

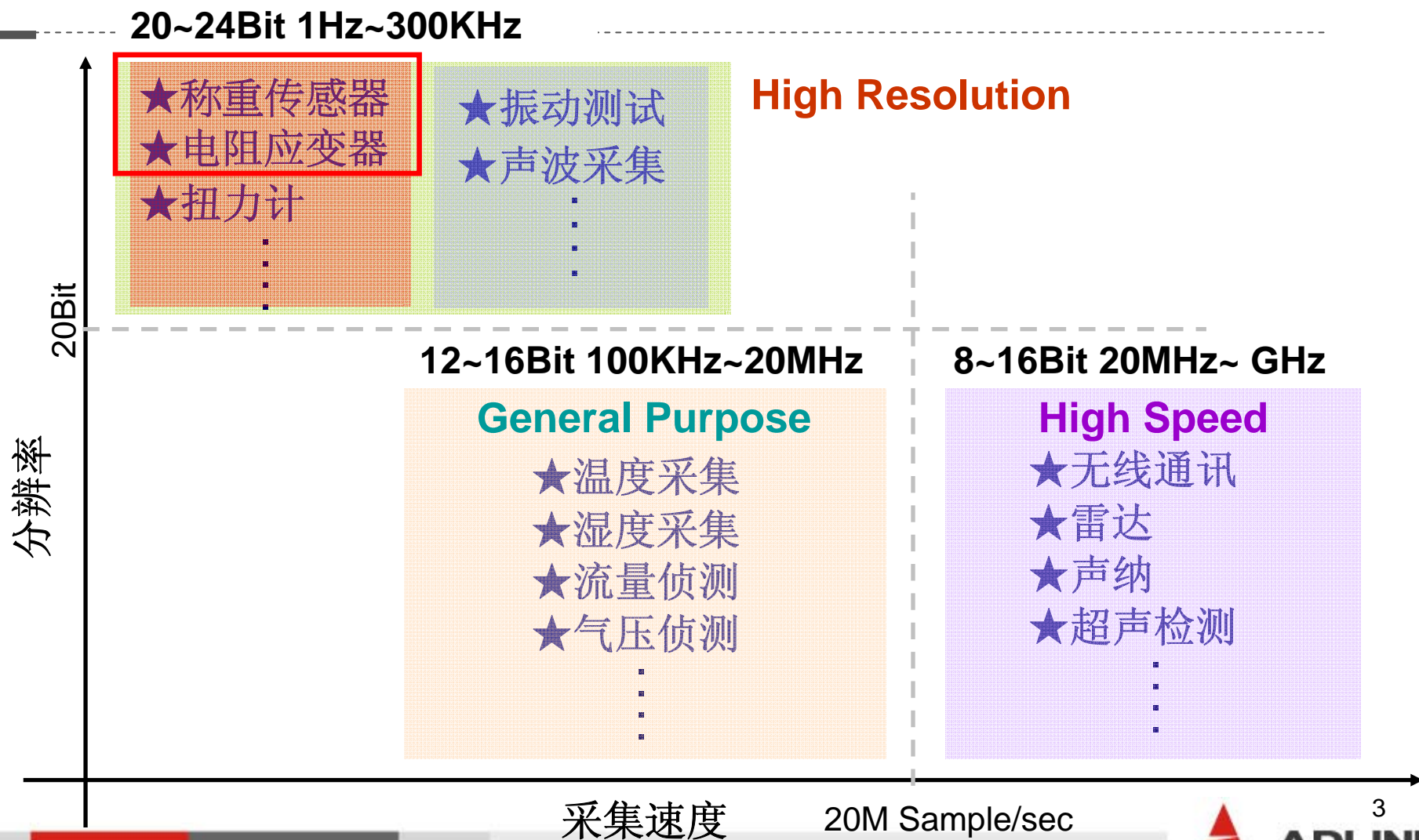
# 高精度低电压数据 采集卡的应用

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量测与自动化产品事业处  
凌华科技

# 大纲

- **Application Overview**
- **Challenges**
  - Noise and Drift Analysis
- **ADLINK Solution**
  - 高精度低电压数据采集卡
- **Summary**
- **Q & A**

# 数据采集卡的应用概观



# 高精度低电压数据采集卡应用

1. Material Fatigue Test
2. Car Door Fatigue Test
3. Mechanism Assemble
4. Bridge Structure Test
5. Mixer System
6. 材料测试机



# 应用一材料测试机(MTS)

## Material Test System

### Methodology

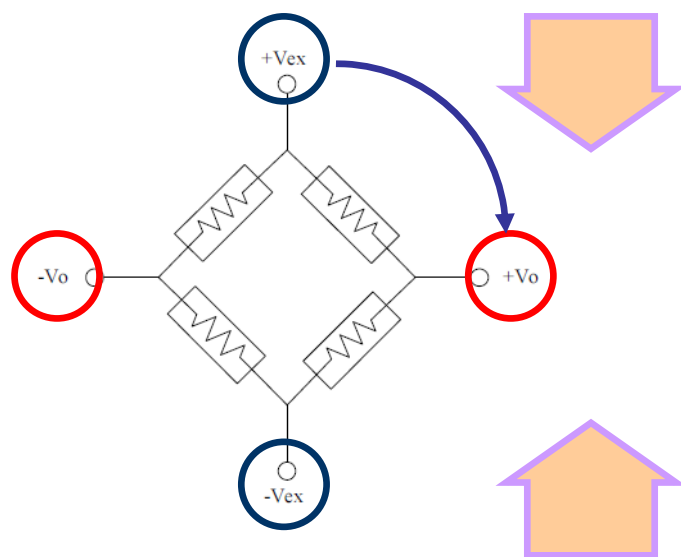
- Apply force by hydraulic actuator or stepper motor(步进马达)
- Measure displacement by linear encoder(线性编码器)
- Sense force by **Load-cell** Transducer (称重传感器)



# 专门用语

## -何谓称重传感器?

- Transforms applied **force to resistive change**.
- A four-terminal device consists of four **resistors**.
- Load-cell Sensitivity(输出灵敏度): **mV/V** (milli-volt per Volt)



# 称重传感器输出电压与荷重关系

- A **4-mV/V** load-cell(称重传感器) with **10-V** excitation, will produce **40mV** across **Vo+** and **Vo-** at **full-load**.

激励电压与输出灵敏度将决定满载时输出电压

# 材料测试机(MTS)的关键规格

## ★ Load-Cell (称重传感器) Measurement

High resolution: 24bit

Noise: < 100nV

Acquisition Speed: 50 ~ 200, up to 4K Sample/s

Stability: < 5PPM drift ( 200000 **count** )



# 专门用语

## - 何谓 'Count' ?

- A unit that describes the '**least significant change**'.
- A weight measurement system can Detect.
- **A stable readable number.**

A load-cell(称重传感器) indicator capable of displaying **1,000,000 counts**, can resolve **1-ppm** of full scale(满刻度)  
i.e. **2-gram on a 2000-kg Load-cell**



# 专门用语

## - 何谓 'Count' ?

The 'Count' is required for different applications.

4 mV/V @10V

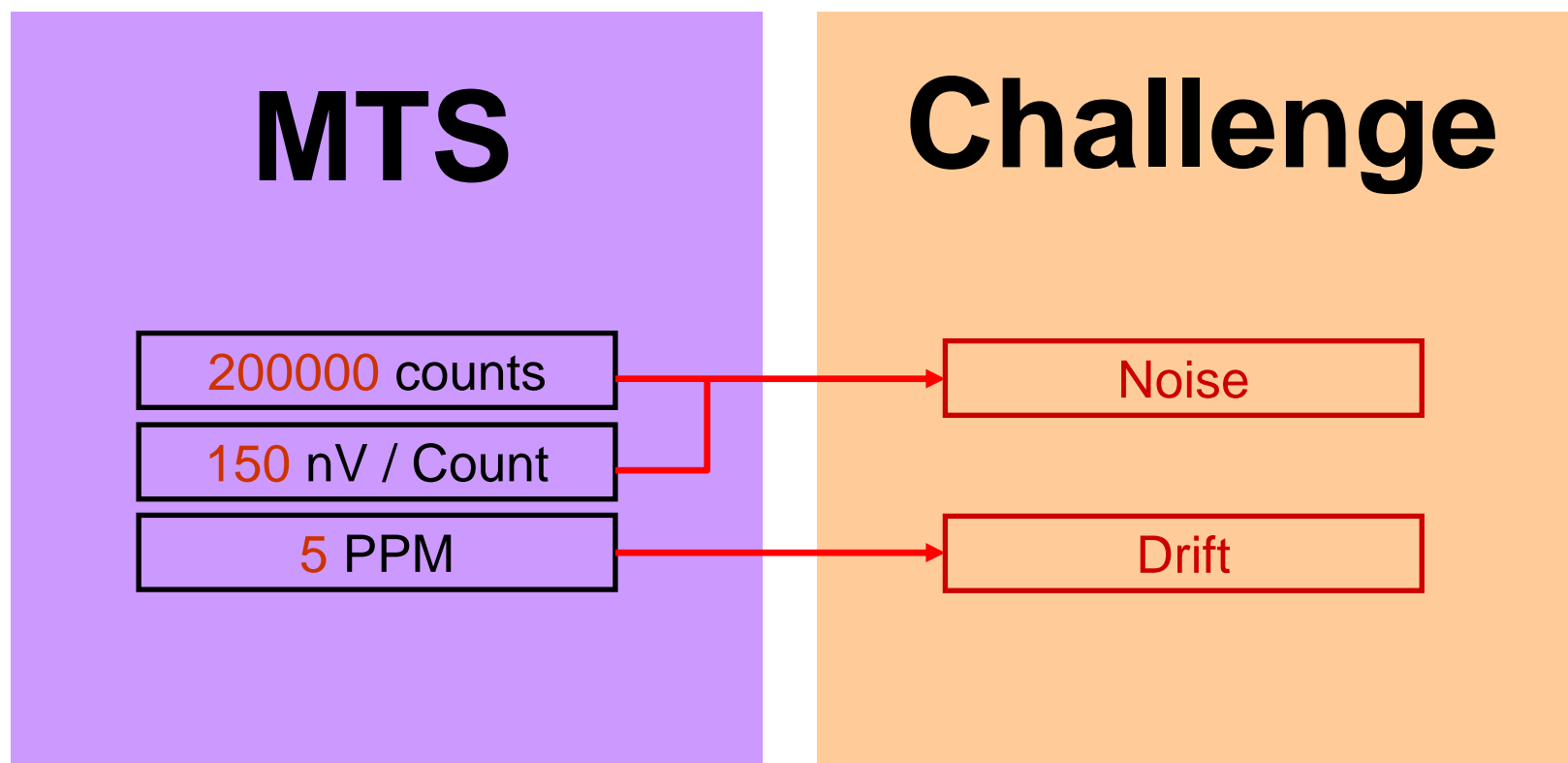
Applications	Counts	Voltage/count
Commercial / Home use	2,000~10,000	20 $\mu$ V
General industrial	5,000~10,000	8 $\mu$ V
MTS applications	10,000~100,000	4 $\mu$ V
Scientific / High-precision MTS	200,000~500,000	<b>200nV</b>

# MTS使用传统数据采集卡泛用规格

- 4 Multiplexed Channels
- Up to 200 Sample/sec
- > **200,000** counts for 3mV/V load-cells (称重传感器)
- 10V Excitation
- Stability: < **5 PPM drift**

$$\text{count} = \frac{3mV / V \times 10V}{200000} = 150nV$$

# MTS数据采集的挑战



3mV/V@10V

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# 传统架构的困境

## - 杂讯与漂移分析

Thermal Couple Effect

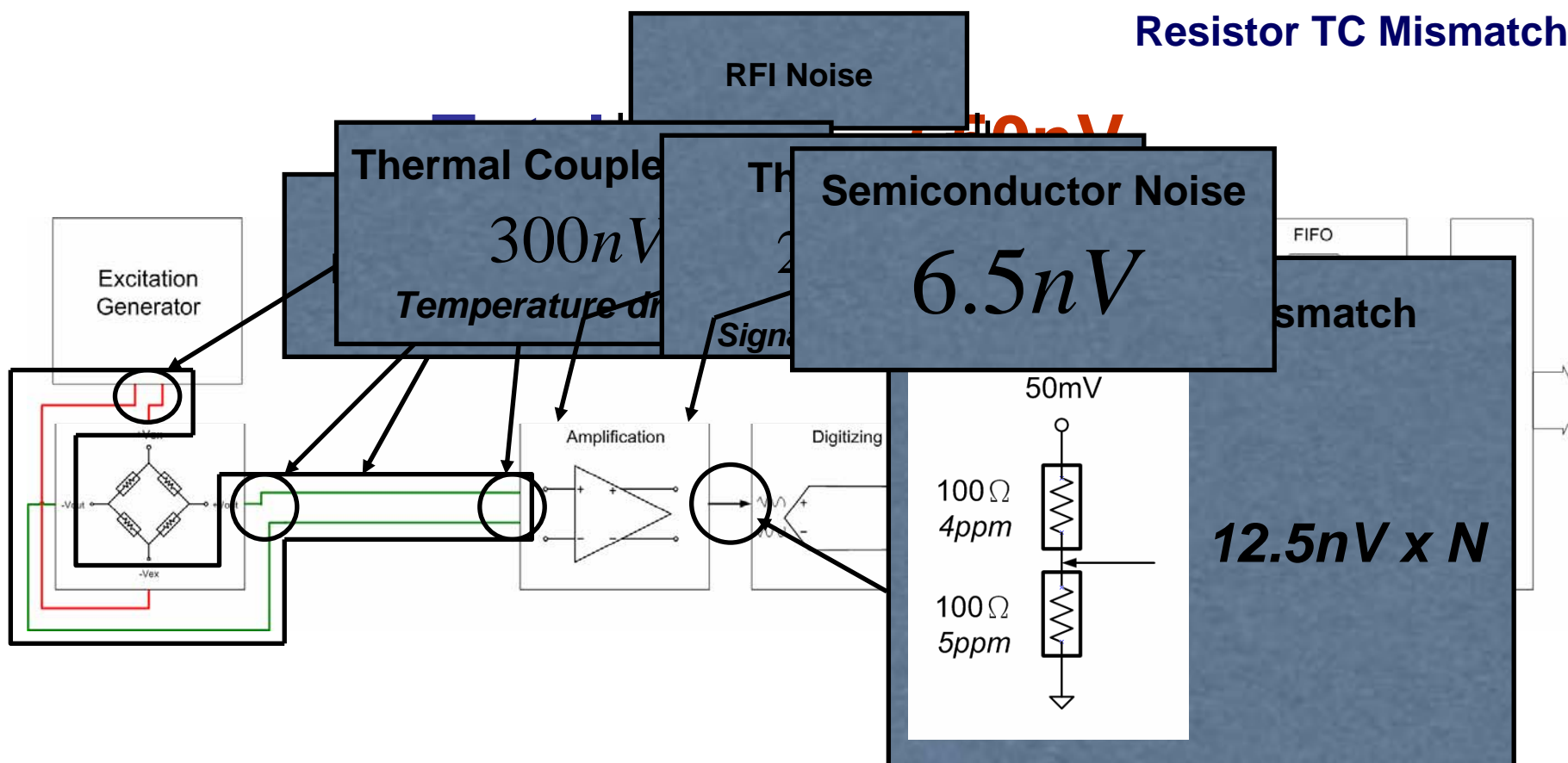
Lead Resistance

Thermal Noise

Semiconductor Noise

RFI Noise

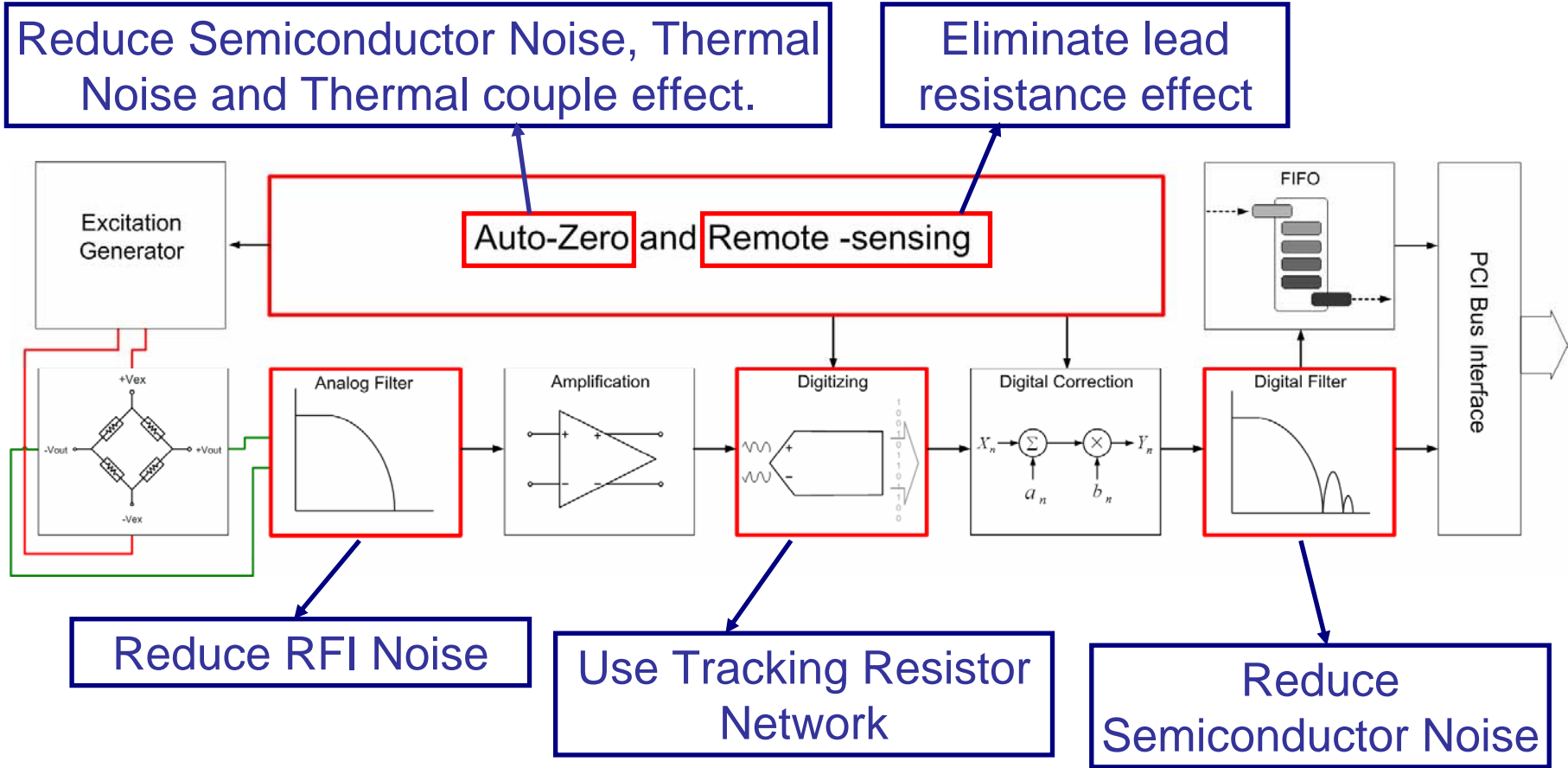
Resistor TC Mismatch



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# 凌统犁构的解决方案

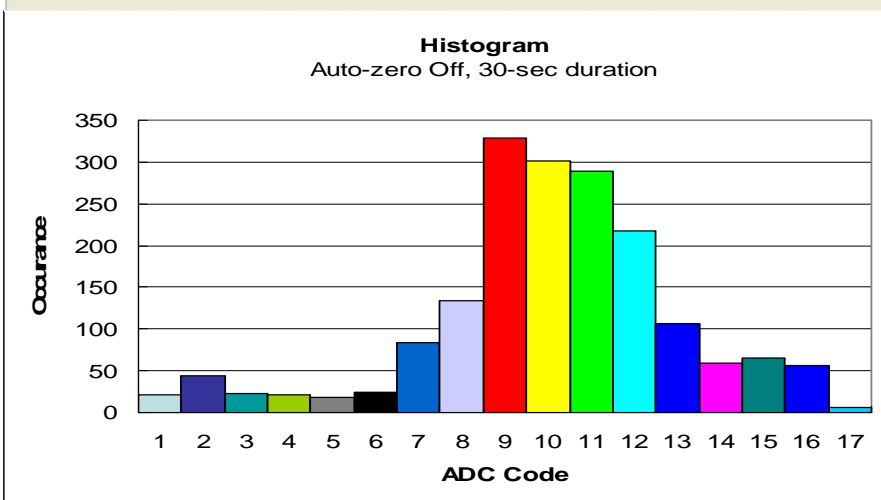
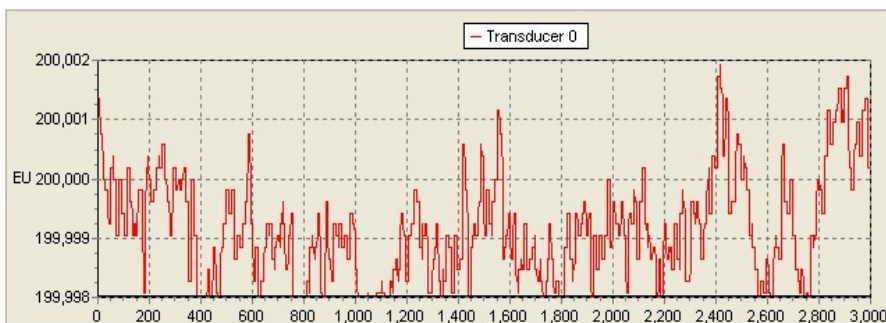




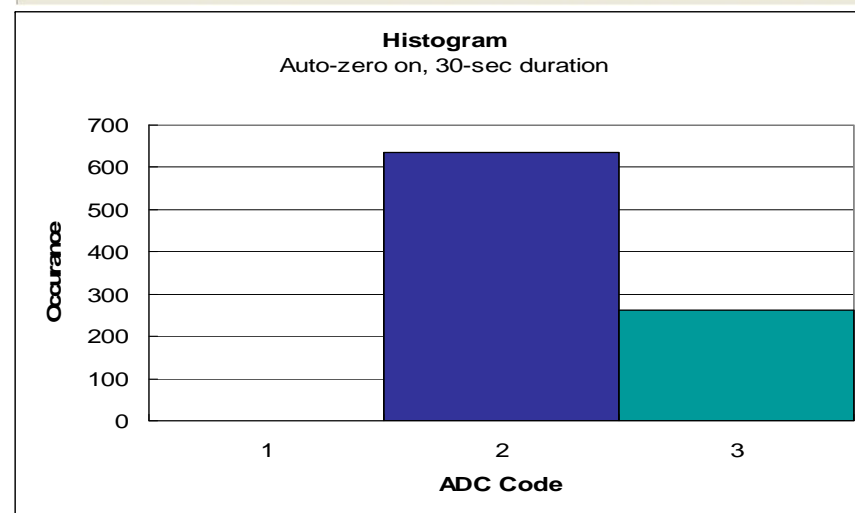
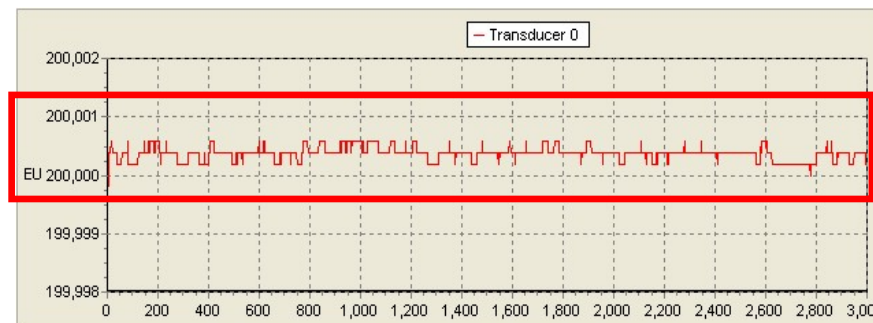
# 传统架构 VS 凌华科技的解决方案

## -直流性能

### 传统架构

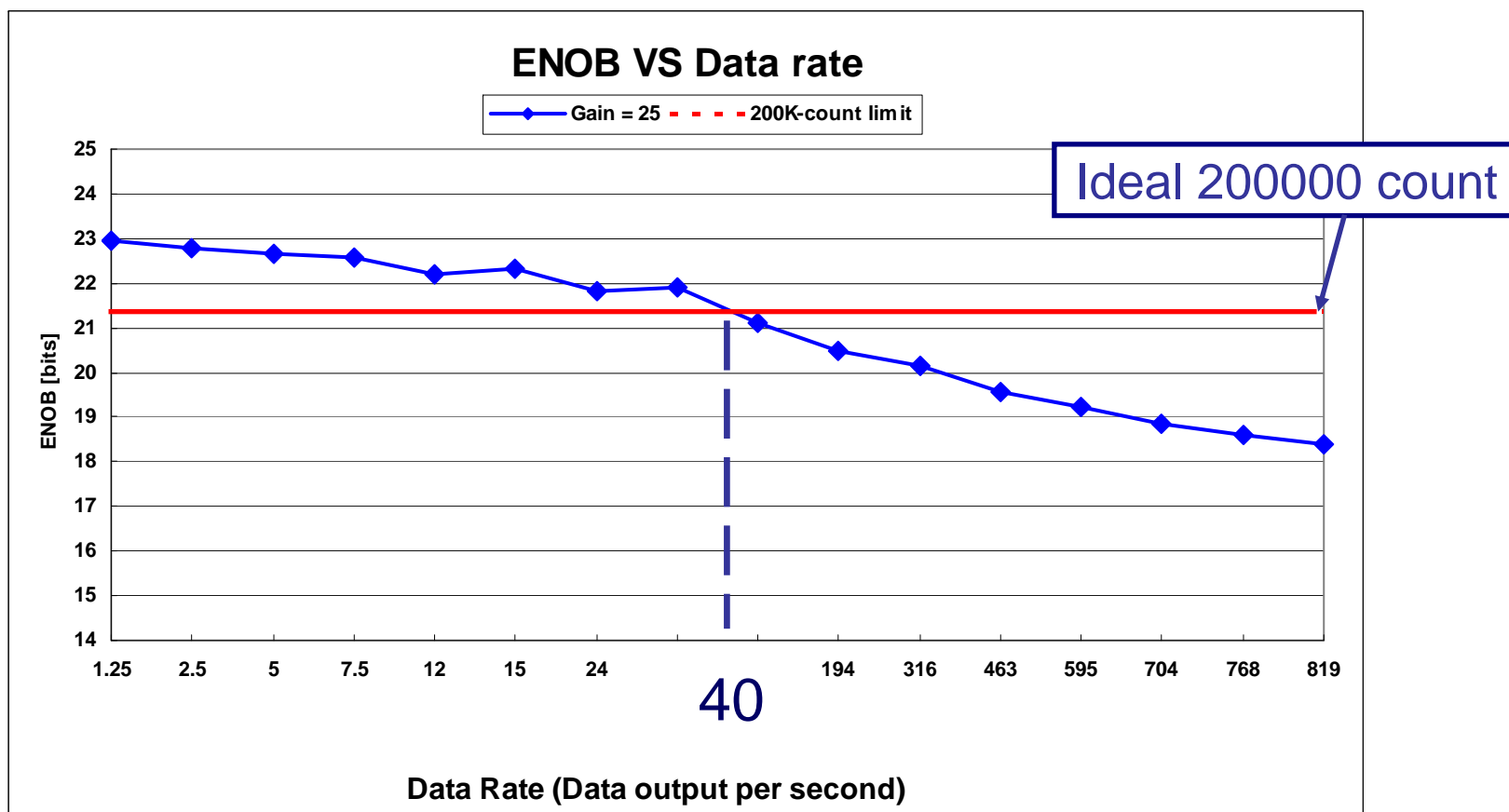


### 凌华科技的解决方案



# 凌华科技的解决方案

## -有效分辨率



# 凌华科技PCI-9524

-完全针对高精度低电压设计的数据采集卡

- **PCI-9524**
  - **Strain gage based transducer measurement**
    - **4 transducer input channels**
    - Support **2.5/10 Vdc excitation voltage**
    - 24-bit Internal A/D resolution
    - Up to **30KS/s** sampling rate for single channel
    - Up to 4KS/s for multiple channels
    - Support 1.0 to 4.0 mV/V sensitivity
    - **Up to 1/200000 accuracy with remote sense and auto zero enabled**
  - **General Analog Input**
    - **24-bit internal A/D resolution**
    - Support  $\pm 10V$ ,  $\pm 5V$ ,  $\pm 2.5V$ ,  $\pm 1.25V$  input range
    - 4 differential inputs
    - Up to 30 KS/s sample rate



**PCI-9524**

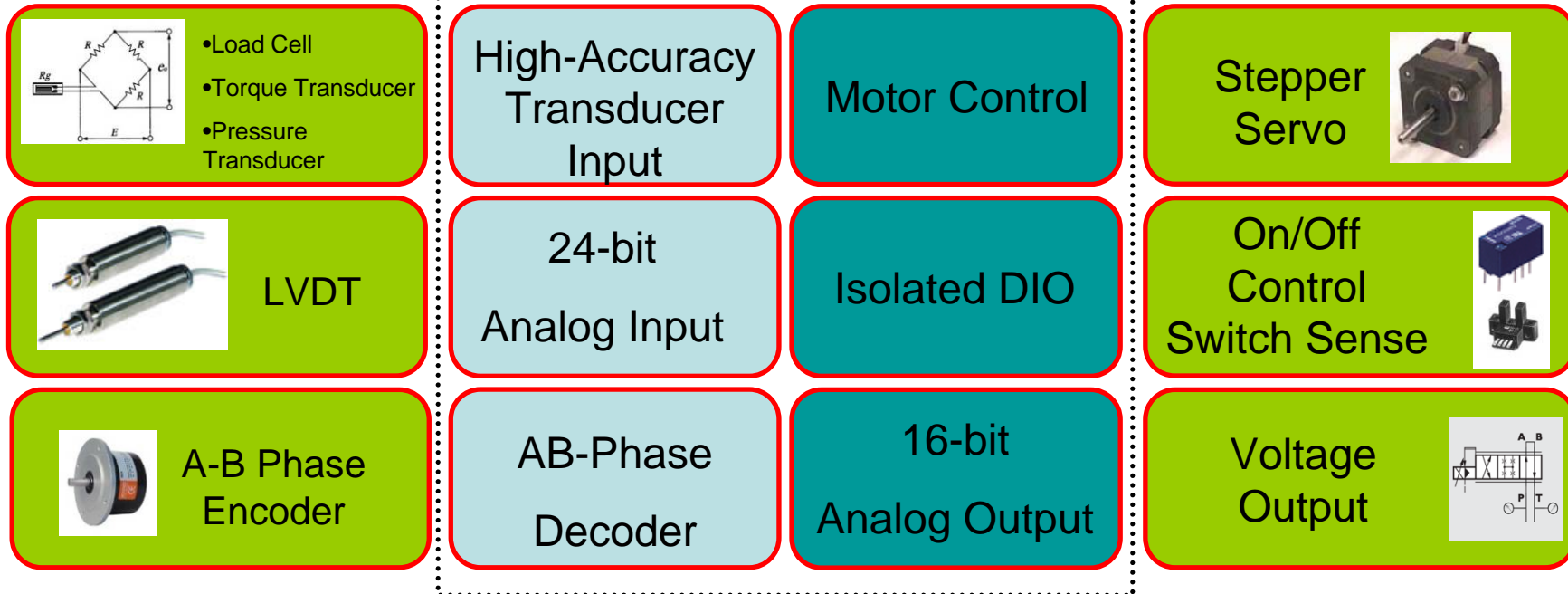
# 凌华科技PCI-9524

-完全针对高精度低电压设计的数据采集卡

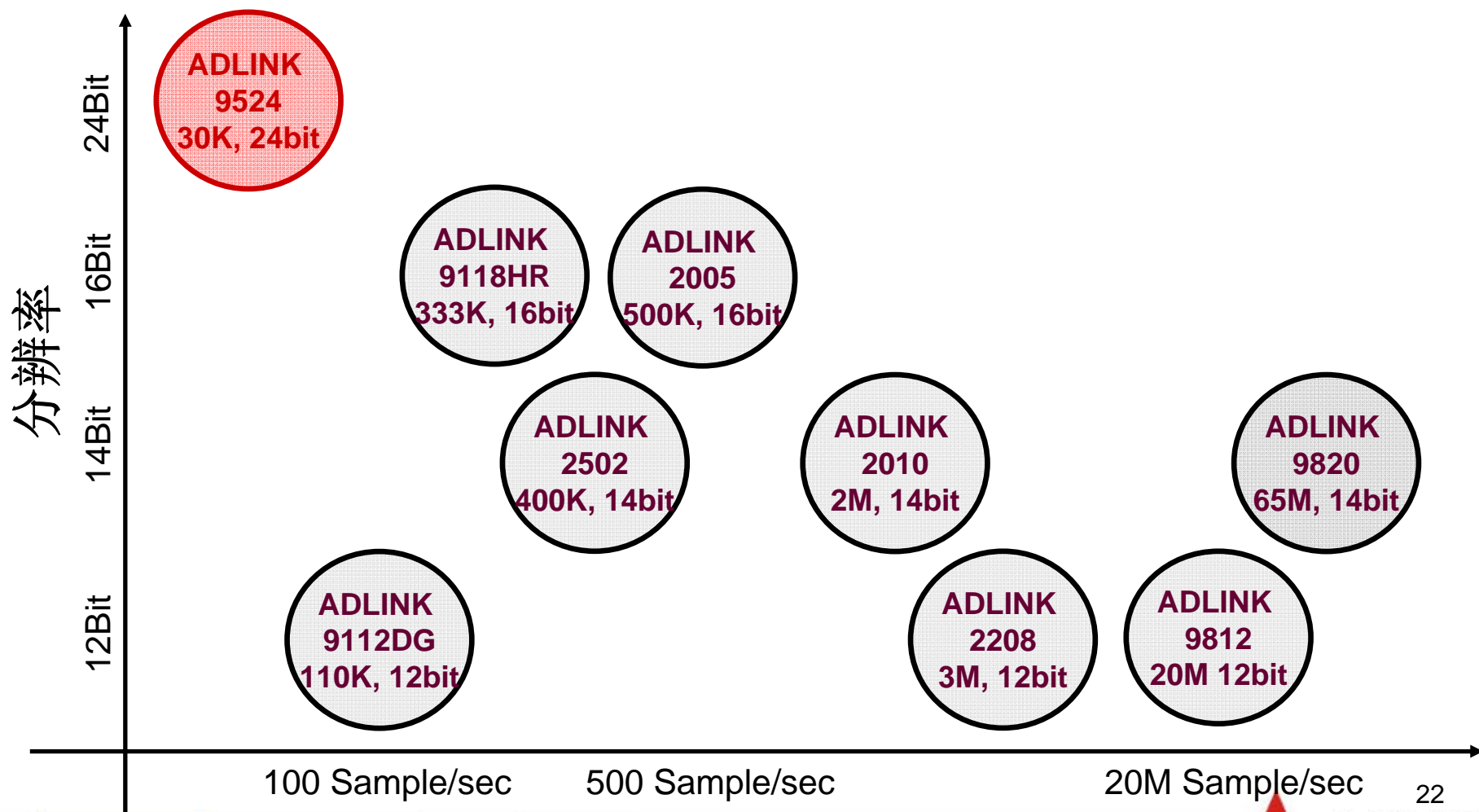
- **Analog Output**
  - **16-bit** internal D/A resolution
  - +/- 10V output range
  - 2 Analog output channels
  - Up to 5KS/s update rate
  - 5 mA driving capability
- **Motion Control**
  - **3 Axis**
  - OUT/DIR, CW/CCW pulse output option
  - Up to 500K output frequency
  - 24-bit up/down counter for incremental encoder feedback
- **DIO**
  - **6-CH** isolated DI and **6-CH** Open collector Darlington DO

# PCI-9524 100% Fit MTS

## ADLink PCI-9524



# 凌华科技全系列数据采集卡



# 您必须要记得的三件事

- PCI-9524高精度低电压数据采集卡成功的解决杂讯及漂移的问题
- PCI-9524提供材料测试机完整的方案
- PCI-9524拥有稳定**200000 Counts**有效分辨率

# Q & A



在**0**与**1**之间重现真实世界



# APPENDIX

## - 杂讯与漂移分析

### 1) Noise Sources

Semiconductor Noise

Thermal Noise

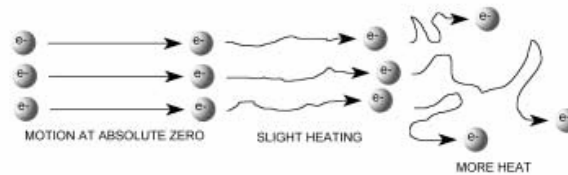
RFI Noise

### 2) Drifts

Thermal Coupling

Lead Resistance

Resistor TC Mismatch



$$E_{th} = \sqrt{4kTRB}$$

$E_{th}$  = Thermal noise voltage in Volts rms  
 $k$  = Boltzmann's constant ( $1.38 \times 10^{-23}$ )  
 $T$  = Absolute temperature (Kelvin)  
 $R$  = Resistance in ohms  
 $B$  = Noise bandwidth in Hertz ( $f_{max}-f_{min}$ )

Copper-Aluminum	5
Copper-Nickel	10
Copper-Copper Oxide	> 500

# APPENDIX

## - 解決方式

### 1) Noise Sources

Semiconductor Noise

→ Auto-zero, digital filtering

Thermal Noise

→ Auto-zero

RFI Noise

→ Input analog filtering

### 2) Drifts

Thermal Couple Effect

→ Auto-zero

Lead Resistance

→ Remote-sense

Resistor TC Mismatch

→ Tracking Resistor Network

# 凌华科技

## -PCI-9524规格

### 关键规格

- 4 transducer input channels
- 24-bit Internal A/D resolution
- 200000 count stable read with remote sense and auto sense

### 辅助规格

- 3 Axis Motion Control
- Encoder feedback