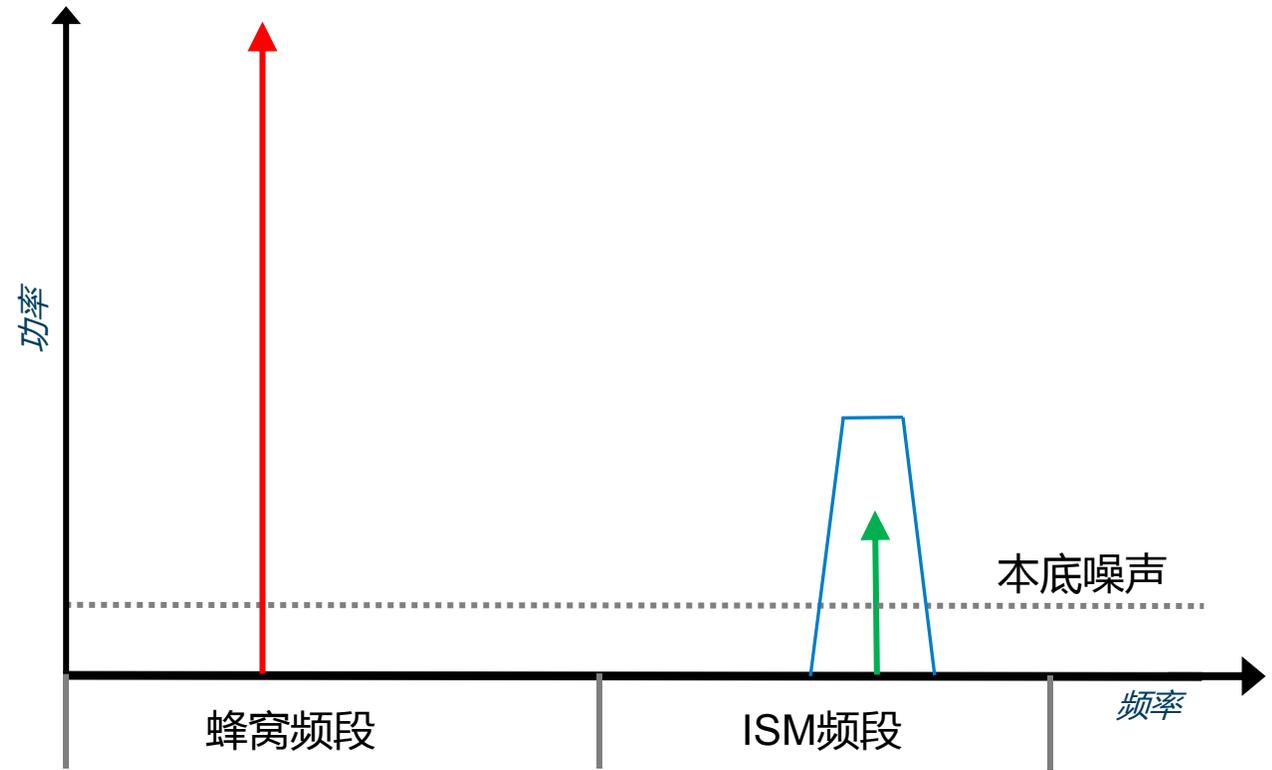
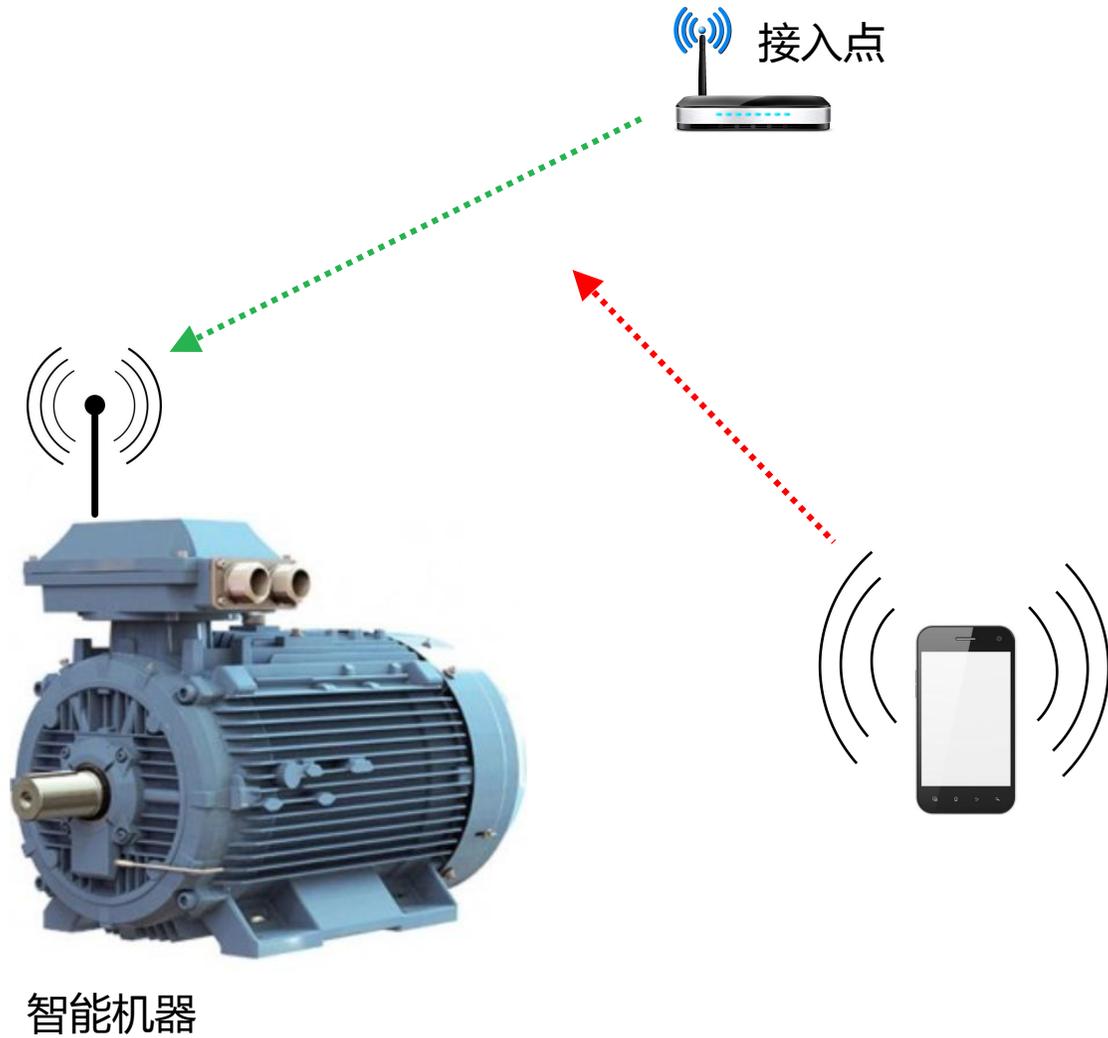
- ▶ 如何抑制邻近干扰信号？
 - 精确的滤波和高质量接收机信号链设计
- ▶ 衡量此因素的数据手册规格是什么？
 - **邻道抑制(ACR)**

CHANNEL SELECTIVITY AND BLOCKING— BER-BASED TEST METHOD		
Configuration 169.43125 MHz/2.4 kbps		
Adjacent Channel (± 12.5 kHz)	66	dB
Alternate Channel (± 25 kHz)	66	dB



拥堵的ISM频段

带外干扰

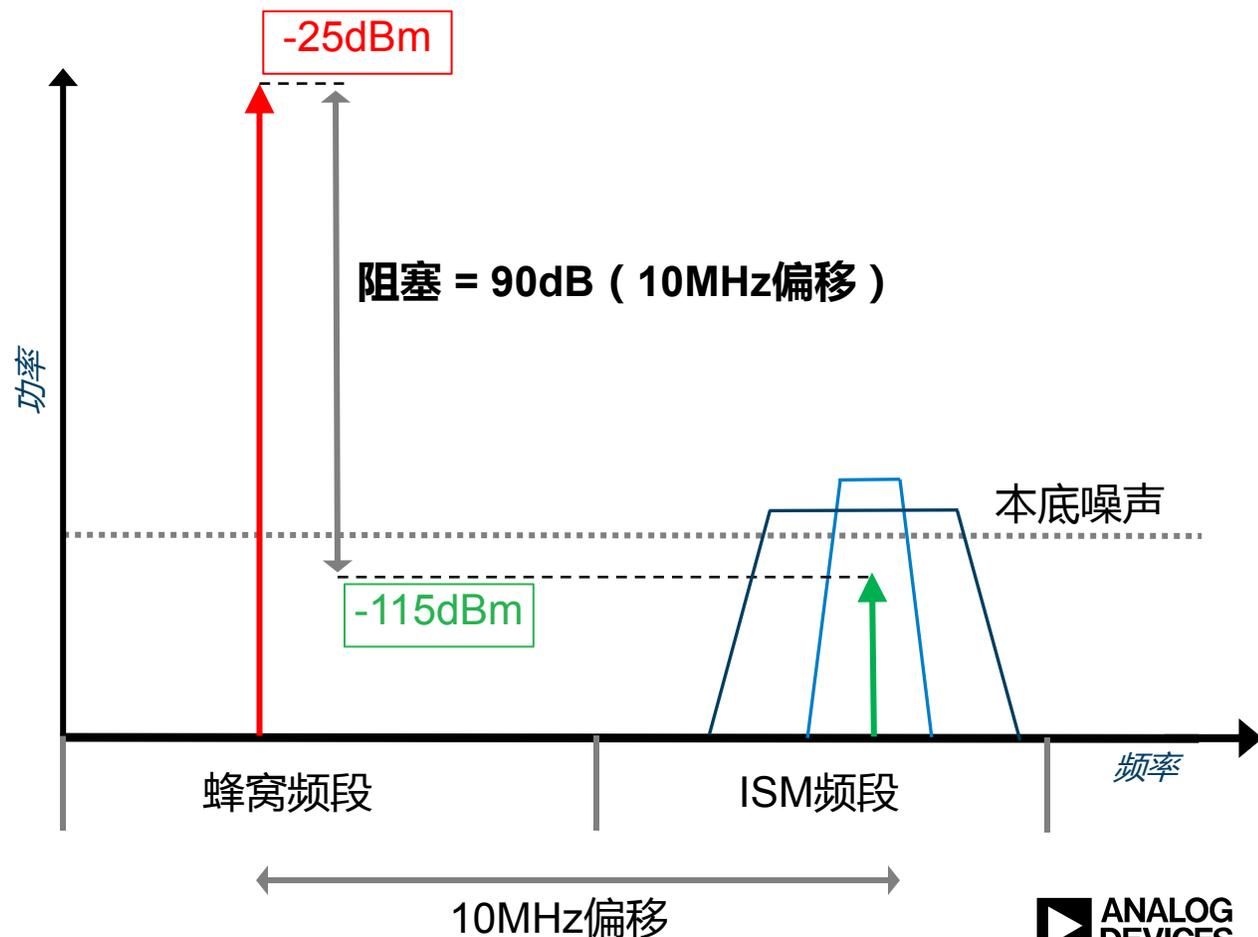


拥堵的ISM频段 阻塞规格

- ▶ 如何抑制带外干扰信号？
 - 其他滤波和高性能相位噪声

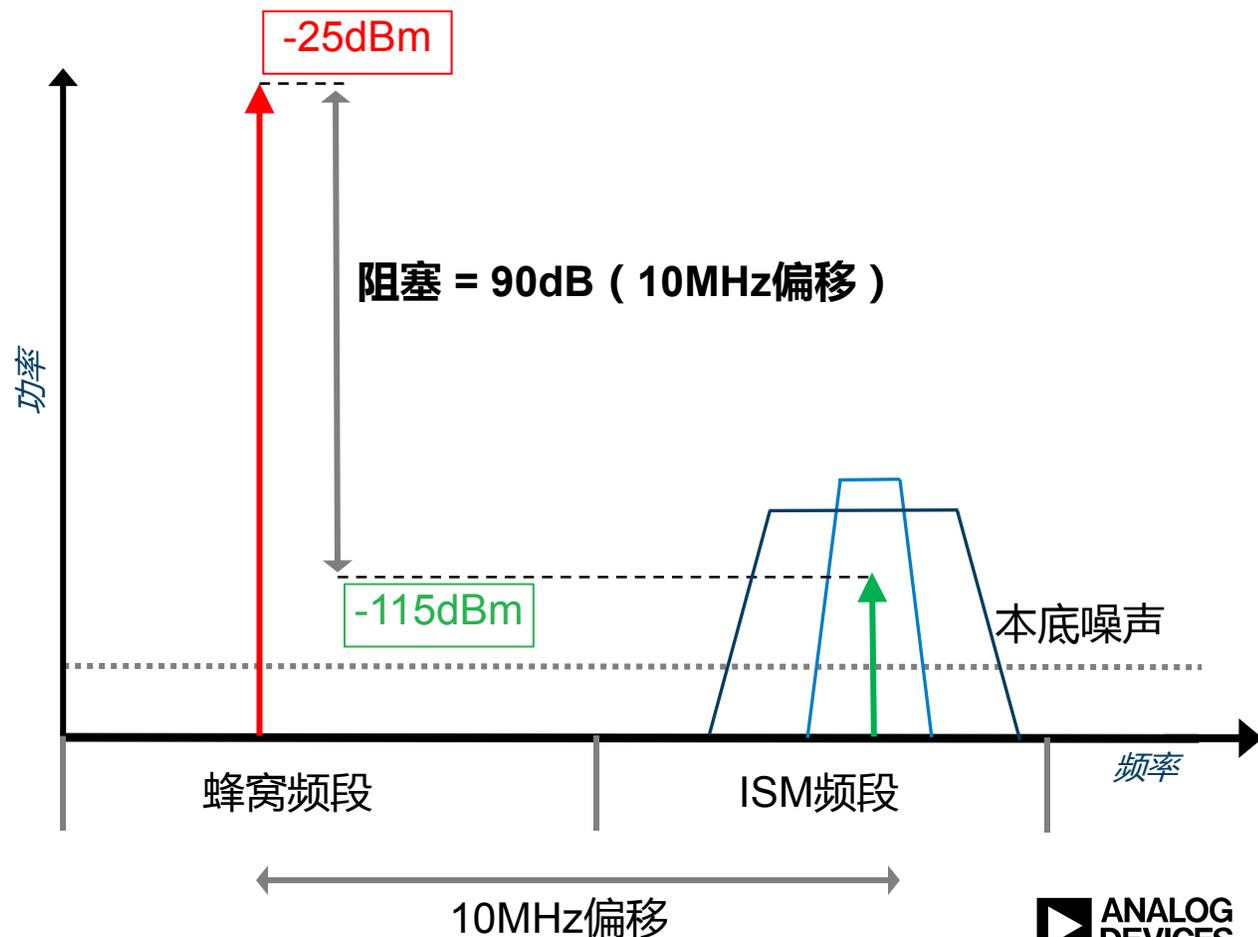
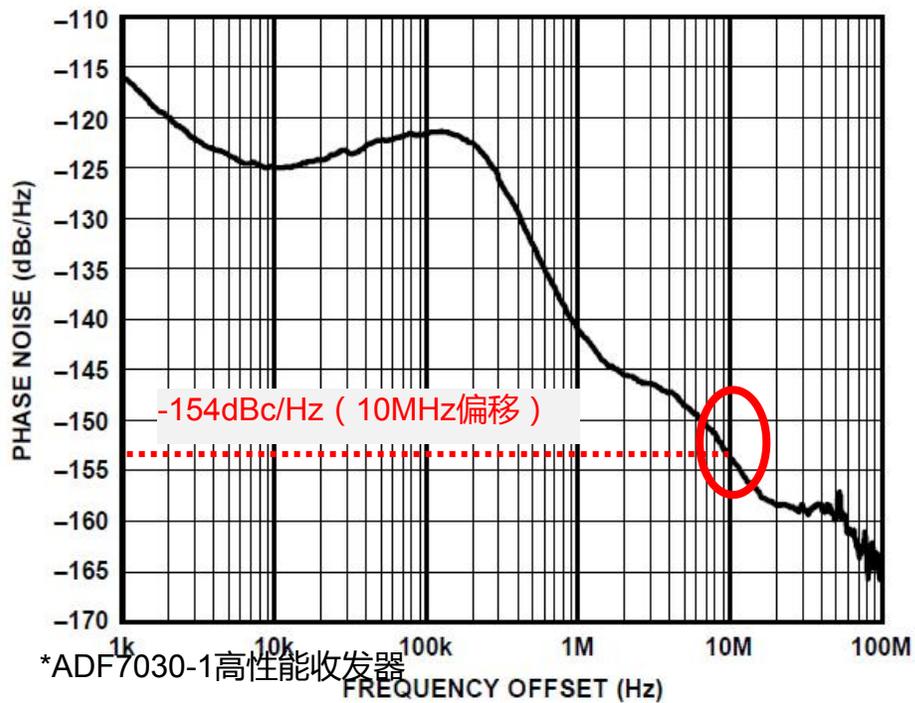
- ▶ 衡量此因素的数据手册规格是什么？
 - **阻塞**

Configuration	169.43125 MHz/2.4 kbps		
Adjacent Channel (± 12.5 kHz)	66		dB
Alternate Channel (± 25 kHz)	66		dB
± 2 MHz	94		dB
± 10 MHz	92		dB
± 20 MHz	102		dB

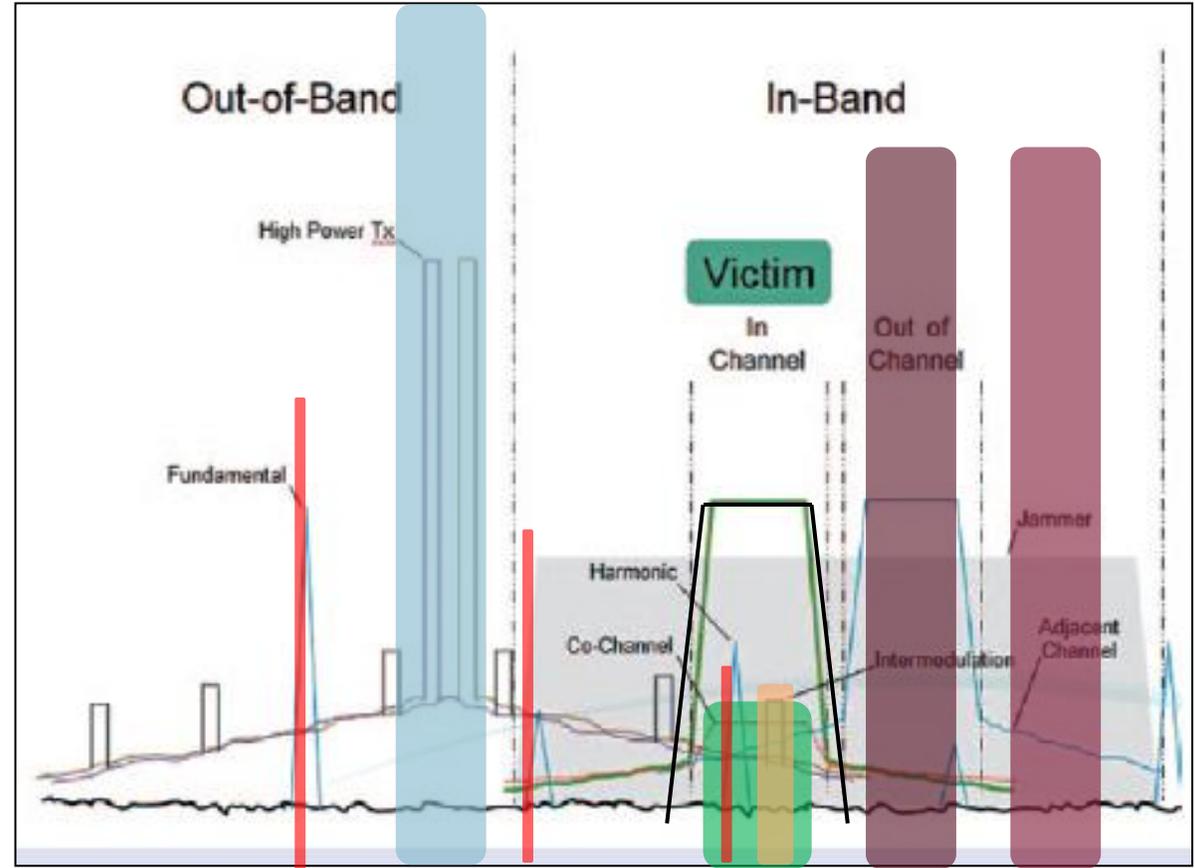


拥堵的ISM频段 阻塞规格

- ▶ 良好阻塞性能的另一指标
 - 相位噪声



拥堵的ISM频段 实际场景



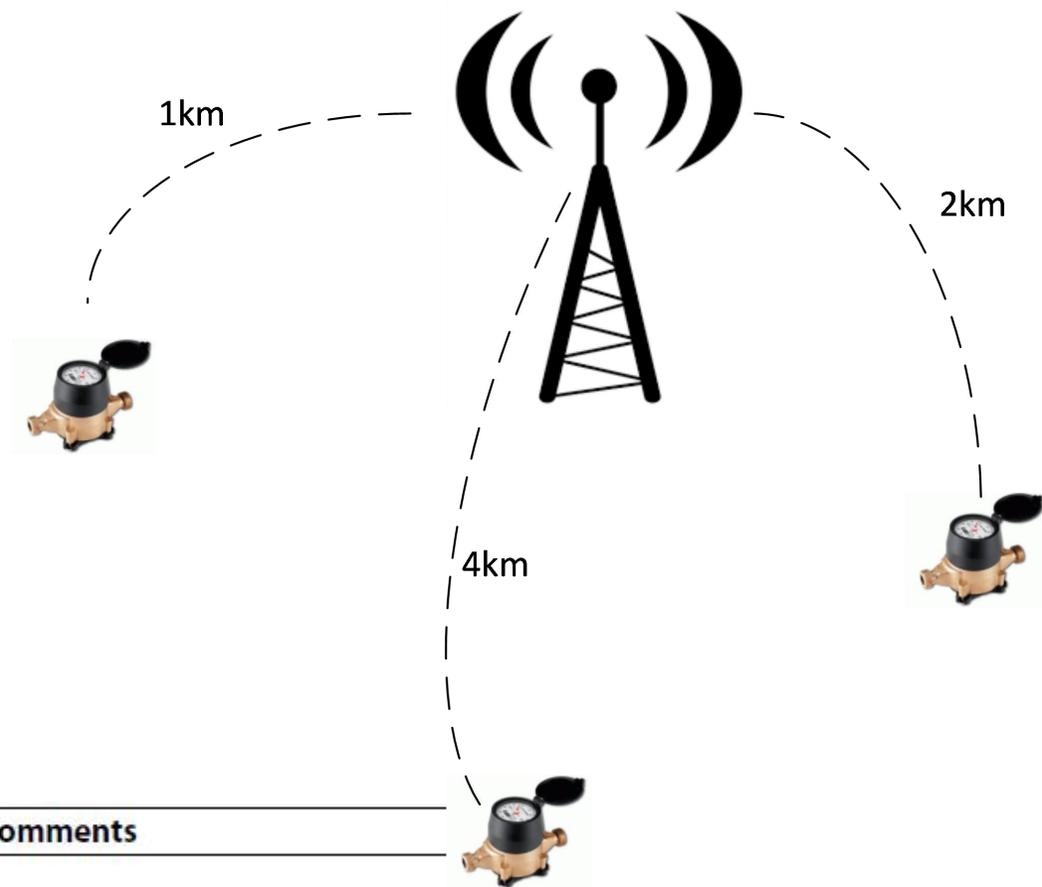
在有干扰的情况下，高性能无线电接收机设计对链路鲁棒性至关重要

长距离 灵敏度

▸ 灵敏度

- 衡量无线电能够解读的信号的最高功率
- 随着数据速率降低，无线电能够检测更弱的信号

- 在数据手册上，**灵敏度**显示为分组差错率(PER)或误码率(BER)水平



Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
SENSITIVITY, PACKET ERROR RATE (PER)					
Configuration 169.41875 MHz/0.1 kbps		-134.3		dBm	At PER = 5%, automatic frequency control (AFC) disabled
Configuration 169.43125 MHz/2.4 kbps		-121.2		dBm	At PER = 5%, AFC enabled, RF frequency error range = ±11.5 ppm
Configuration 169.41875 MHz/4.8 kbps		-119.4		dBm	At PER = 5%, AFC enabled, RF frequency error range = ±11.5 ppm

长距离

灵敏度相对于频率误差的稳定性

- ▶ 温度和老化效应可能导致发射机与接收机之间出现频率误差

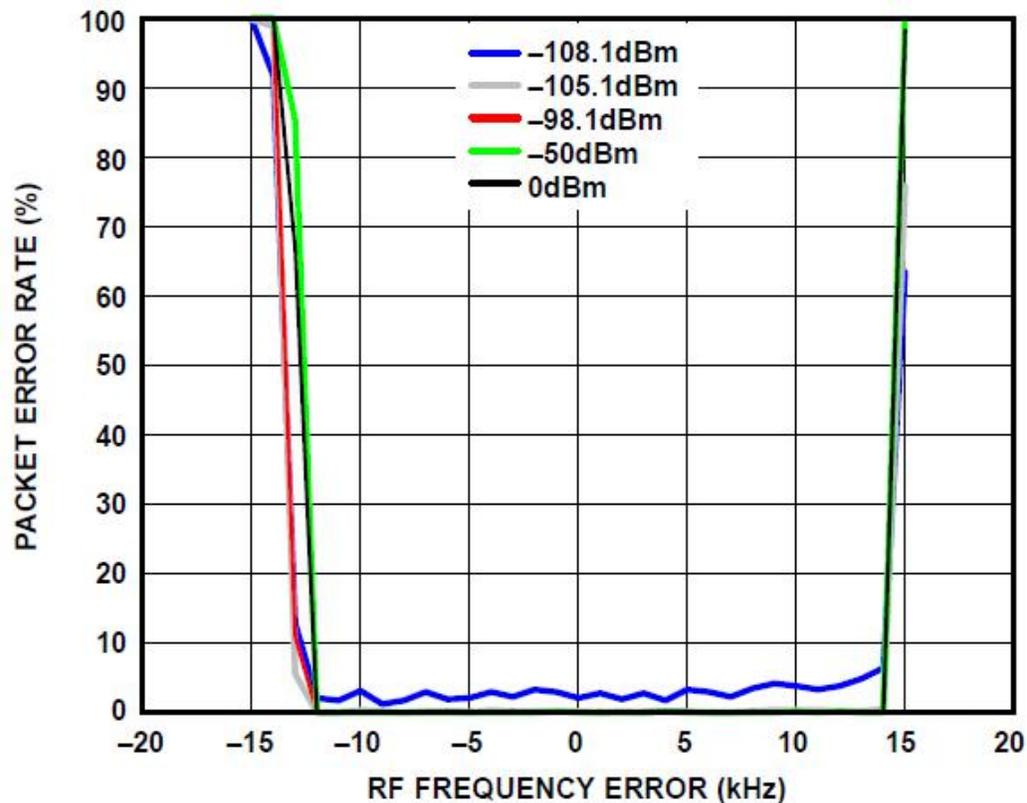


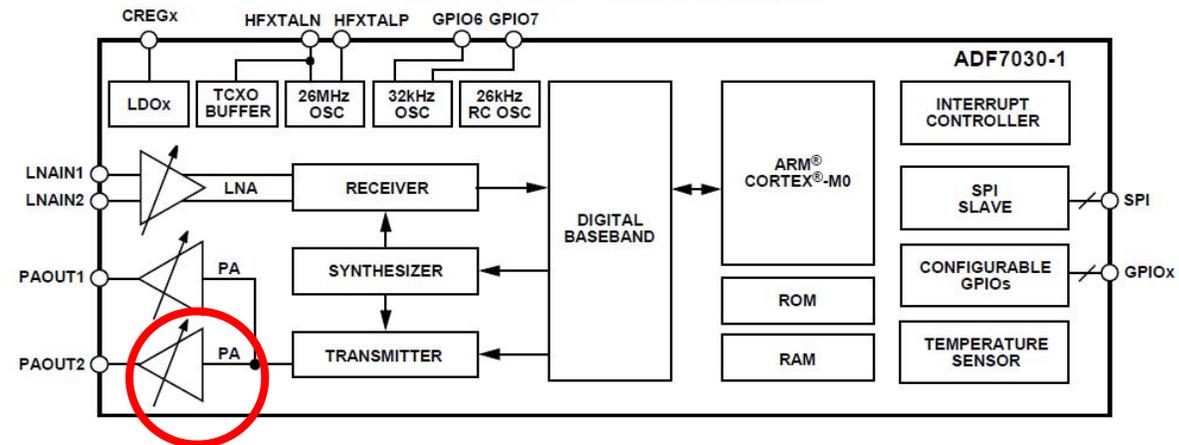
Figure 23. Packet Error Rate vs. RF Frequency Error and RF Input Power; Configuration 433 MHz/50 kbps, AFC Enabled; $V_{DD} = 3.0$ V; $T_A = 25^\circ\text{C}$

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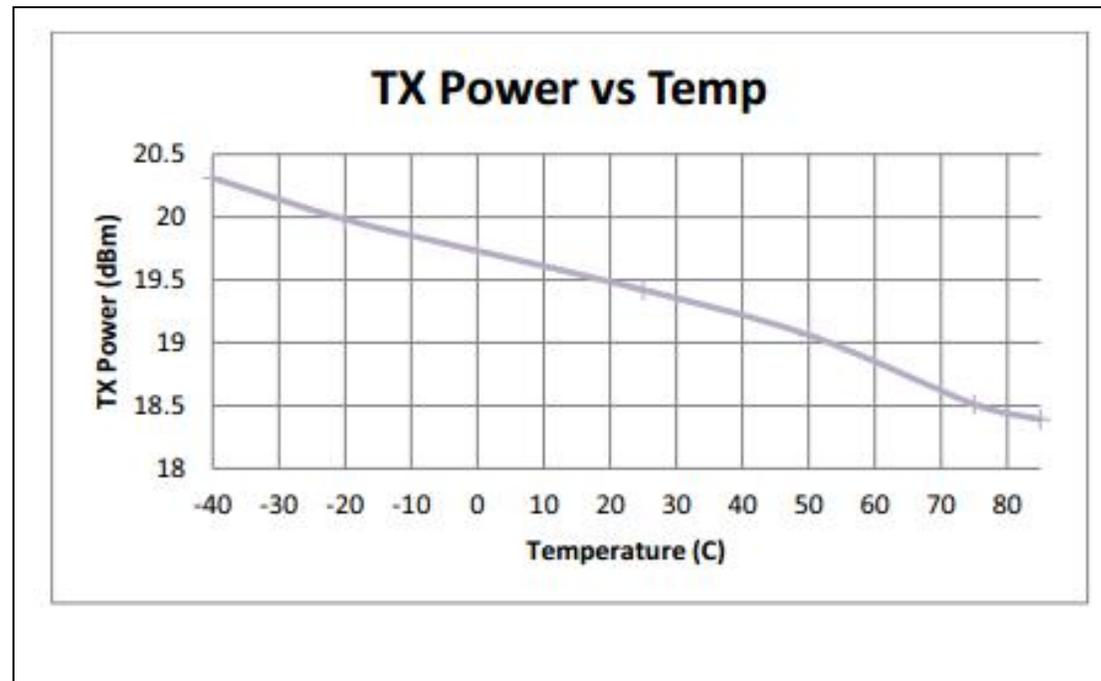
确保在规定的频率误差范围内，灵敏度保持稳定

输出功率稳定性 温度效应

FUNCTIONAL BLOCK DIAGRAM

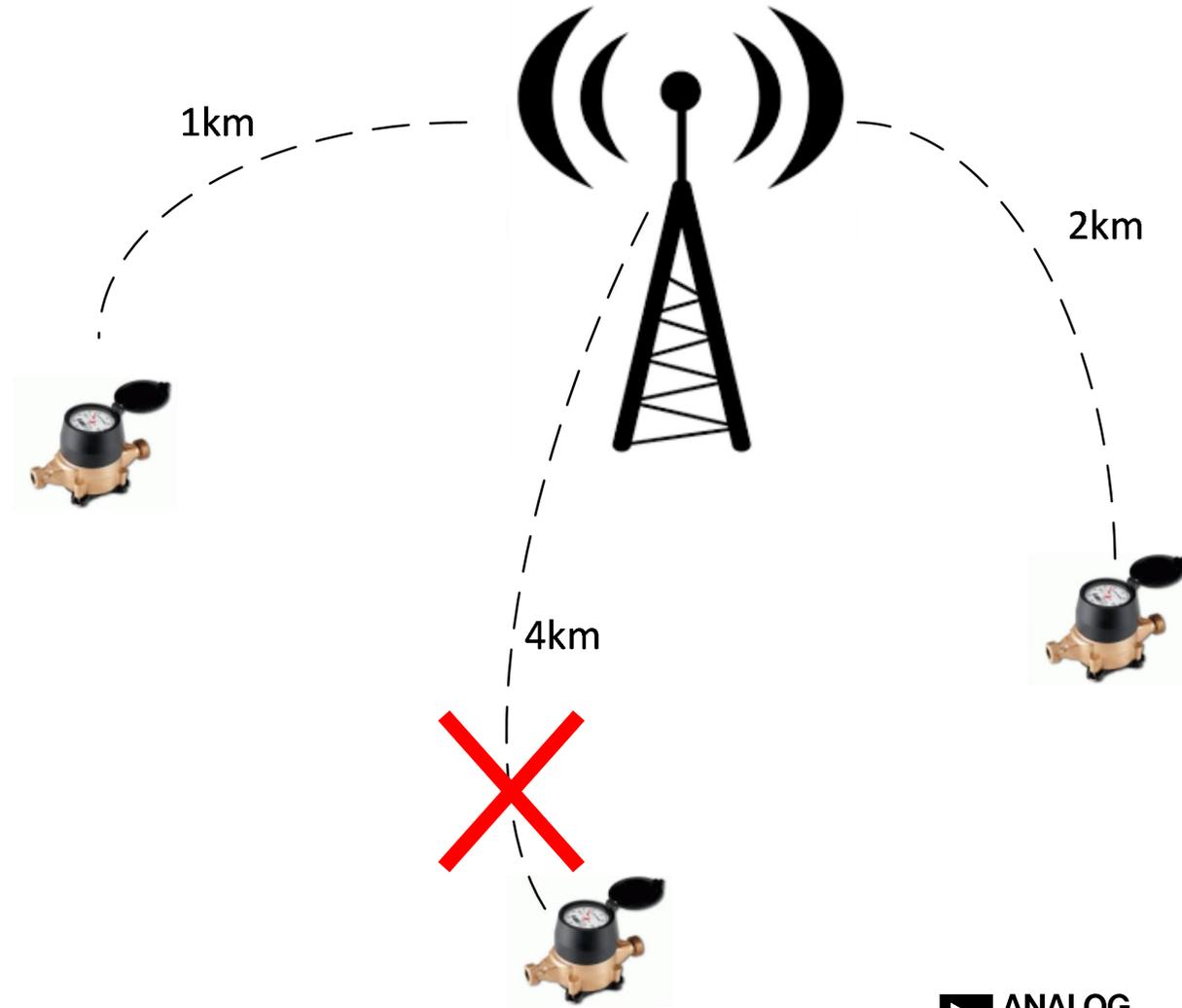
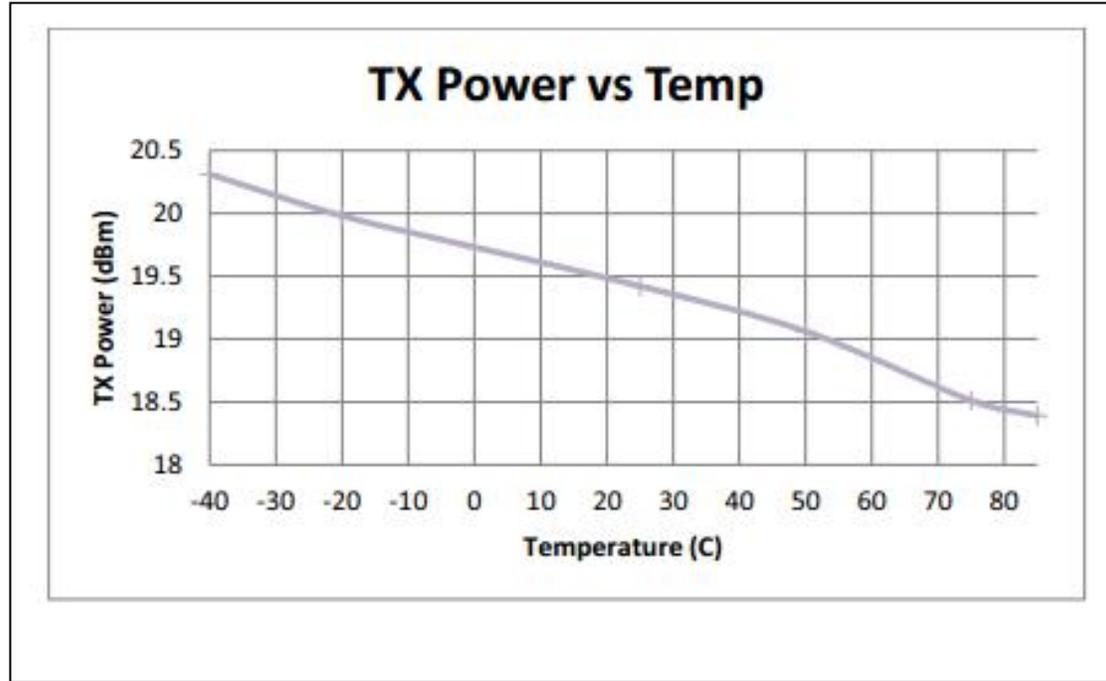


▶ PA电路易受温度变化影响

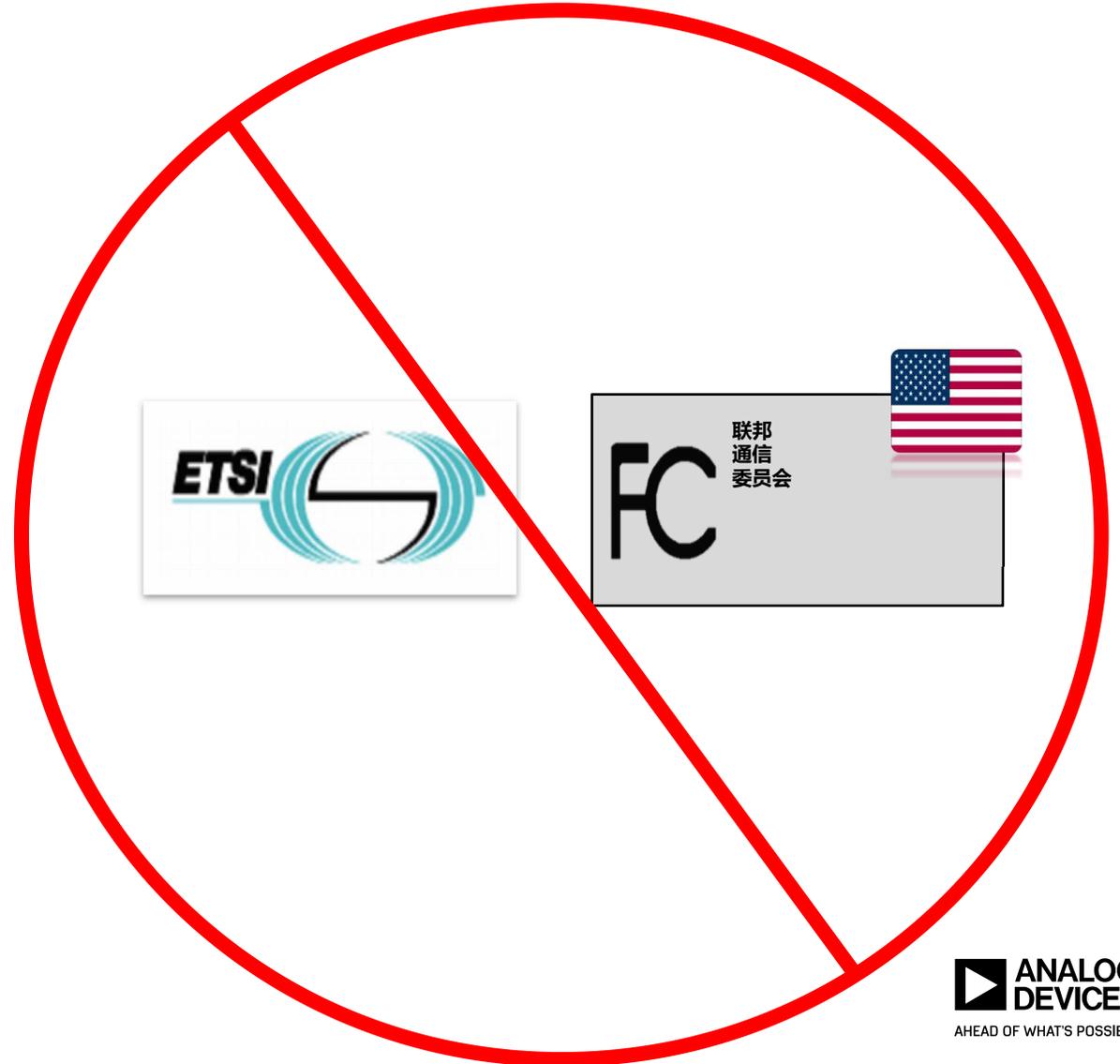
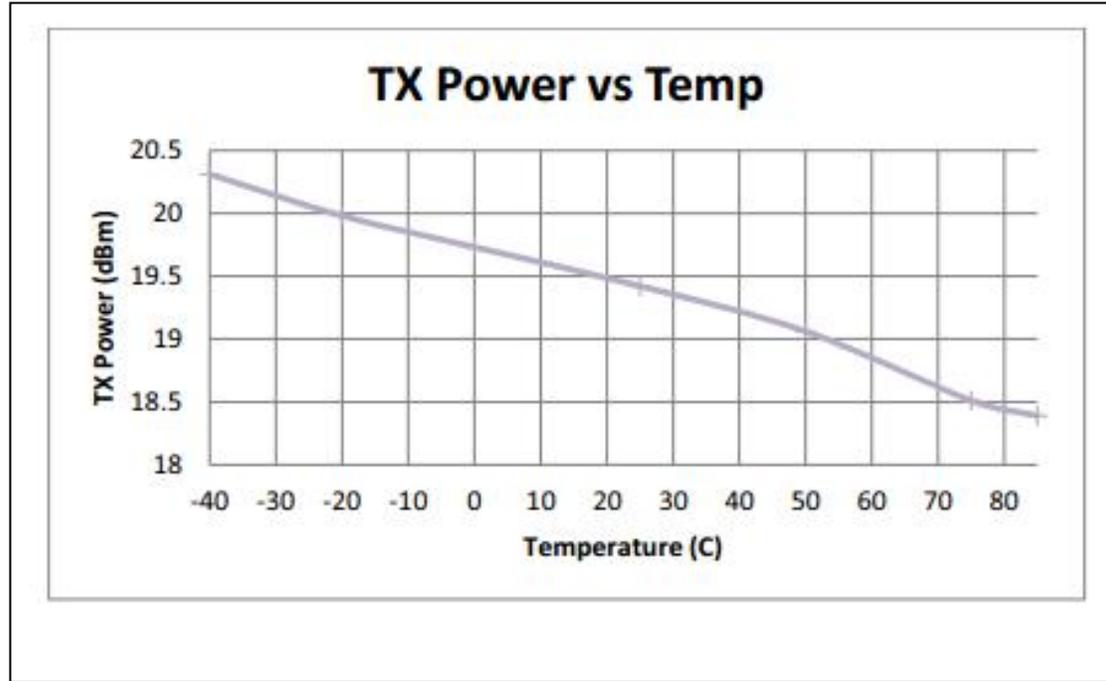


▶ 发射功率可能随温度而变化

输出功率稳定性 温度效应



输出功率稳定性 温度效应

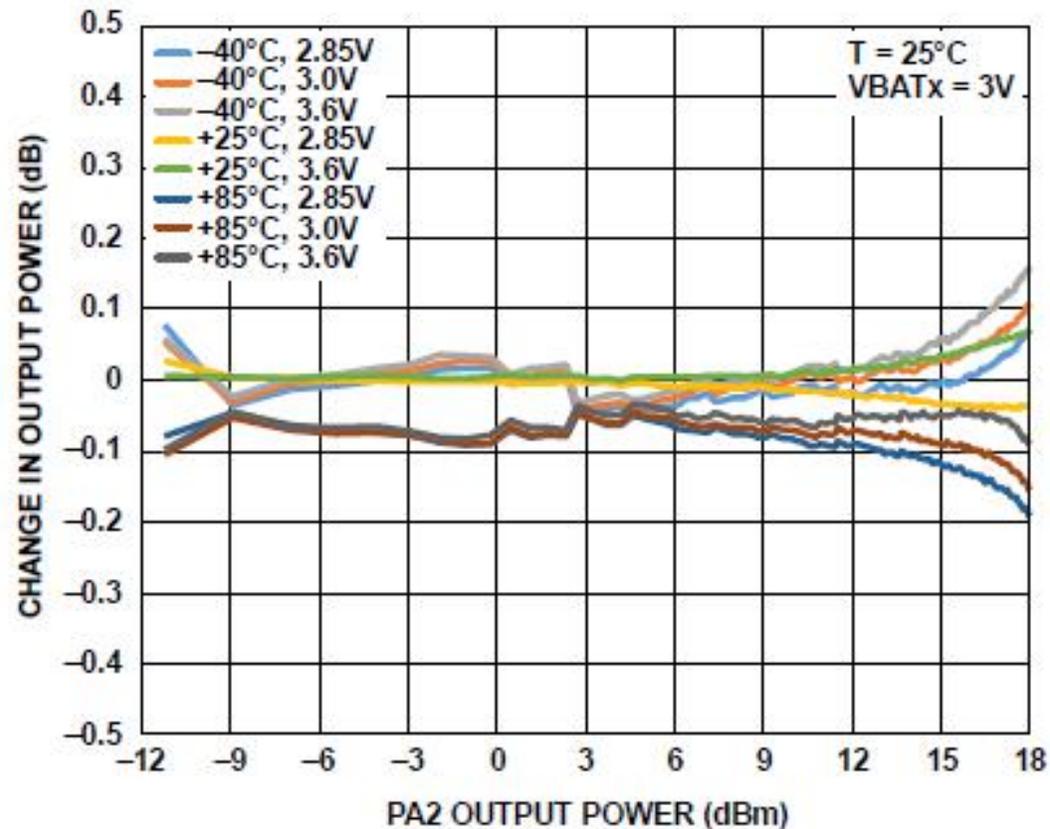


输出功率稳定性 温度效应

▶ 数据手册规格

- 确保PA输出功率在整个温度范围内保持稳定

Parameter	Min	Typ	Max	Unit
POWER AMPLIFIER (PA)				
Power Amplifier 1 (PA1)				
Transmit Power Maximum		13		dBm
Transmit Power Minimum		-20		dBm
Transmit Power Step Resolution		0.1		dB
Transmit Power Variation vs. Temperature		±0.15		
Transmit Power Variation vs. V_{DD}		±0.1		

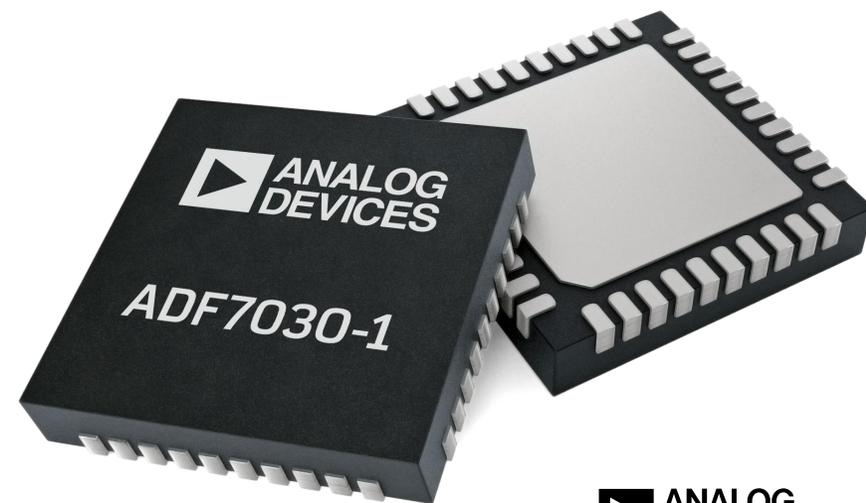


*ADF7030-1高性能收发器

确保无线电在实际状况中保持稳定

结语

- ▶ 可靠连接是低功耗互连传感器大规模应用的关键
- ▶ 连接不可靠对应用的影响
 - 数据包重新传输会消耗电池电力
 - 高数据丢失率
- ▶ 通过良好的无线电设计可以消除环境RF危害的影响
 - 拥堵的ISM频段：**ACR、阻塞、相位噪声**
 - 范围：**灵敏度稳定性**
 - 温度效应：**PA稳定性**
- ▶ **ADI公司的ADF7030-1**通过出色的RF设计提供鲁棒的连接



谢谢观看！

- ▶ **ADI中国地区技术支持热线：4006 100 006**
- ▶ **ADI中国地区技术支持信箱：**
china.support@analog.com
- ▶ **ADI样片申请网址：**
<http://www.analog.com/zh/sample>