Welcome!
Texas Instruments New Product Update

- **This webinar will be recorded and available at www.ti.com/npu**

- **Phone lines will be muted**

- **Please post questions in the chat or contact your sales person or field applications engineer**

TEXAS INSTRUMENTS

New Product Update: V³Link™ Industrial SerDes

Amelia Weaver

TEXAS INSTRUMENTS

Agenda

- What does a high speed video link need?

- Introduction to V³Link™

- New V³Link chipsets and features
  - TSER953 serializer
  - TDES954 dual hub deserializer
  - TDES960 quad hub deserializer

- Key online resources

TEXAS INSTRUMENTS

Basic components of a vision system
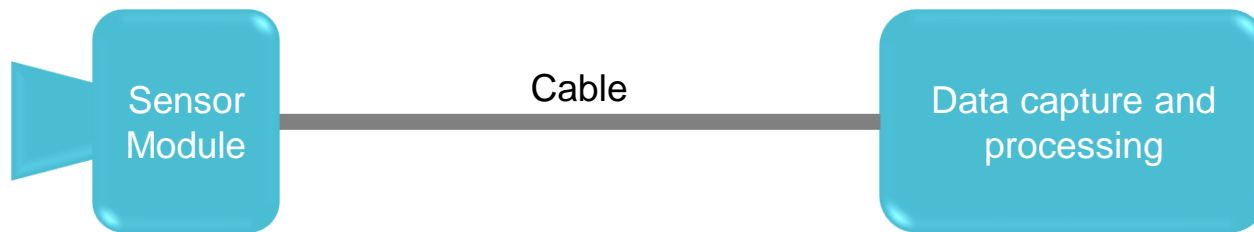
Sensor Module

Cable

Data capture and processing

Ideal characteristics of a vision system

- Capture and transfer high-resolution video data from sensor end to the processing end

- Transfer control and peripheral data from the processing end to the sensor end

- Maintain good signal integrity, no data loss

- Minimal cabling, using a single flexible cable

- Small size on sensor side

- Low power

- Deterministic low latency
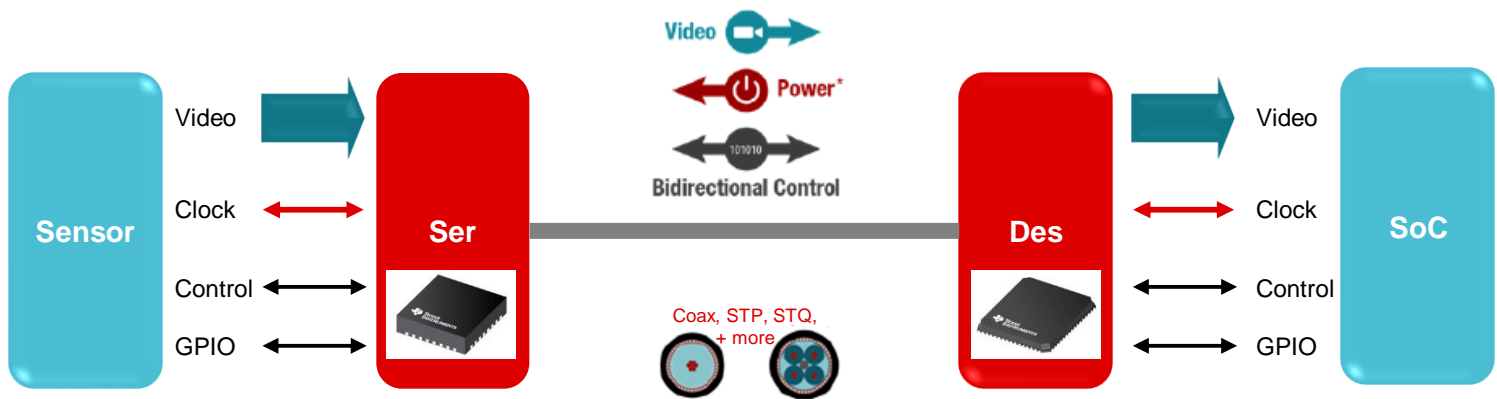
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✓ Deterministic low latency

✓ **Enabled by V³Link**

TEXAS INSTRUMENTS

What is V³Link?

- **High-speed, uncompressed video transport technology**
  - Aggregates video, clock, control, and peripheral data from camera, RADAR, LIDAR, or ToF sensor to SoC over a single wire or cable up to 15m

TEXAS INSTRUMENTS

Video data rates

Video Data Rate (bps) = Hor_Resolution x Ver_Resolution x frame rate (fps*) x color depth (bpp)**

Imager data rate in Gbps

No CSI-2 overhead, multiplied by 10% blanking overhead, approximated 1MP = 1e6 pixels resolution

	10 bpp			12 bpp			16 bpp			20 bpp		
	15 fps	30 fps	60 fps	15 fps	30 fps	60 fps	15 fps	30 fps	60 fps	15 fps	30 fps	60 fps
1 MP	0.2	0.3	0.7	0.2	0.4	0.8	0.3	0.5	1.1	0.3	0.7	1.3
2 MP	0.3	0.7	1.3	0.4	0.8	1.6	0.5	1.1	2.1	0.7	1.3	2.6
3 MP	0.5	1.0	2.0	0.6	1.2	2.4	0.8	1.6	3.2	1.0	2.0	4.0
4 MP	0.7	1.3	2.6	0.8	1.6	3.2	1.1	2.1	4.2	1.3	2.6	5.3
5 MP	0.8	1.7	3.3	1.0	2.0	4.0	1.3	2.6	5.3	1.7	3.3	6.6
6 MP	1.0	2.0	4.0	1.2	2.4	4.8	1.6	3.2	6.3	2.0	4.0	7.9
7 MP	1.2	2.3	4.6	1.4	2.8	5.5	1.8	3.7	7.4	2.3	4.6	9.2
8 MP	1.3	2.6	5.3	1.6	3.2	6.3	2.1	4.2	8.4	2.6	5.3	10.6
9 MP	1.5	3.0	5.9	1.8	3.6	7.1	2.4	4.8	9.5	3.0	5.9	11.9
10 MP	1.7	3.3	6.6	2.0	4.0	7.9	2.6	5.3	10.6	3.3	6.6	13.2
11 MP	1.8	3.6	7.3	2.2	4.4	8.7	2.9	5.8	11.6	3.6	7.3	14.5
12 MP	2.0	4.0	7.9	2.4	4.8	9.5	3.2	6.3	12.7	4.0	7.9	15.8

Multiply by x2 for YUV format.

*fps - frames per second

**bpp - bits per pixel

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TEXAS INSTRUMENTS

V³Link released devices

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TEXAS INSTRUMENTS

Forward channel data rate examples

- TSER/TDES devices support up to 3.3Gbps video per lane.

  – 1MP imager with 12bpp color depth at 120fps over CSI-2 interface?
  - 1280 x 1024 x 12 x 120 x 1.25* = **2.36Gbps**   *< 3.3Gbps?* ✔

  – 2MP imager with 12bpp color depth at 60fps over CSI-2 interface?
  - 1920 x 1080 x 12 x 60 x 1.25* = **1.87Gbps**   *< 3.3Gbps?* ✔

  – 8MP imager with 10bpp color depth at 30fps over CSI-2 interface?
  - 3840 x 2160 x 10 x 30 x 1.25* = **3.11Gbps**   *< 3.3Gbps?* ✔

*accounts for overheads

TEXAS INSTRUMENTS

V³Link in medical

Benefits

– High data rate for safety-critical applications

– Low power

– Good signal integrity over long cables

– Minimal, robust cabling

– Flexible configurations

– Bidirectional live control

Common Applications

– Endoscopes

– Surgical Robots

– Patient Care Monitors

TEXAS INSTRUMENTS

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- Good signal integrity over long cables
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- Bidirectional live control

Texas Instruments

V³Link in appliances

Benefits

- Simple connection for easy manufacturability
- Industry-standard interface compatibility
- Scalable solutions for modular & future-proof designs
- Low power operation
- Minimal cabling for flexible routing <1m → 15m

Common Applications

- Refrigerators
- Ovens
- Coffeemakers

# V³Link in factories & buildings

Benefits

- Ultra-low and deterministic latency
- Clock sync & camera aggregation aligns multiple cameras
- Minimal chips and cables
- Replication mode option
- Good signal integrity over long cables
- Low power operation

Common Applications

- Industrial Robots,
- QR Code Readers
- High speed sorting cameras
- Surveillance
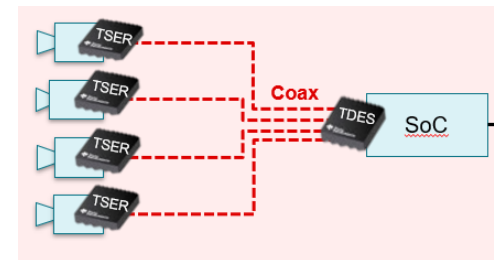
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TEXAS INSTRUMENTS

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TEXAS INSTRUMENTS
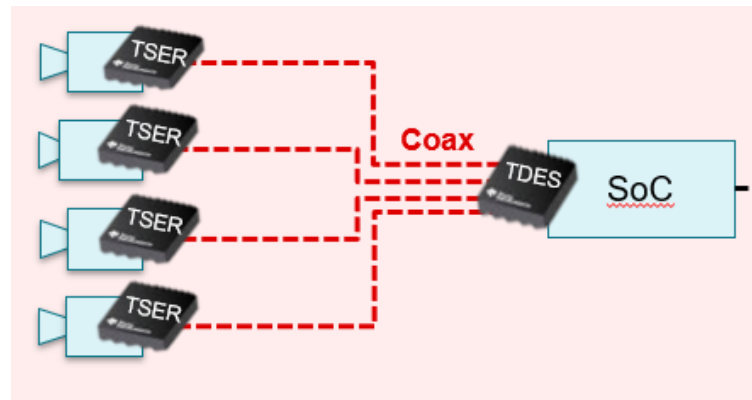
Summary

- V^{3}Link is used anytime a video signal is transmitted from one element to another with:
  - Minimal cable size and quantity over links **<1m → 15m**
  - Good signal integrity
  - High data rate with low latency, no compression
- Development tools available through third party partners
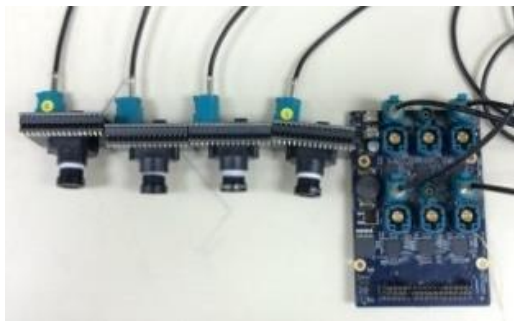
Additional resources

Product Pages

V³Link Homepage

Find your V³Link™ SerDes

	TSER953	TDES954	TDES960
Device type	Serializer	Dual hub deserializer	Quad hub deserializer
Line rate	4.16 Gbps	4.16 Gbps per lane	4.16 Gbps per lane
Input compatibility	MIPI® CSI-2	FPD-Link III	FPD-Link III
Ouput compatibility	FPD-Link III	MIPI CSI-2	MIPI CSI-2
Functional Safety-Capable	✓	✓	✓

Learning Tools

TI training and videos

WHAT IS V³LINK™?

Industrial SerDes Fundamentals

TI Precision Labs

Development Support

Post and get questions answered on our E2E™ support forums

E2E™ design support >

Featured Technical Article

How to transfer high-res video data over a single wire in machine vision-based applications

E2E™ support forums ›

Technical articles › Industrial

TEXAS INSTRUMENTS

Visit www.ti.com/npu

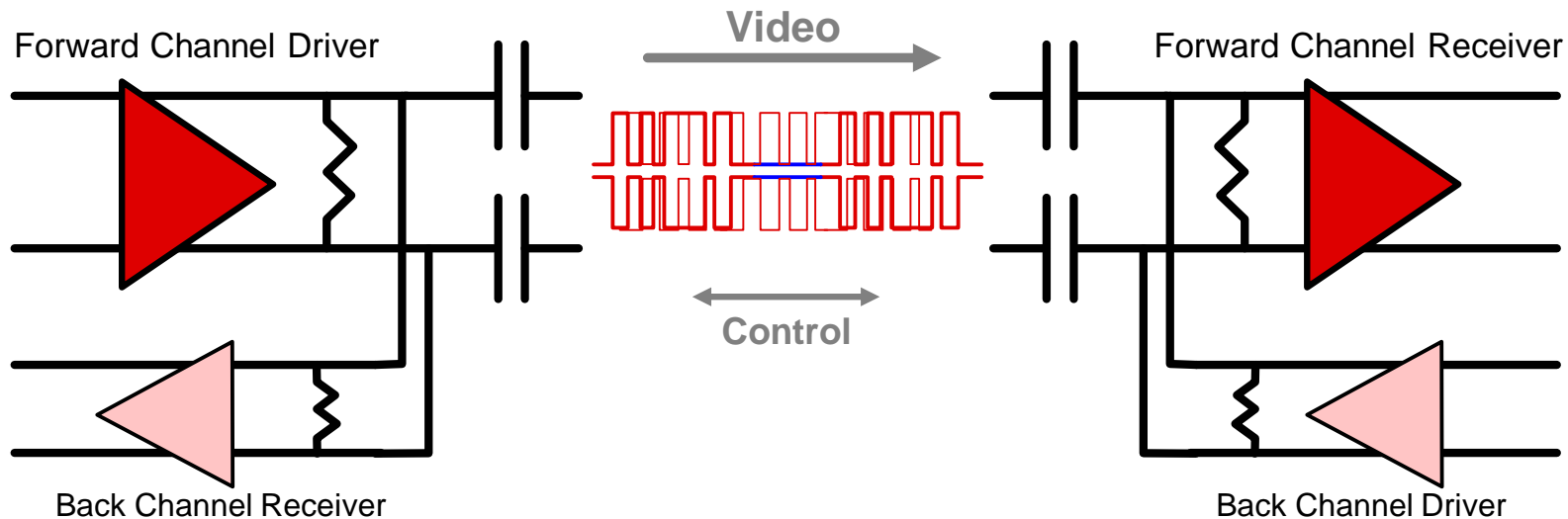For more information on the New Product Update series, calendar and archived recordings

TEXAS INSTRUMENTS

Continuous, Low-Latency Backchannel

Full duplex communication

Forward Channel Driver

Video →

Control ↔

Forward Channel Receiver

Back Channel Receiver

Back Channel Driver

Forward channel:

- Serializer → Deserializer
- High speed (multi-Gbps) data transmission
- Video payload, I^{2}C/SPI/GPIO data, and info on link diagnostics to Des

Back Channel:

- Deserializer → Serializer
- Lower-speed data transmission
- Provides CLK for line rate, sync
- I^{2}C/SPI/GPIO data to Ser

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# Adaptive Equalization

At Transmitter

After 10m Cable

After Adaptive EQ
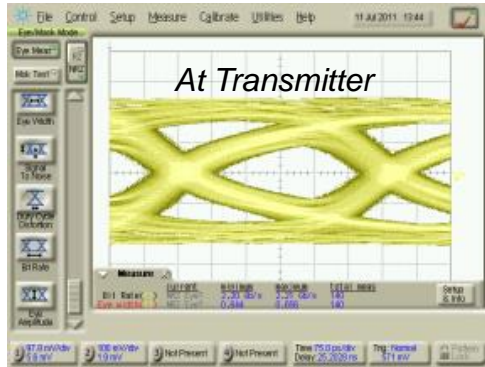
- Automatic algorithm
    - **No adjustment – Adapts continually**
- Compensates for cable type, cable length, cable ageing, wear-and-tear of connectors, temperature effects, changing electromagnetic environments, and more
- Valuable diagnostic function
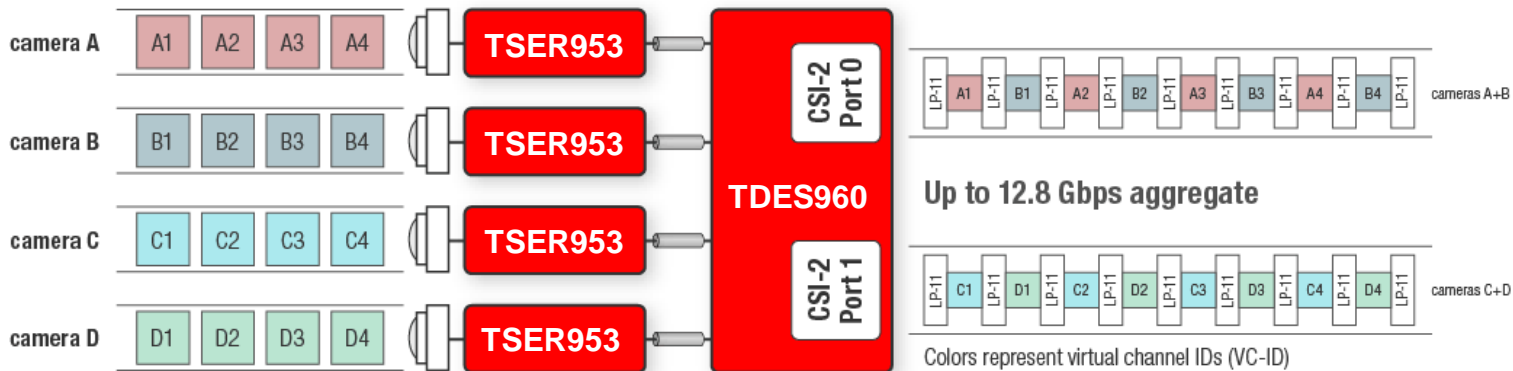   - Read out EQ level to monitor cable health

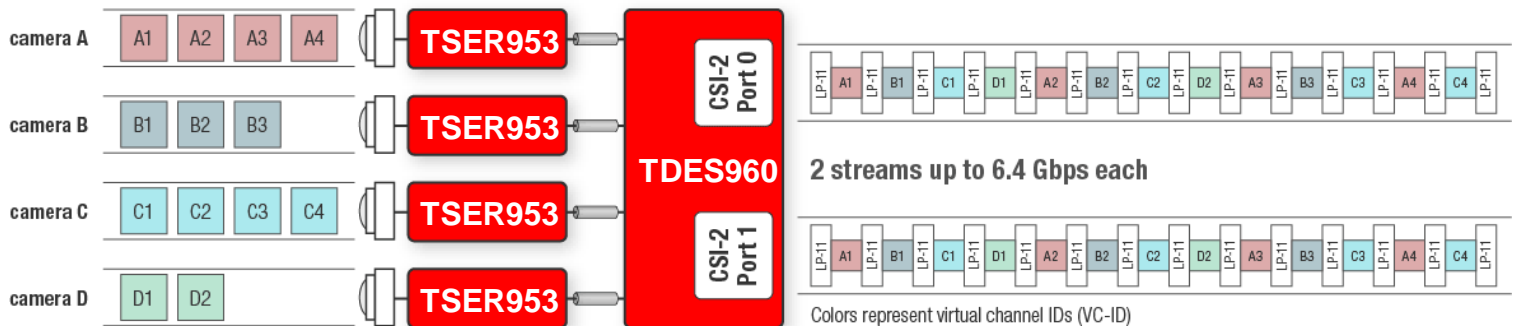# Synchronized sensors with the 953/954/960
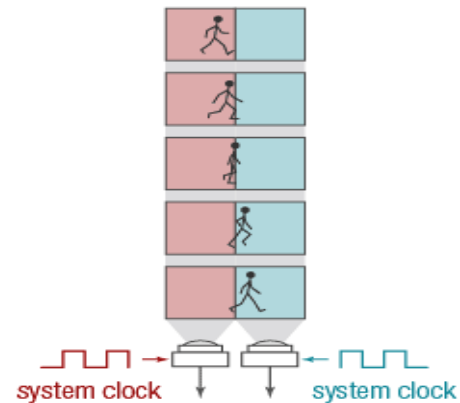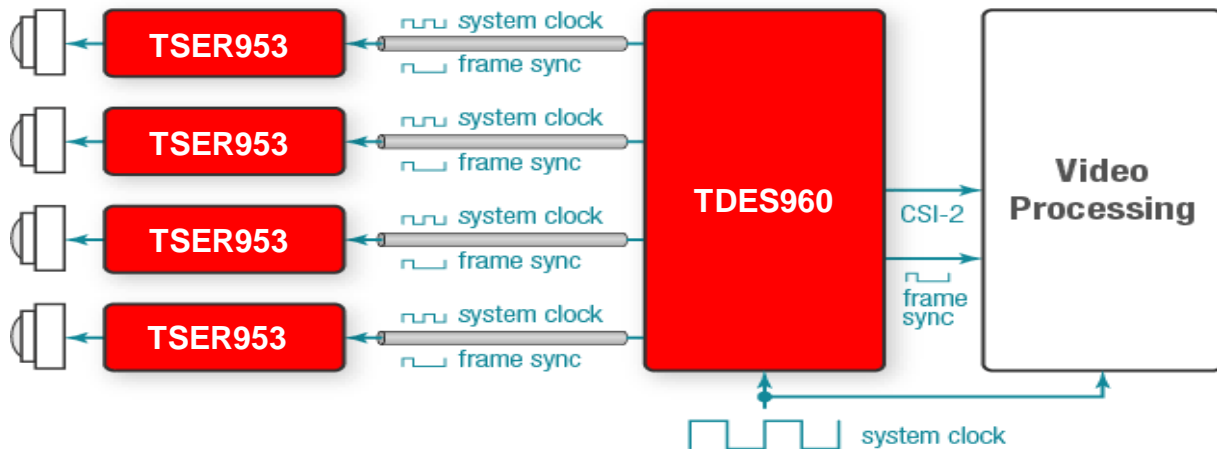
- All cameras are synchronous to processor
  - also saves oscillator cost/space in cameras

- No frame buffers or extra circuitry required
  - saves four frames of buffer memory

- Enables easier seamless image stitching & sensor fusion

- The 954/960 also generates frame sync automatically (programmable)

# Virtual Channels & Mapping/Replication Modes

Aggregation Mode

Up to 12.8 Gbps aggregate

Colors represent virtual channel IDs (VC-ID)

Replication Mode

2 streams up to 6.4 Gbps each

Colors represent virtual channel IDs (VC-ID)

TEXAS INSTRUMENTS

Data Protection & Diagnostics
Supporting Overall System Functional Safety

- **TSER953 sends camera diagnostics to ECU**
  - **PoC voltage, temp, link & clock status, bit errors, etc.**
- **Programmable sensor module health alarm signal**
- **Multiple levels of CRC data protection & checking**
- **I2C write protection**
- **Line fault detection**
- **Unique die security ID**
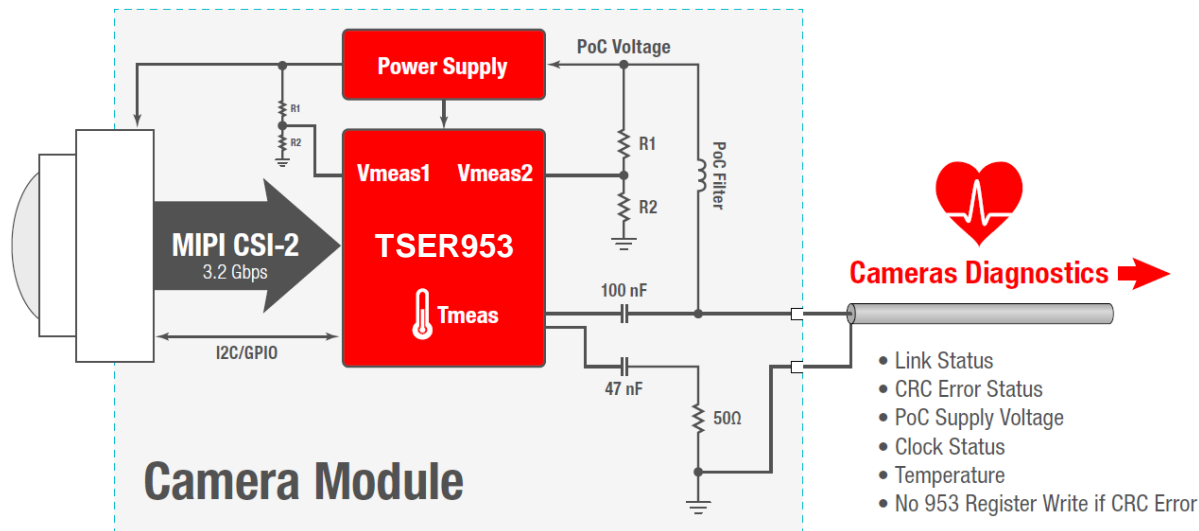
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