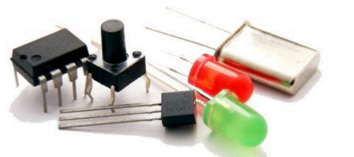
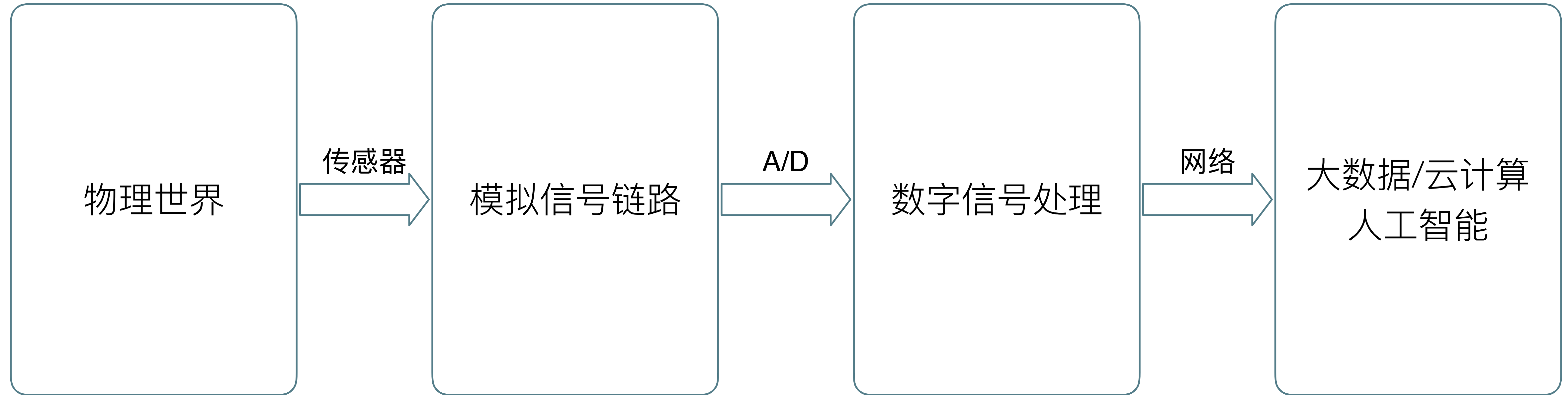


# 电子产品的系统构成及电路基础

由电流构成的回路，由电压/电流表征的信号



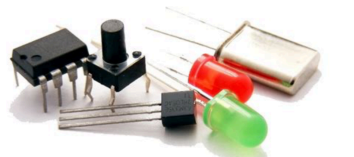
# 所有电子产品都是用电信号对物理世界进行表征和计算的过程



$$V=I \cdot R$$

时域  
频域

数字域





# 基本的电路理论

# 主要公式

**Ohm's Law**

**Power (P)**  
The total work performed by a current

**Voltage (V)**  
Electrical force or pressure

**Current (I)**  
The number of electrons passing in a single point

**Resistance (R)**  
Resistance to the flow of current

**Basic Units**

Quantity	Unit
Capacitance	F Farad
Charge	C Coulomb
Current	A Ampere
Energy	J Joule
Force	N Newton
Frequency	Hz Hertz
Inductance	H Henry
Magnetic Flux	Wb Weber
Potential	V Volt
Power	W Watt
Resistance	Ω Ohm

**Kirchhoff's Laws**

**Closed Loop Rule**  
The directed sum of the electrical potential differences (voltage) around any closed circuit is zero

$\sum \Delta V_{\text{close loop}} = 0$   
 $V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$

**Junction Rule**  
The sum of currents entering the junction are thus equal to the sum of currents leaving.

$\sum i_{in} = \sum i_{out}$   
 $i_1 = i_2 + i_3$

**Resistor Network**

**Series**  
 $R_T = R_1 + R_2 + R_3$

**Parallel**  
 $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

**Capacitor Network**

**Series**  
 $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

**Parallel**  
 $C_T = C_1 + C_2 + C_3$

**Unit Prefixes**

Prefix	Symbol	Factor
Tera	T	$\times 10^{12}$
Giga	G	$\times 10^9$
Mega	M	$\times 10^6$
Kilo	K	$\times 10^3$
Hecto	H	$\times 10^2$
Deka	Da	$\times 10^1$
(base)	-	$\times 10^0$
Deci	d	$\times 10^{-1}$
Centi	c	$\times 10^{-2}$
Milli	m	$\times 10^{-3}$
Micro	μ	$\times 10^{-6}$
Nano	n	$\times 10^{-9}$
Pico	p	$\times 10^{-12}$

examples:  
 $25 \mu\text{A} = 25 \times 10^{-6} \text{ A} = 0.000025 \text{ A}$   
 $4.7\text{M}\Omega = 4.7 \times 10^6 \Omega = 4,700,000 \Omega$

**Alternating Current**

Peak Positive Voltage (Vp+)  
 Peak Negative Voltage (Vp-)  
 Peak-to-Peak Voltage (Vpp)  
 RMS Voltage (VRMS)

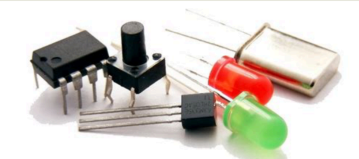
Average AC Voltage  
 $= 0.637 \times \text{Peak}$   
 $= 0.9 \times \text{RMS}$

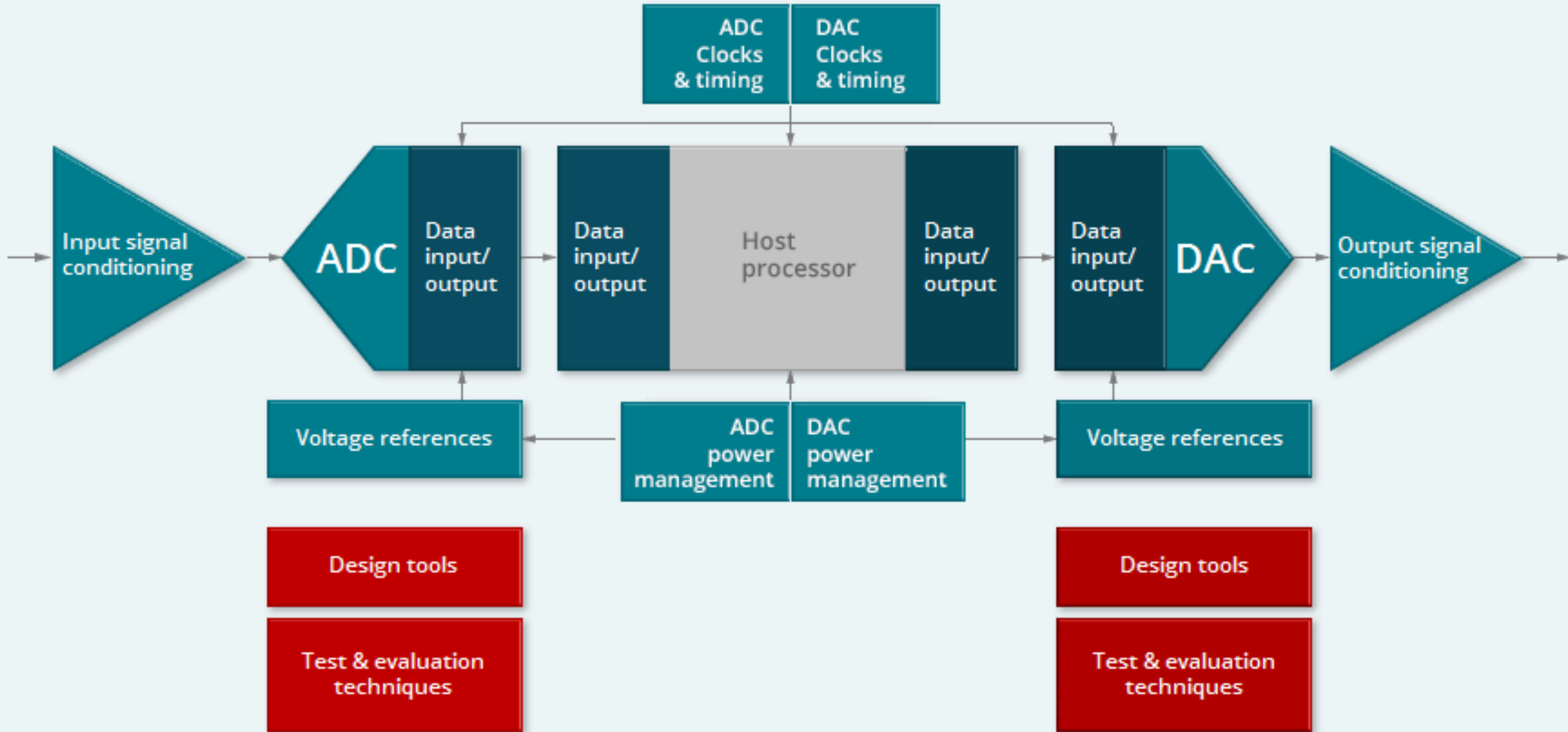
RMS AC Voltage  
 $= 0.707 \times \text{Peak}$   
 $= 1.11 \times \text{Average}$

Peak AC Voltage  
 $= 1.414 \times \text{RMS}$   
 $= 1.57 \times \text{Average}$

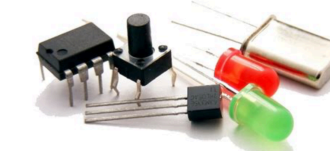
**Basic Electronics Theory**  
[www.josericafort.com/shop](http://www.josericafort.com/shop)  
 Email: me@josericafort.com

Parameter	Symbol	Measuring Unit	Description
Voltage	Volt	V or E	Unit of Electrical Potential $V = I \times R$
Current	Ampere	I or i	Unit of Electrical Current $I = V \div R$
Resistance	Ohm	R or Ω	Unit of DC Current $R = V \div I$
Conductance	Siemen or Mho	G or σ	Unit of Conductance $G = 1 \div R$
Power	Watts	W	Unit of Power $P = V \times I$
Capacitance	Farad	C	Unit of Capacitance $C = Q \div V$
Inductance	Henry	L or H	Unit of Inductance $V_L = -L(di \div dt)$
Impedance	Ohm	Z	Unit of AC Resistance $Z^2 = R^2 + X^2$
Charge	Coulomb	Q	Unit of Electrical Charge $Q = C \times V$
Frequency	Hertz	Hz	Unit of Frequency $f = 1 \div T$
Period	sec	s	Unit of Period $T = 1 \div f$

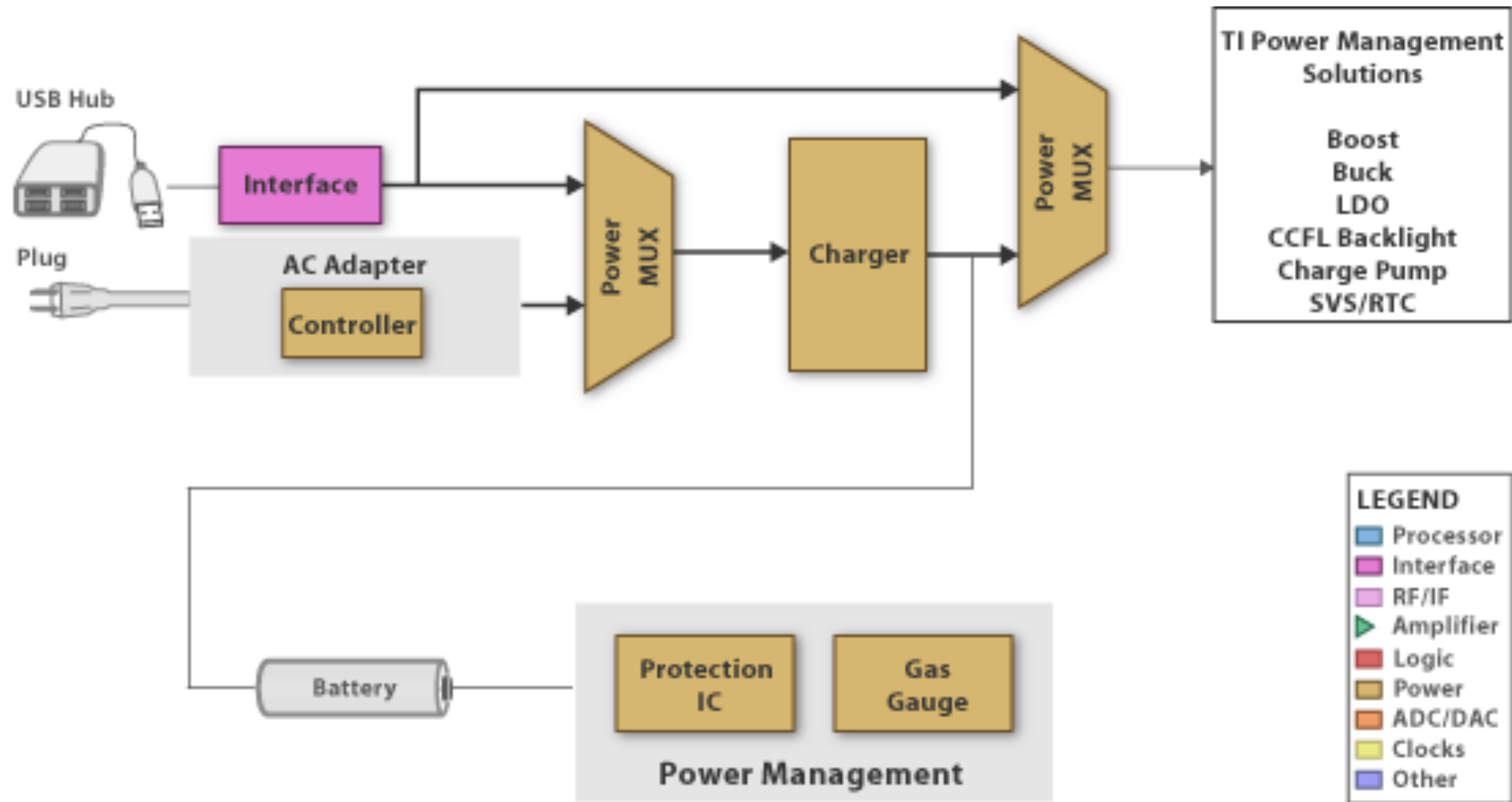




## 理解电子产品的系统构成及各部分的工作原理

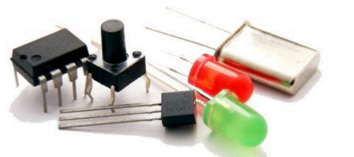


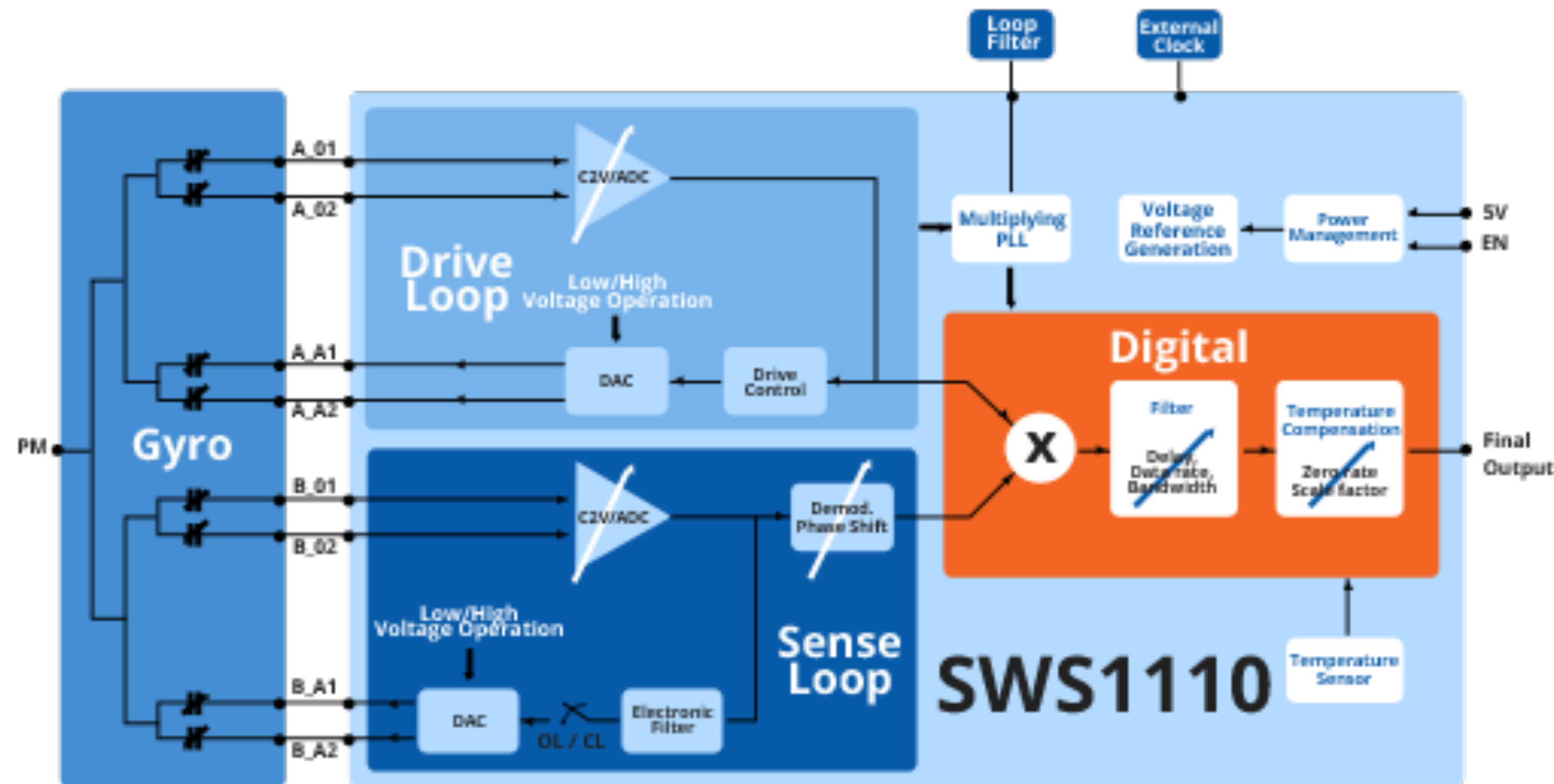
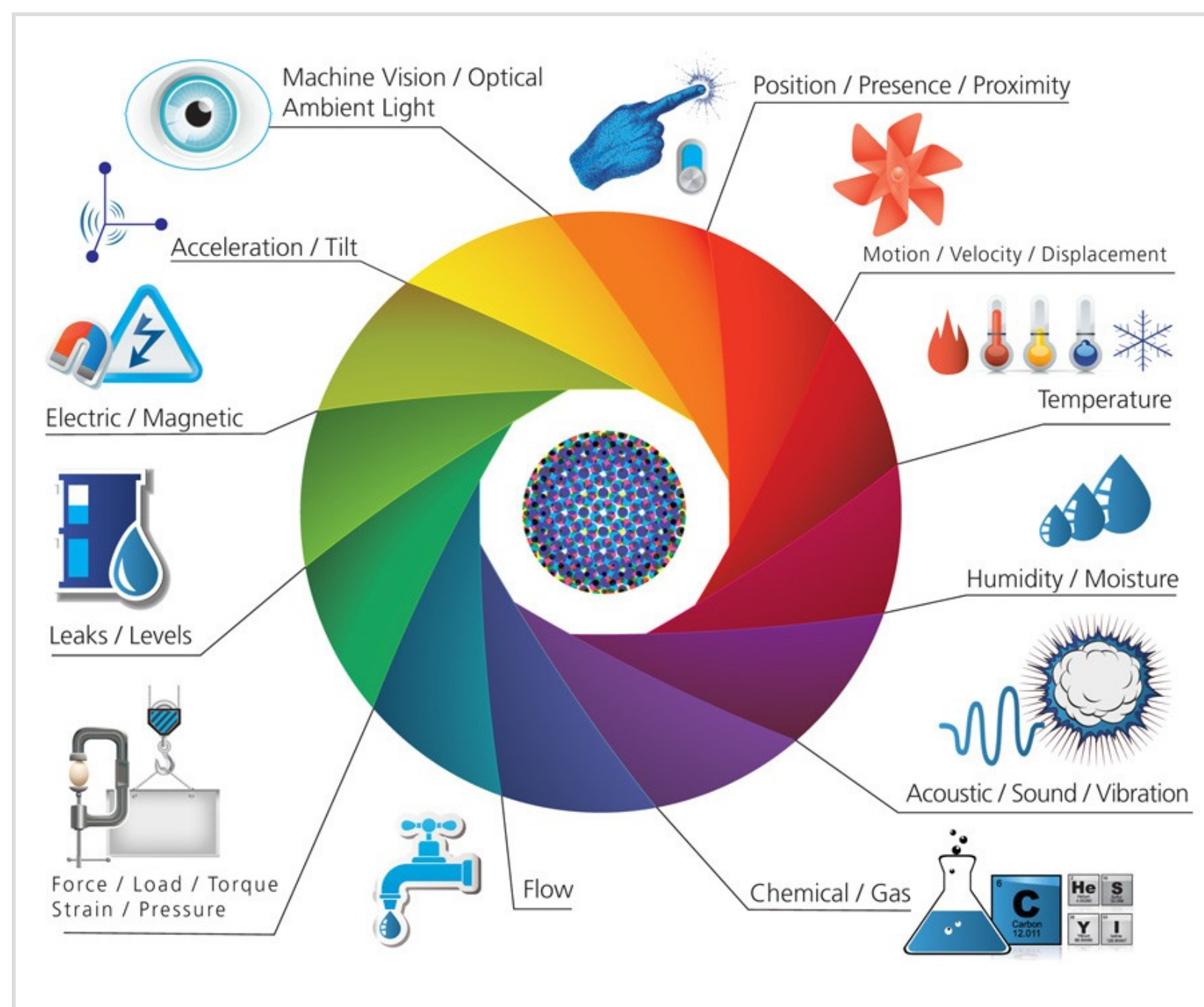




# 电源部分

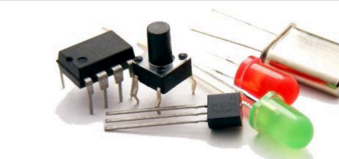
所有电子产品都需要供电





传感器 - 物理信号转变为电信号

对物理世界用电信号进行表征

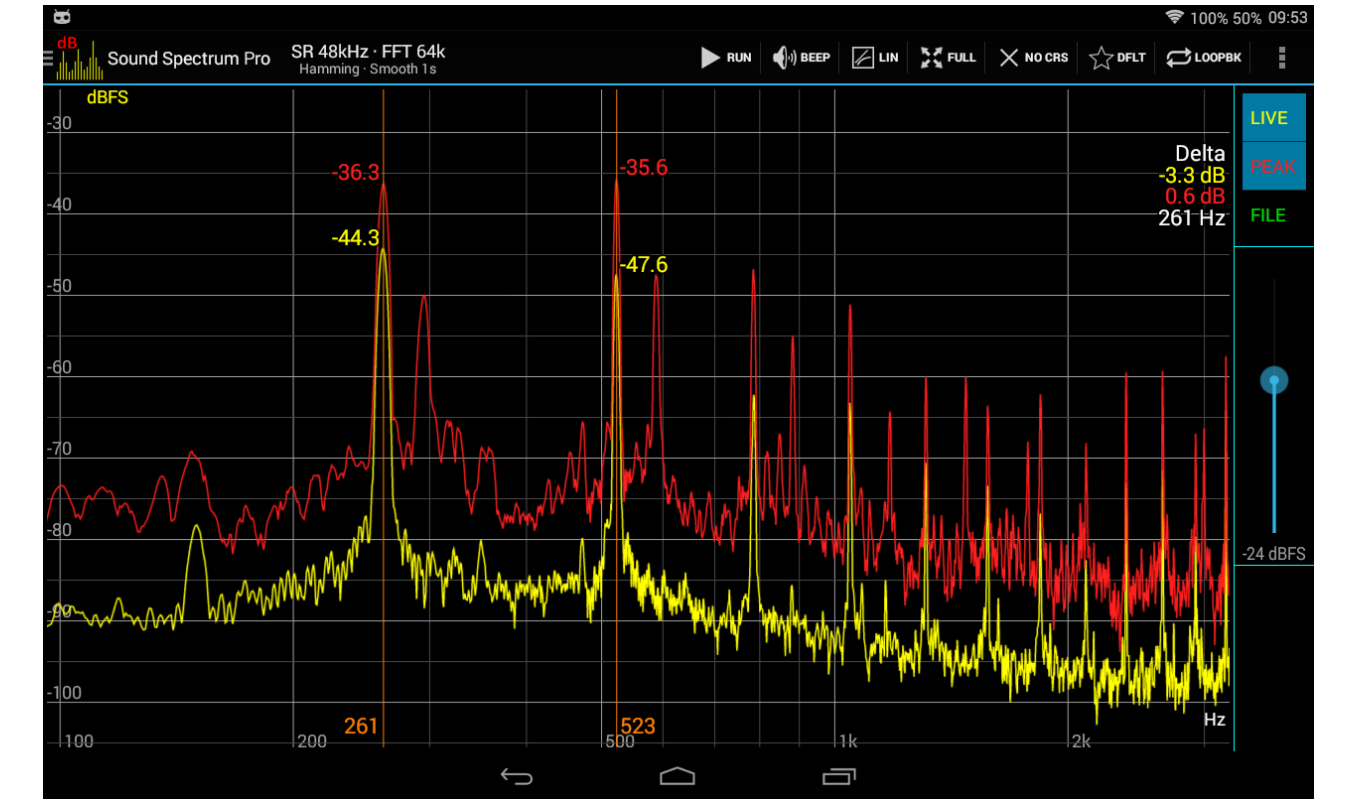
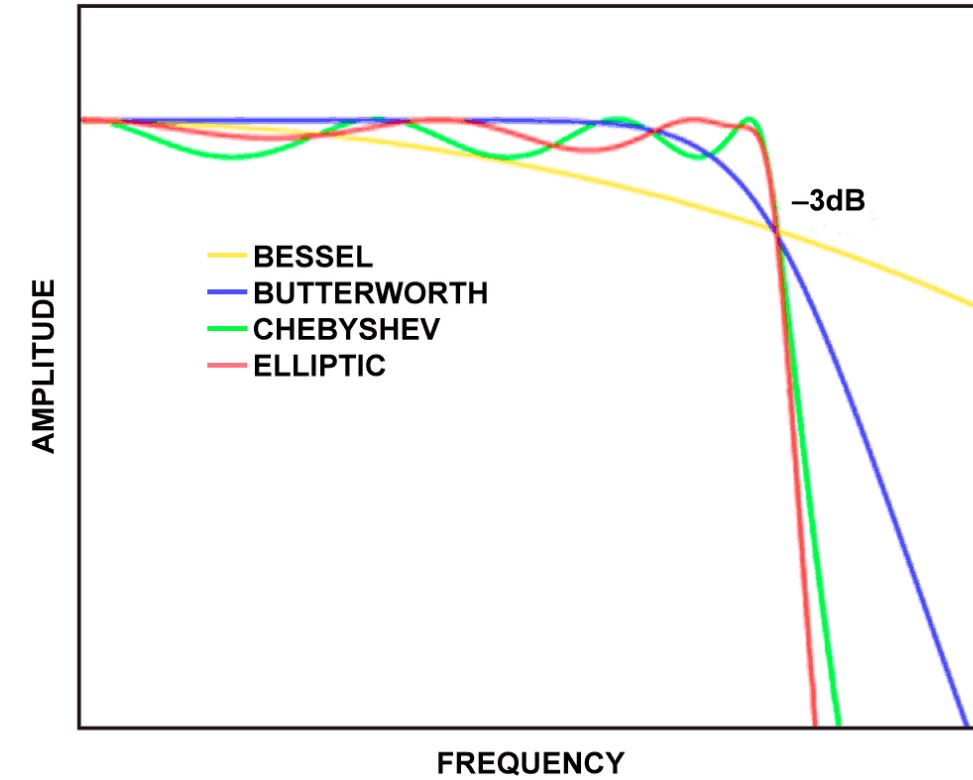






# 模拟信号调理 - 频域：滤波器

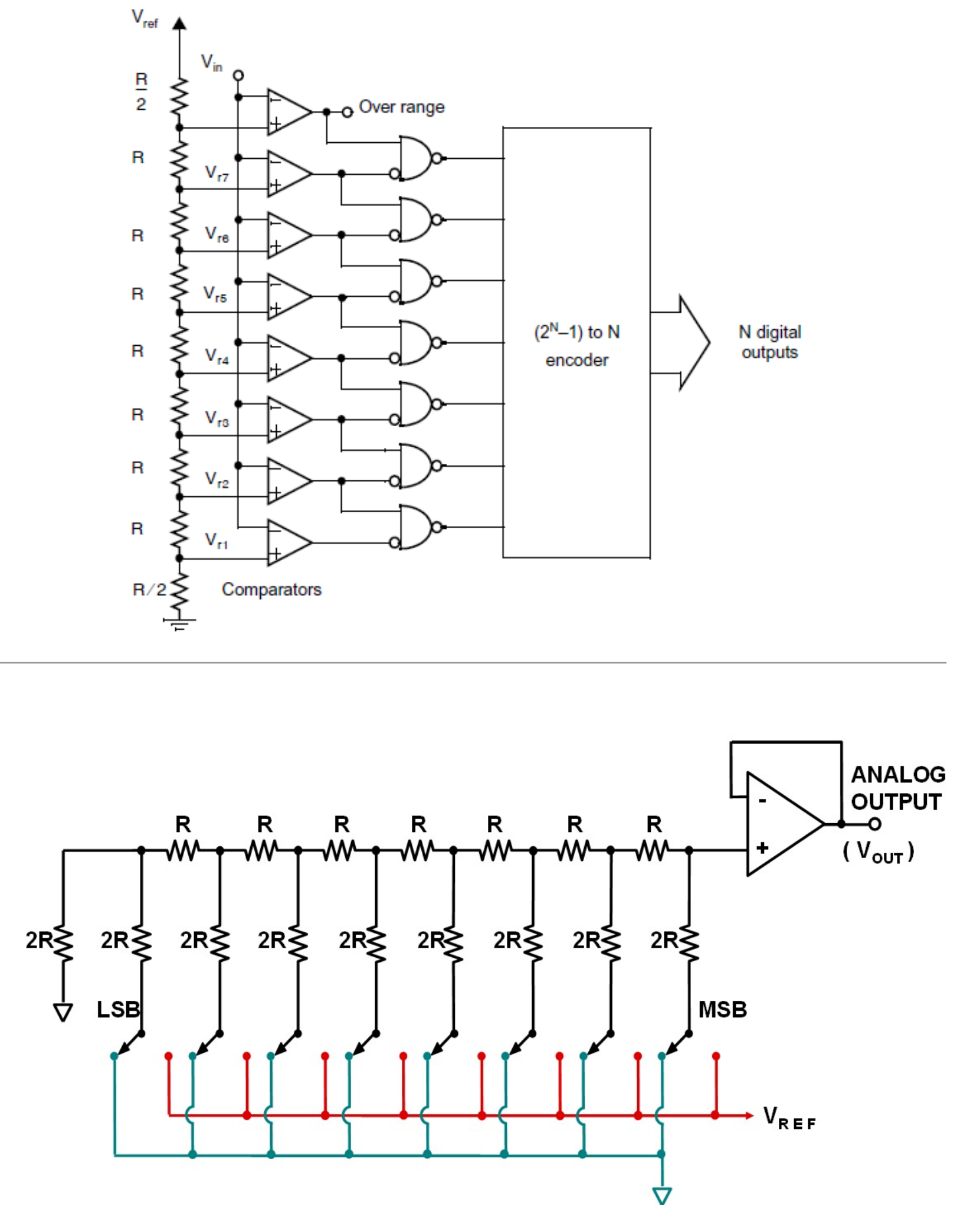
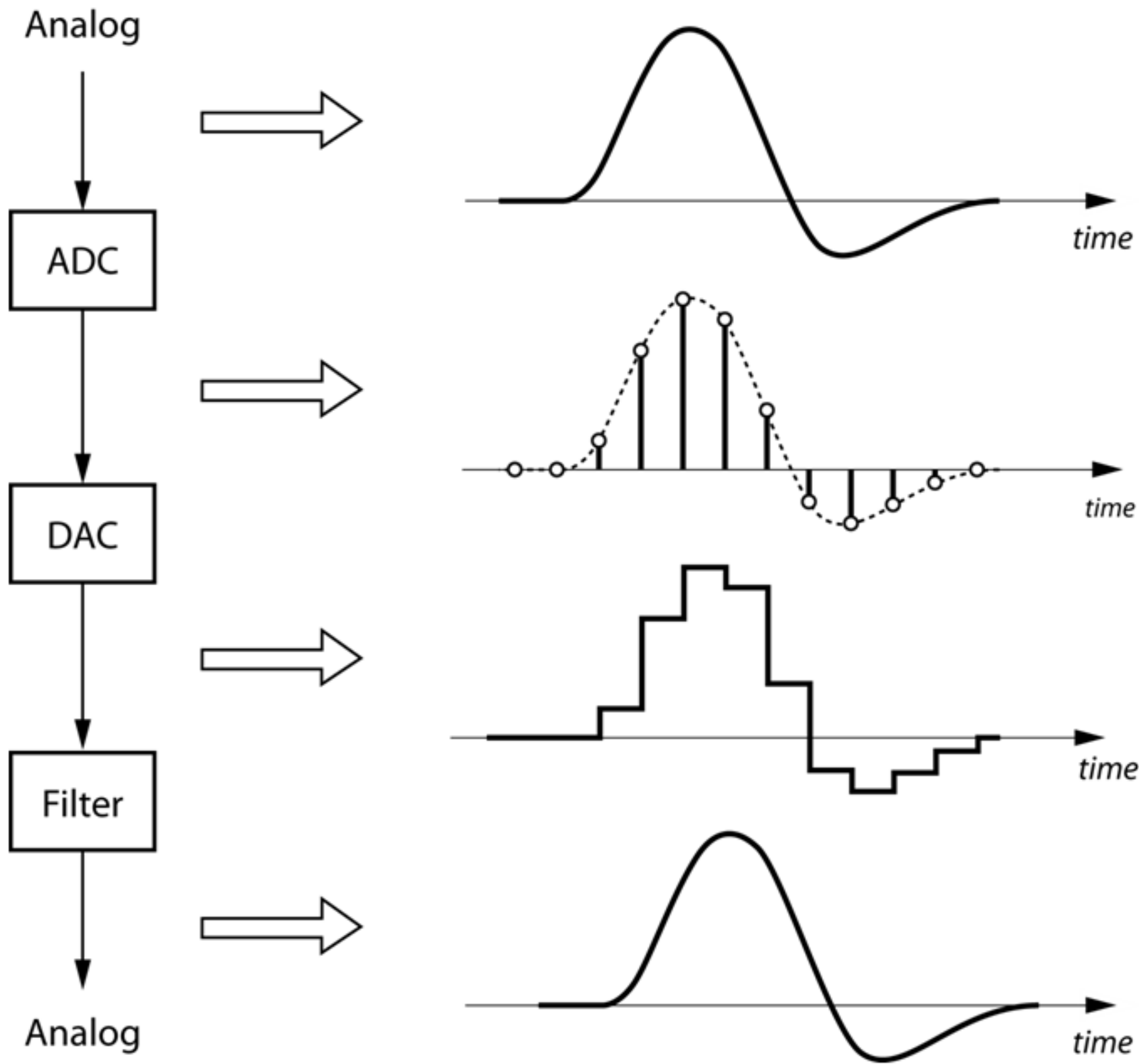
- 主要类型：低通、带通、高通
- 主要指标：
  - 过渡带衰减
  - 抑制度
  - 带内波动
  - 相位特性
- 有源滤波/无源滤波
- 测量仪器 - FFT/频谱仪



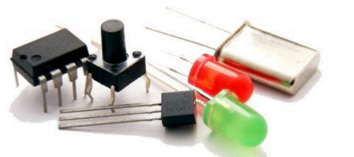
	过渡带 衰减速度	通带内起伏	通带外抑制	相位特性
贝塞尔滤波器	非常慢	带内无起伏， 单调衰减	衰减慢	通带内的相 应近乎线性
巴特沃斯滤波器	比较慢	无起伏，最平坦	单调衰减	
切比雪夫滤波器	比较快	有起伏，等波纹	单调衰减	
椭圆滤波器	非常快	有起伏，等波纹	有起伏，等波纹	良好





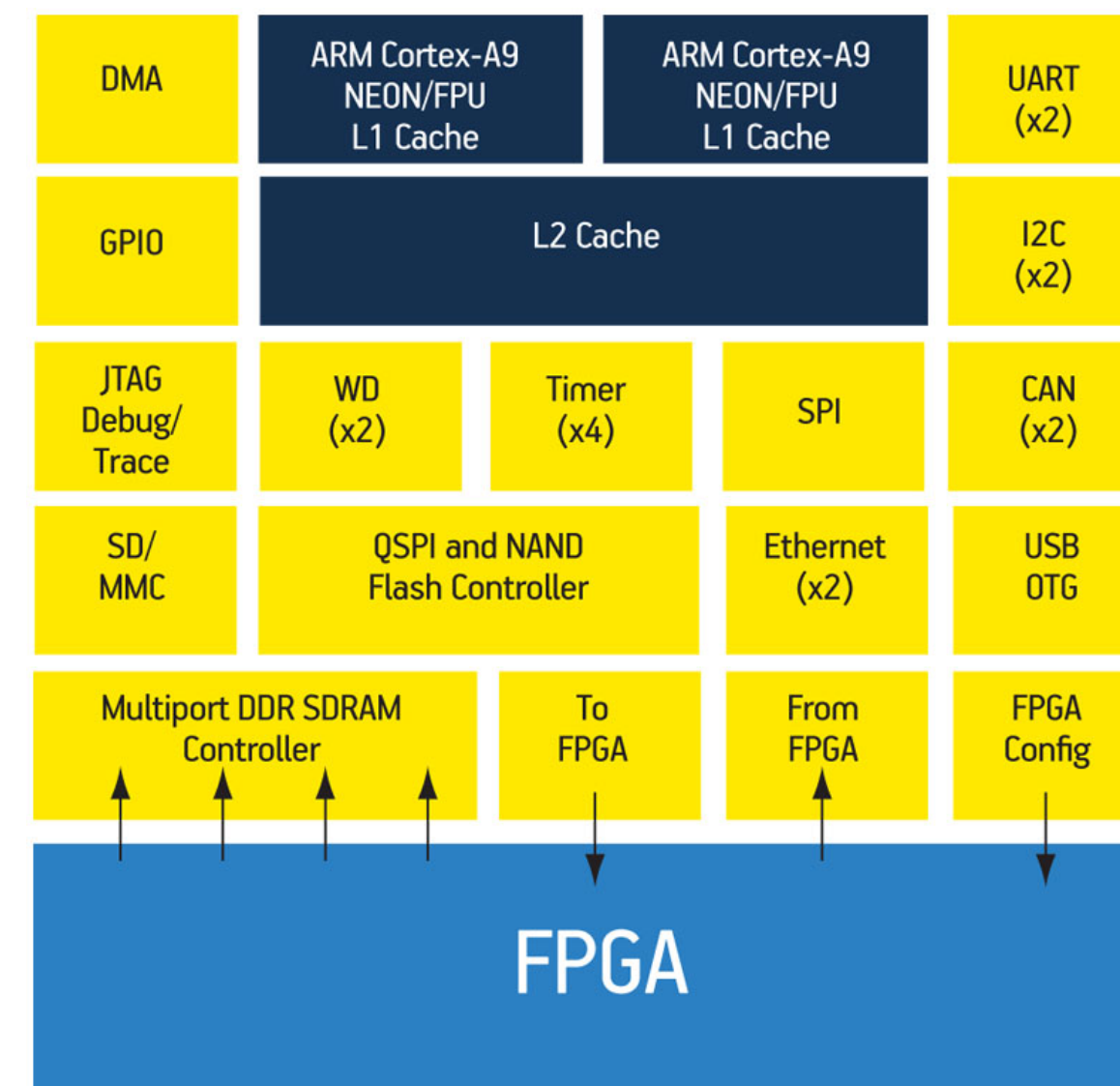
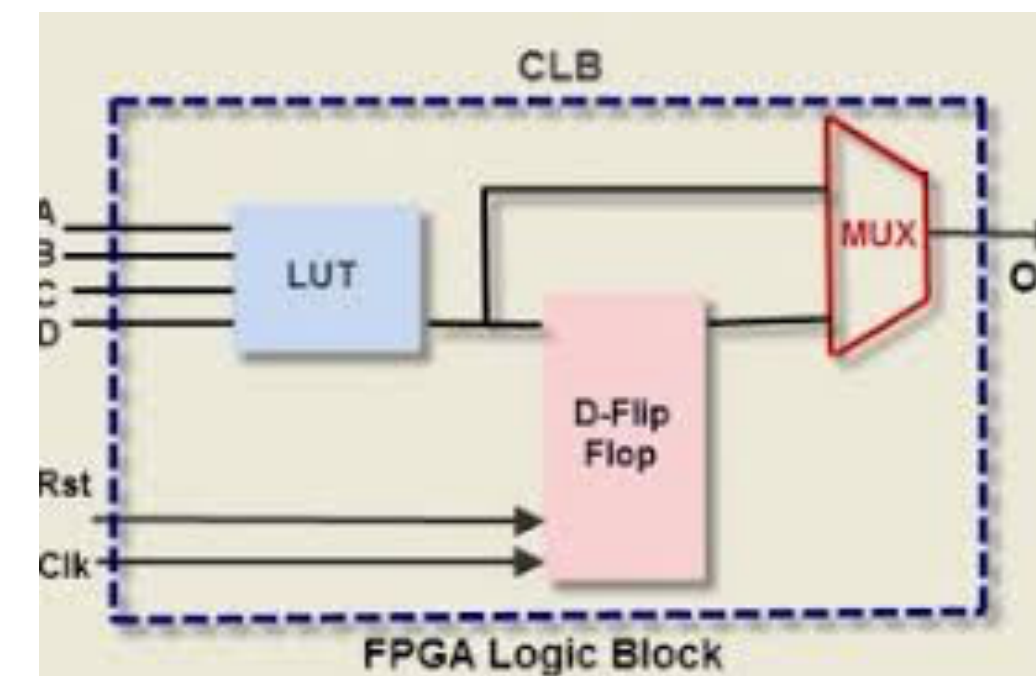
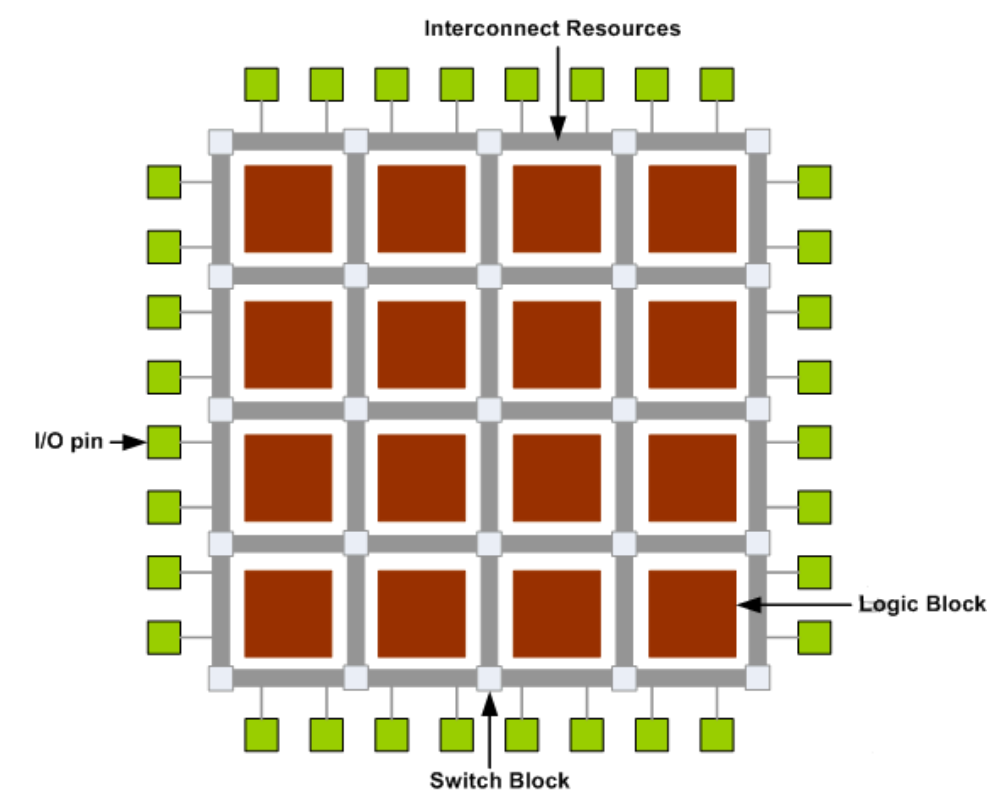
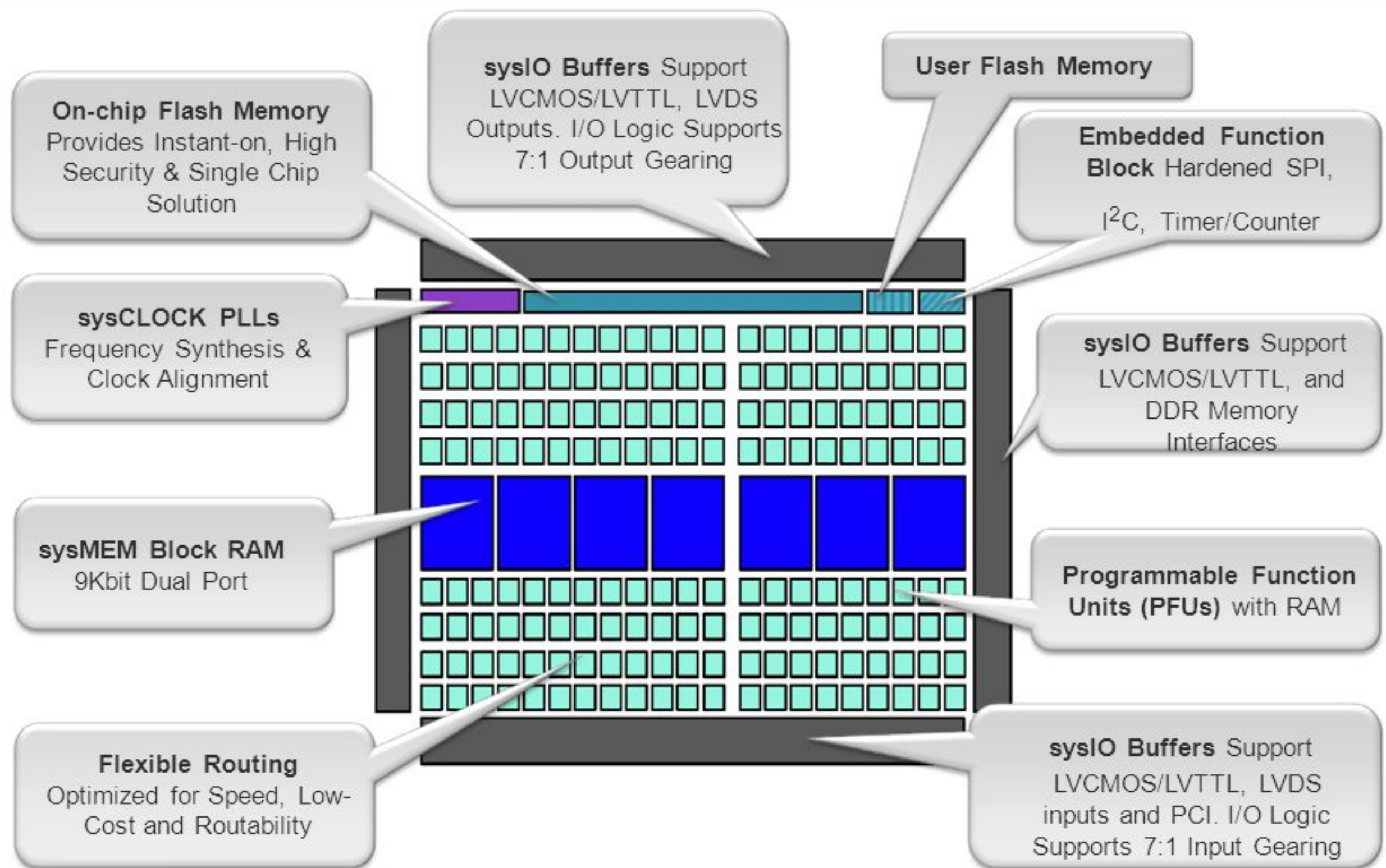


## 数据转换 - ADC/DAC：连接模拟信号和数字信号的桥梁 - 转换率/分辨率

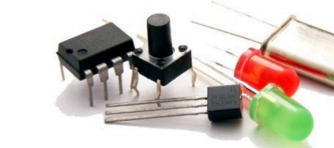


# MACHXO2 BLOCK DIAGRAM (XO2-1200)

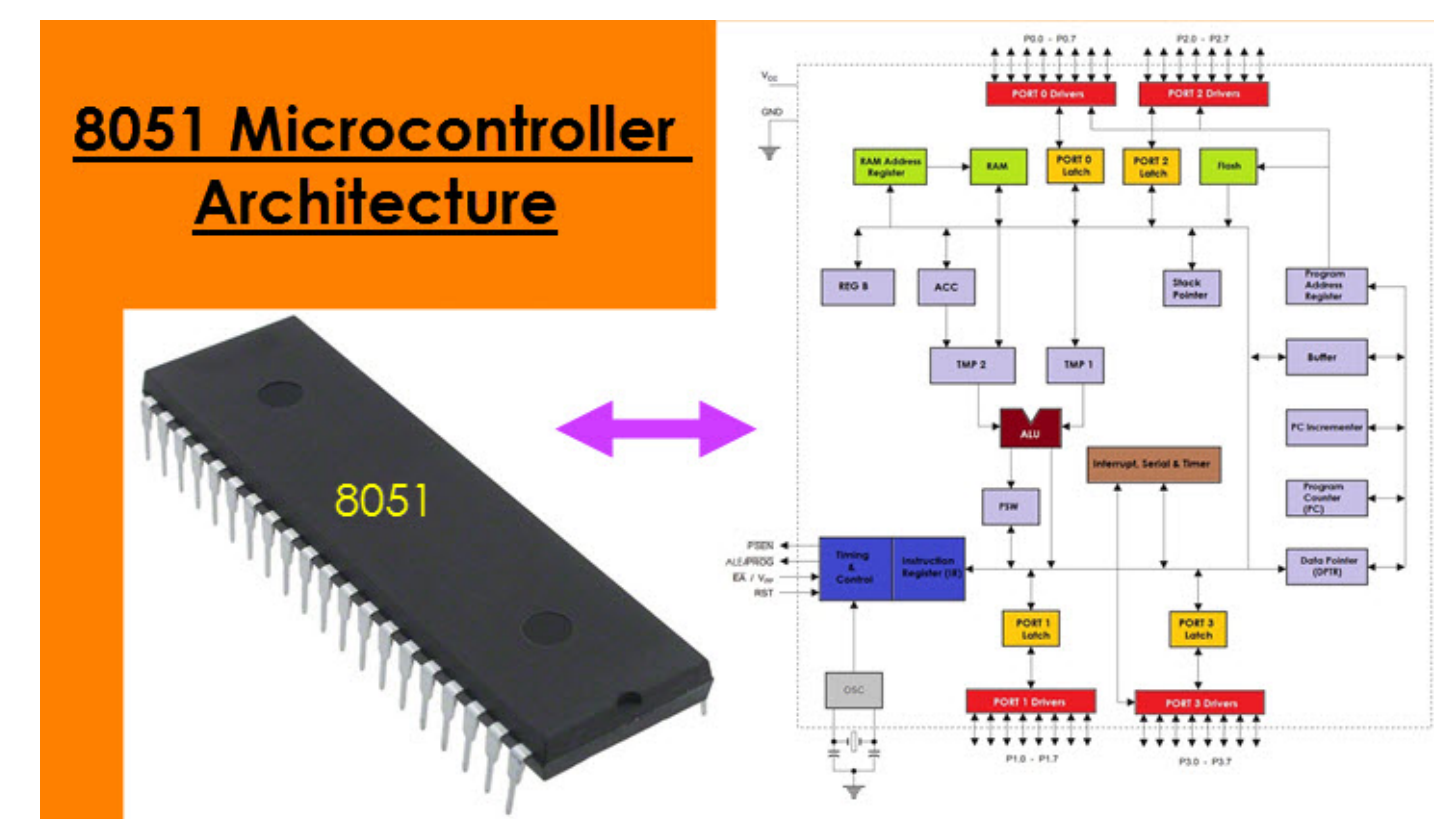
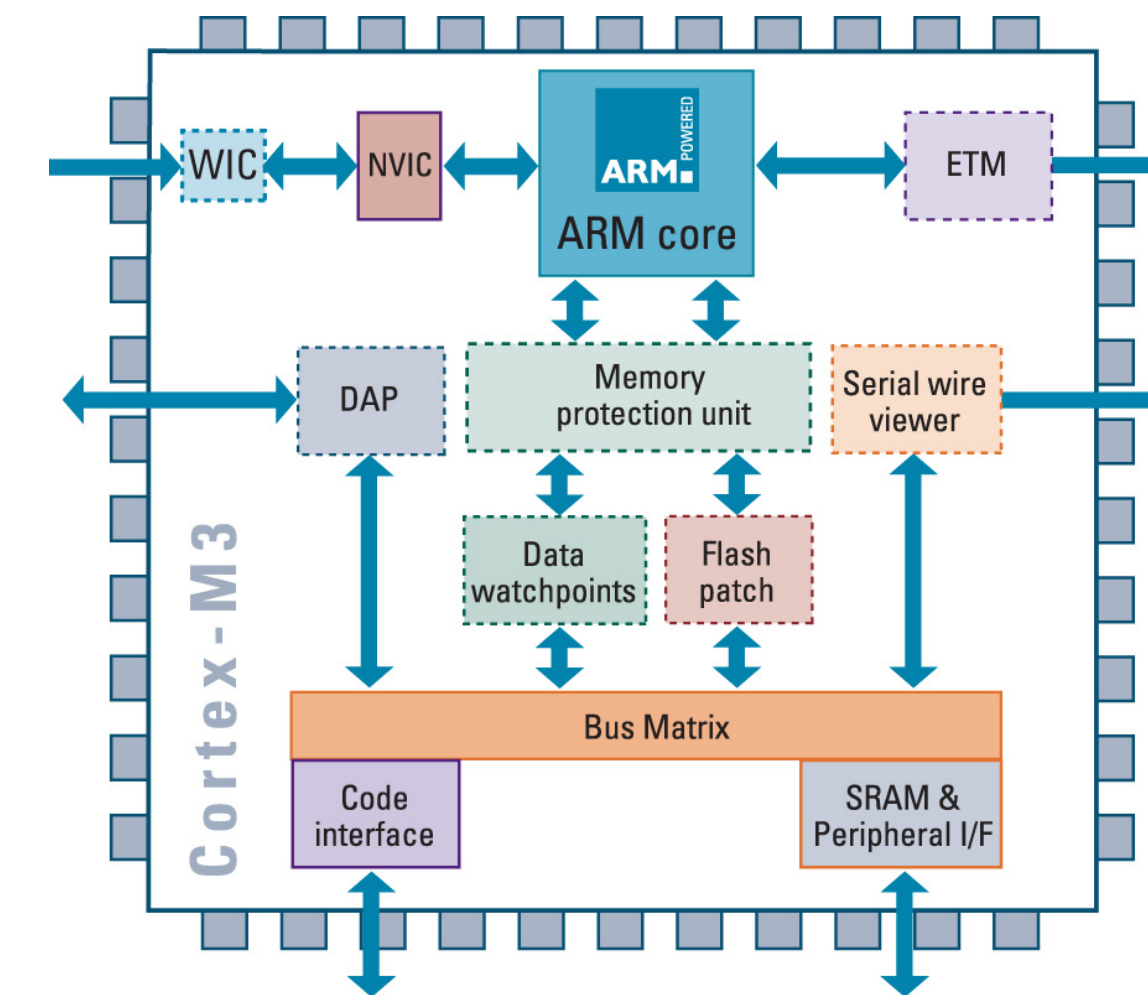
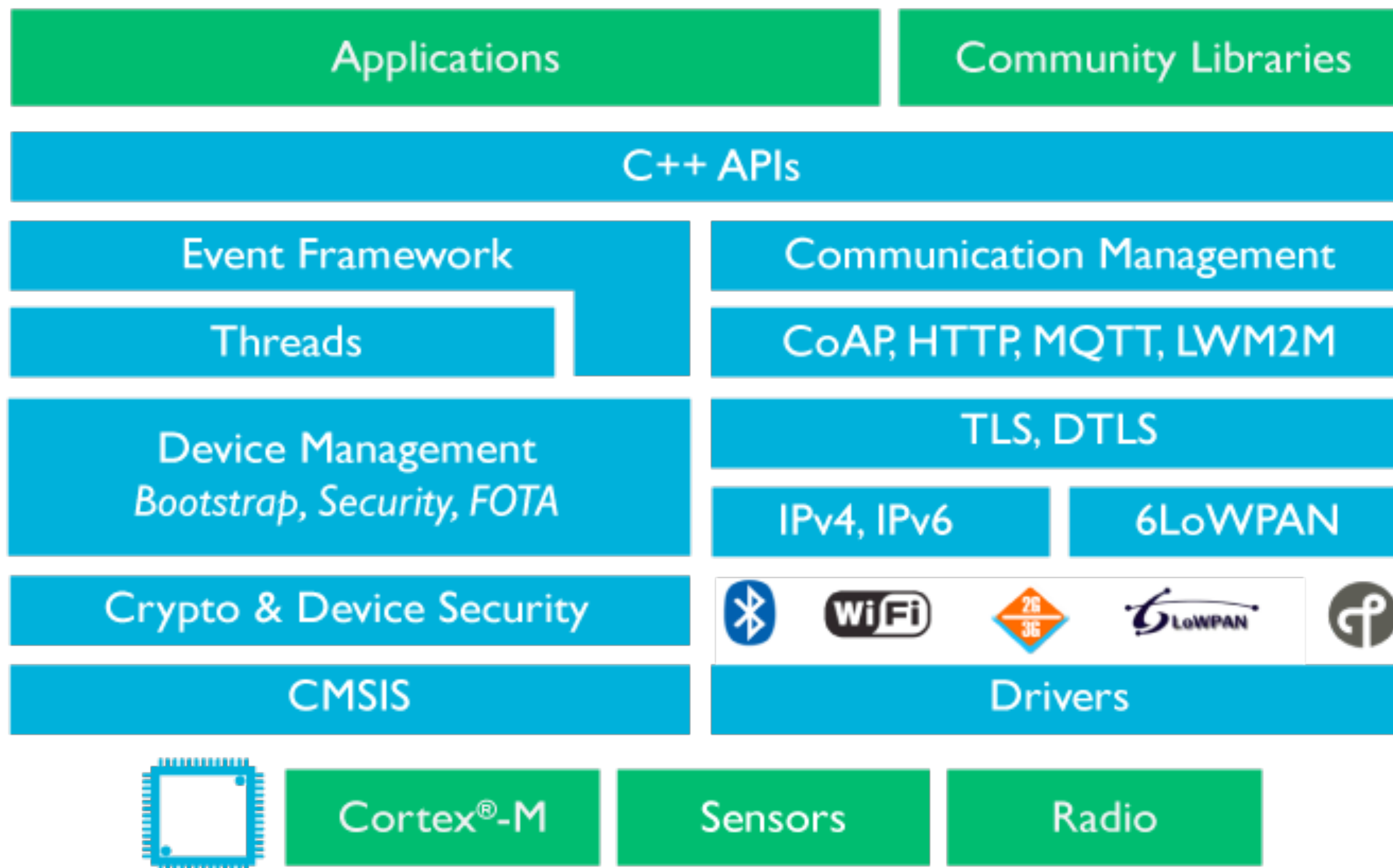
'Value added' features in and around the core



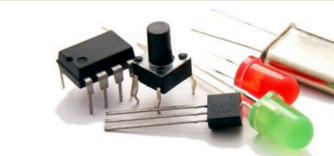
## 数字信号/逻辑处理



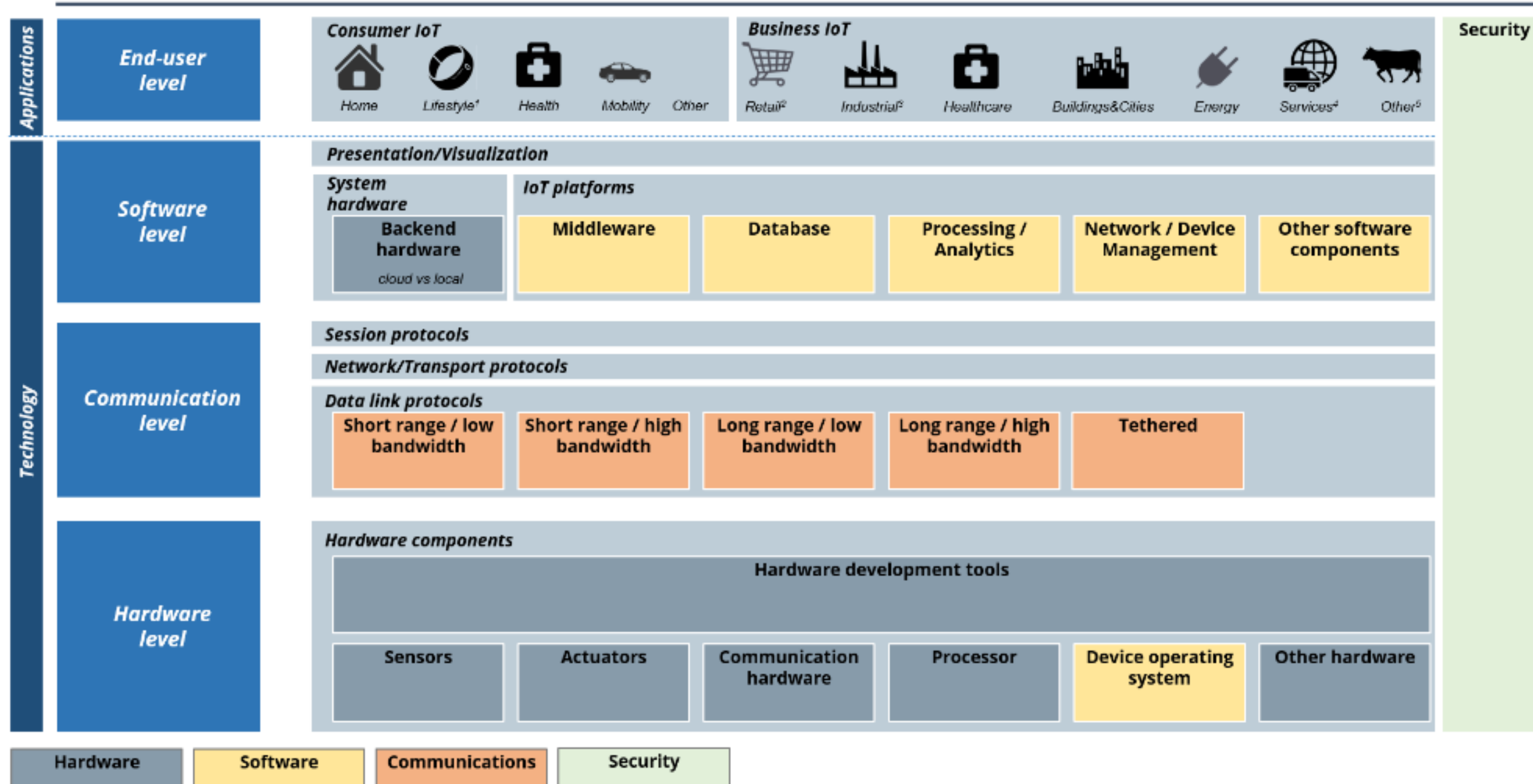




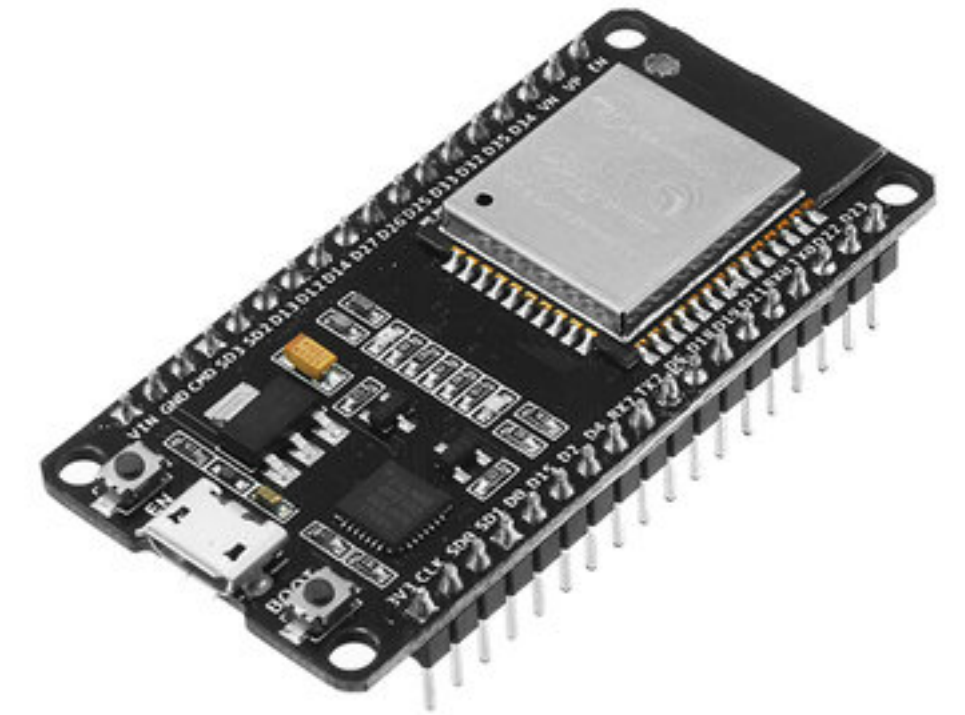
微处理器/微控制器：智能硬件/物联网产品的核心



## Internet of Things - Technology architecture

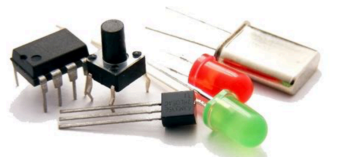


1. Lifestyle incl Quantified-self products 2. Incl all other B2B commercial IoT 3. Industrial goods business 4. Services incl. finance and insurance 5. Other including education, public and military, media, telecom,  
 Note: Product, image, or service names are the property of the respective owners  
 Source: [www.IoT-Analytics.com](http://www.IoT-Analytics.com) 2015



# 网络通信

物与物之间的连接





# 各部分的核心参数

电路	关键参数
电源	电压、负载能力、纹波、效率
传感器	灵敏度、接口方式
模拟链路	幅度、频带
A/D、D/A	转换率、分辨率、SFDR、接口方式
数字信号处理/FPGA	逻辑资源、存储资源、IO、速度
MPU/MCU	速度、接口、内部资源、开发环境
网络通信	通信方式、速率、接口、协议

