



FPD-Link II Display Solutions for Automotive Applications

DS90UR241/DS90UR124





Panelists

- **Alex Tan**
 - High Speed Data Path Marketing

- **John Goldie**
 - High Speed Data Path Applications

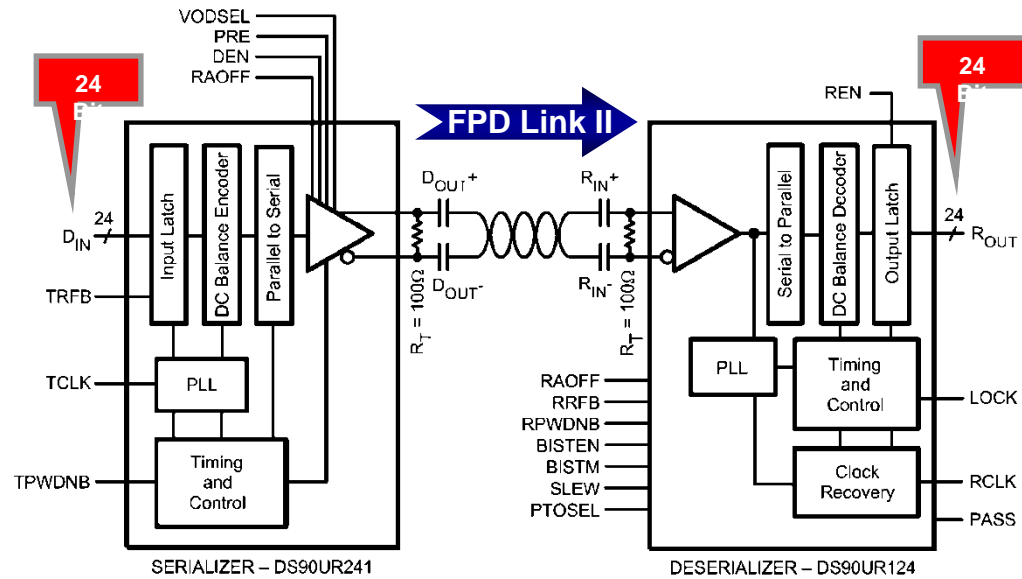
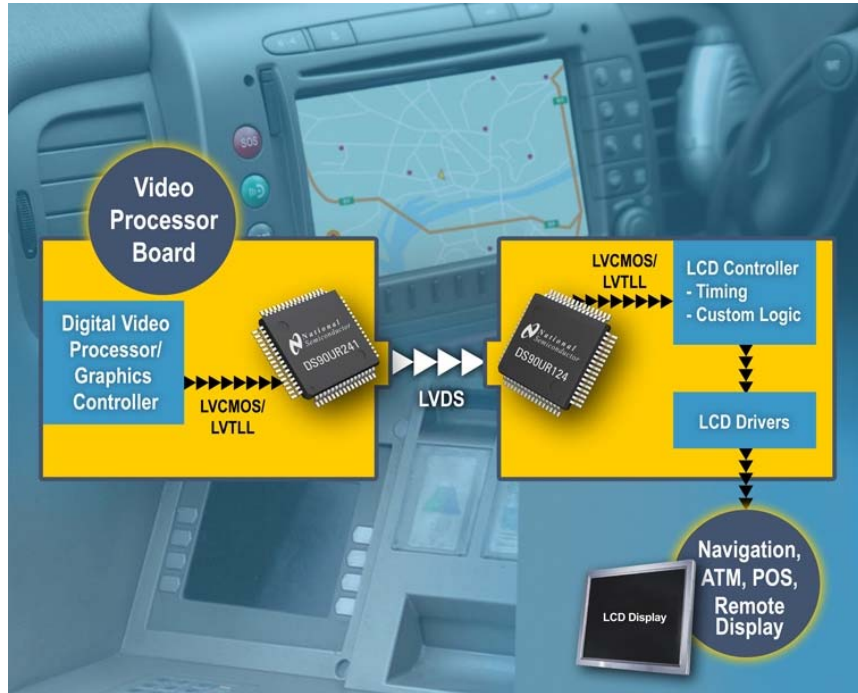


Objectives

- **List which automotive applications are targeted for the DS90UR241/124 FPD-Link II chipset.**
- **Explain the key system benefits that the chipset delivers.**
- **Discuss the main features of the chipset and their value to the system.**
- **Suggest complementary products that support the FPD-link II chipset and expand its functionality.**

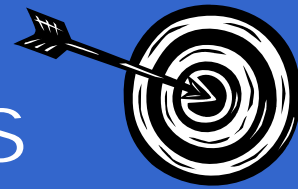
FPD-Link II Auto Display Applications

DS90UR241 SER / DS90UR124 DES



Targeted Applications

DS90UR241 SER / DS90UR124 DES



- **Mainly Used for Automotive Display Applications**
 - **Central Information Display (CID)**
 - **Rear Seat Entertainment (RSE)**
 - **Instrumentation Display**
 - **Navigation Display**
 - **Other: e.g. Heads Up Display, Mirror Alternatives,....**
 - **Camera / Sensor / Assist applications also**

 - **WVGA format is most popular resolution**
 - **800 x 480 – WVGA resolution**
 - **18bpp (color depth, 6 bits of RGB)**
 - **clocks in the 30MHz range**

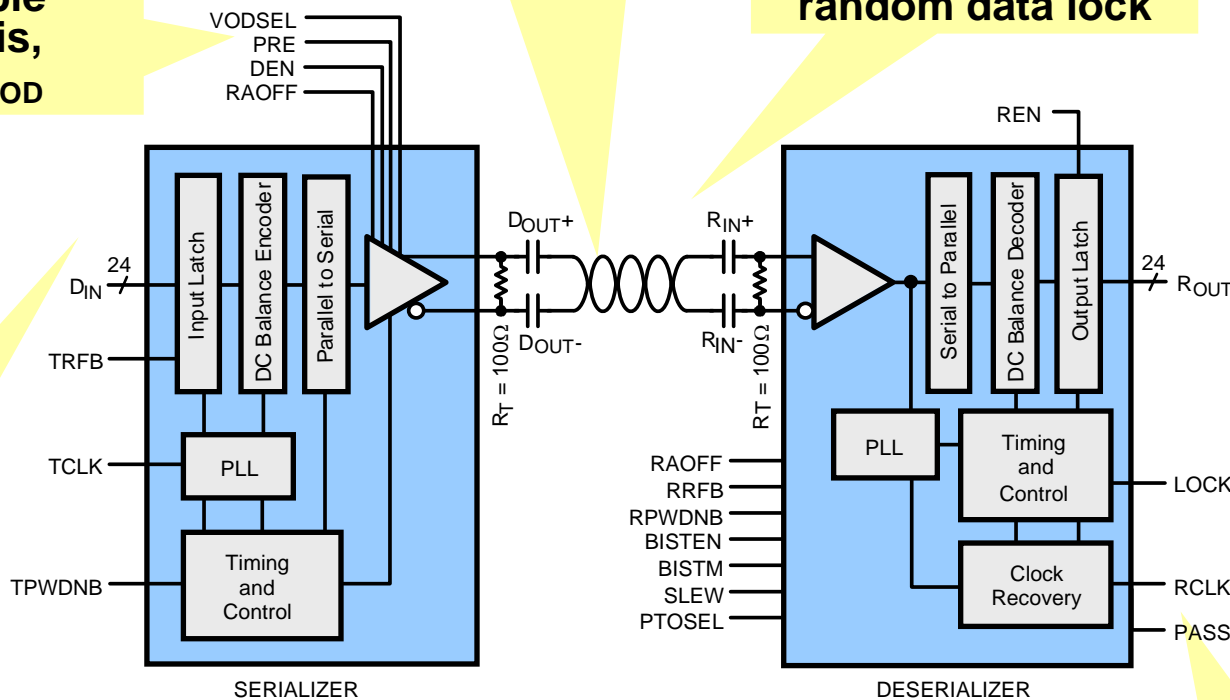
FPD-Link II Chipset Overview

Improved signal integrity: programmable pre-emphasis, selectable V_{OD}

DC-balanced data and clock sent over a single differential pair

Hot plug support and random data lock

24-bit payload RGB Parallel Bus & Control



True embedded clock

~~REF CLK~~

EMI reductions: PTO, SSCG, selectable drive strength, variable pre-emphasis, scrambling, SER accepts SSC inputs

@Speed BIST





Why?

- **Why Automotive Displays?**
 - Safety, Quality of Life, Entertainment, and also Efficiency!
- **Why Serial?**
 - Less cabling, lower cost, less pins, less weight, smaller holes in frame, higher gas mileage!
- **Why LVDS Signaling?**
 - Differential transmission is very robust to noise, also can deliver the bandwidth needed, enables single pair, long cable drive, de-facto standard
- **Why National?**
 - Proven track record in Display Interface, Inventors of LVDS, High Quality and Volume Manufacturing (AEC-Q100)

Display Interface & Systems

National
Invents
LVDS &
FPD-Link



1st FPD-Link
TCONs for
Notebook PCs



National invents
RSDS for LCD
Monitors and TV's



National invents PPDS™
for LCD TVs



Mobile Pixel Link
(MPL) for Mobile
Devices

1995

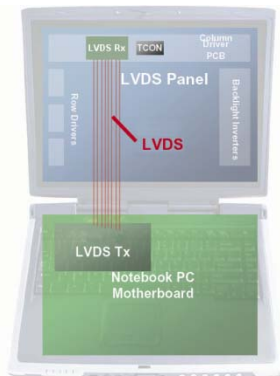
1998

2000

2005

2006

2009



National invents
FPD-Link II
True Embedded Clock
SerDes for automotive
applications



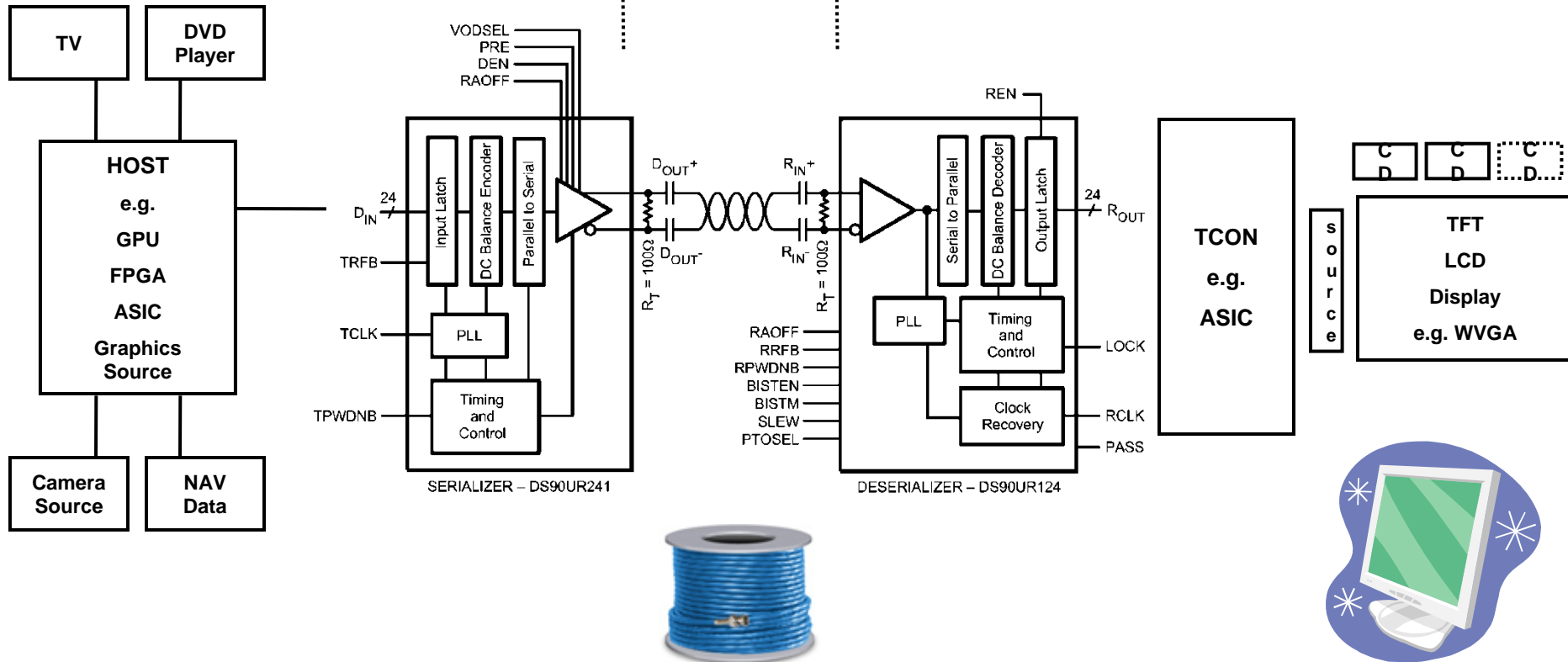
Auto Infotainment Application Diagram



HOST SIDE

Interconnect

TARGET SIDE

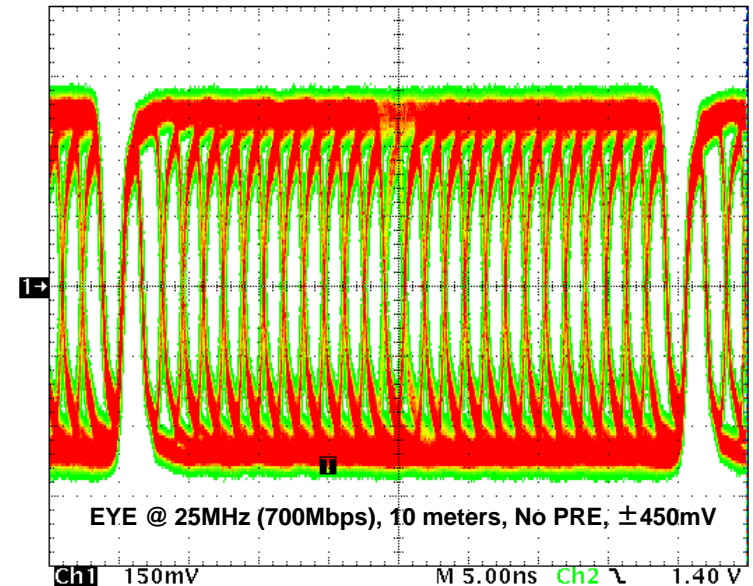


Key Features to Note

- **SERDES & LVDS – enables Single Pair Link**
- **24 bit payload (supports 18bit color + control + AUX)**
- **SigCon for extended length interconnects – 10m**
- **EMI Minimizer Features**
 - **Serial Randomization, Balancing & Scrambling**
 - Improves Signal Quality, Reduces EMI, Supports AC coupling for fault tolerance
 - **Low EMI Parallel Output (SSO reducer, SLEW control)**
- **No REF Clock required on DES**
- **BIST mode (factory test, diagnostics)**
- **AEC-Q100 level 2 (Auto Qualified)**

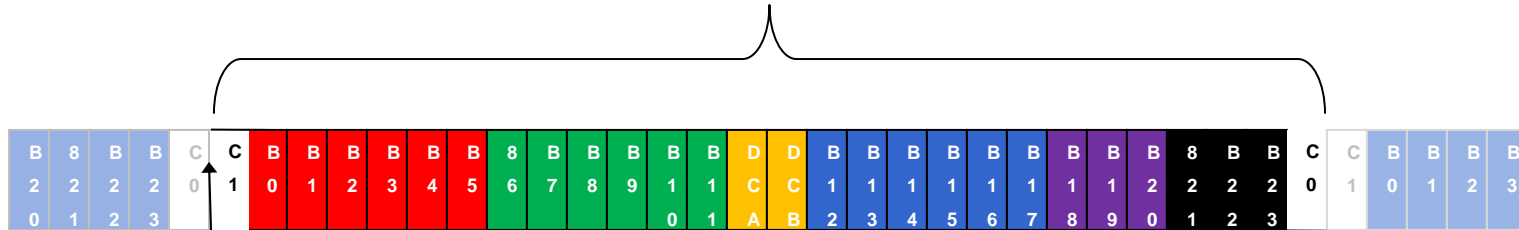
LVDS

- **Small differential swing**
- **Low current magnitude**
- **Equal and opposite currents**
- **Wide common mode range**
- **High noise rejection**
- **Proven, Reliable, & Robust**



FPD-Link II Payload

28 bit (24 bit data) Payload



C1 = Clock bit HIGH

C0 = Clock bit LOW

DCA & DCB = Control Bits

B0 to B23 = Data Bits

RGB666

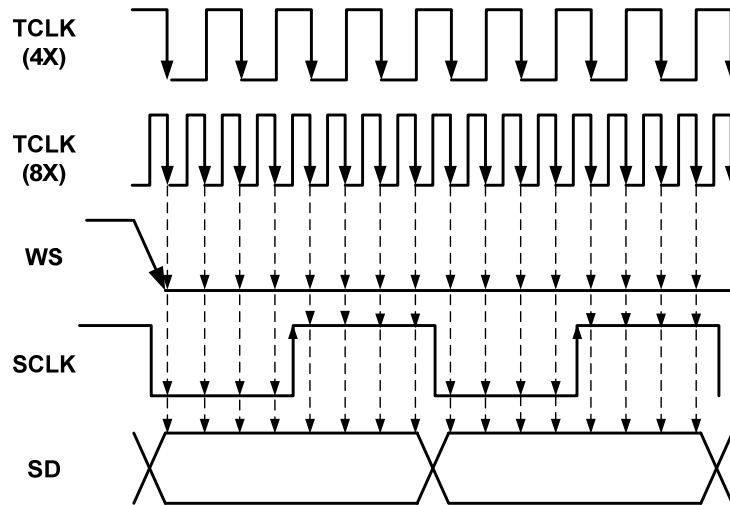
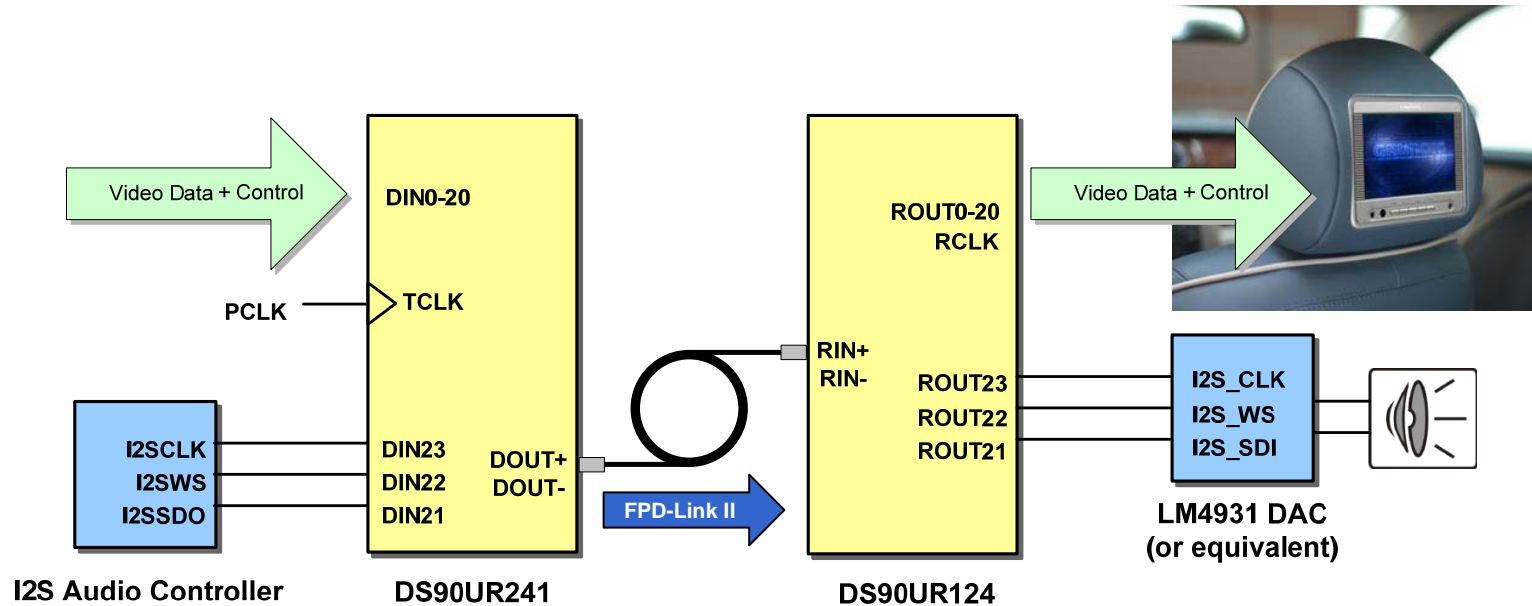
VS, HS, DE

AUX (3) e.g. I2S

Note: Payload bits are *Randomized, Balanced & Scrambled*

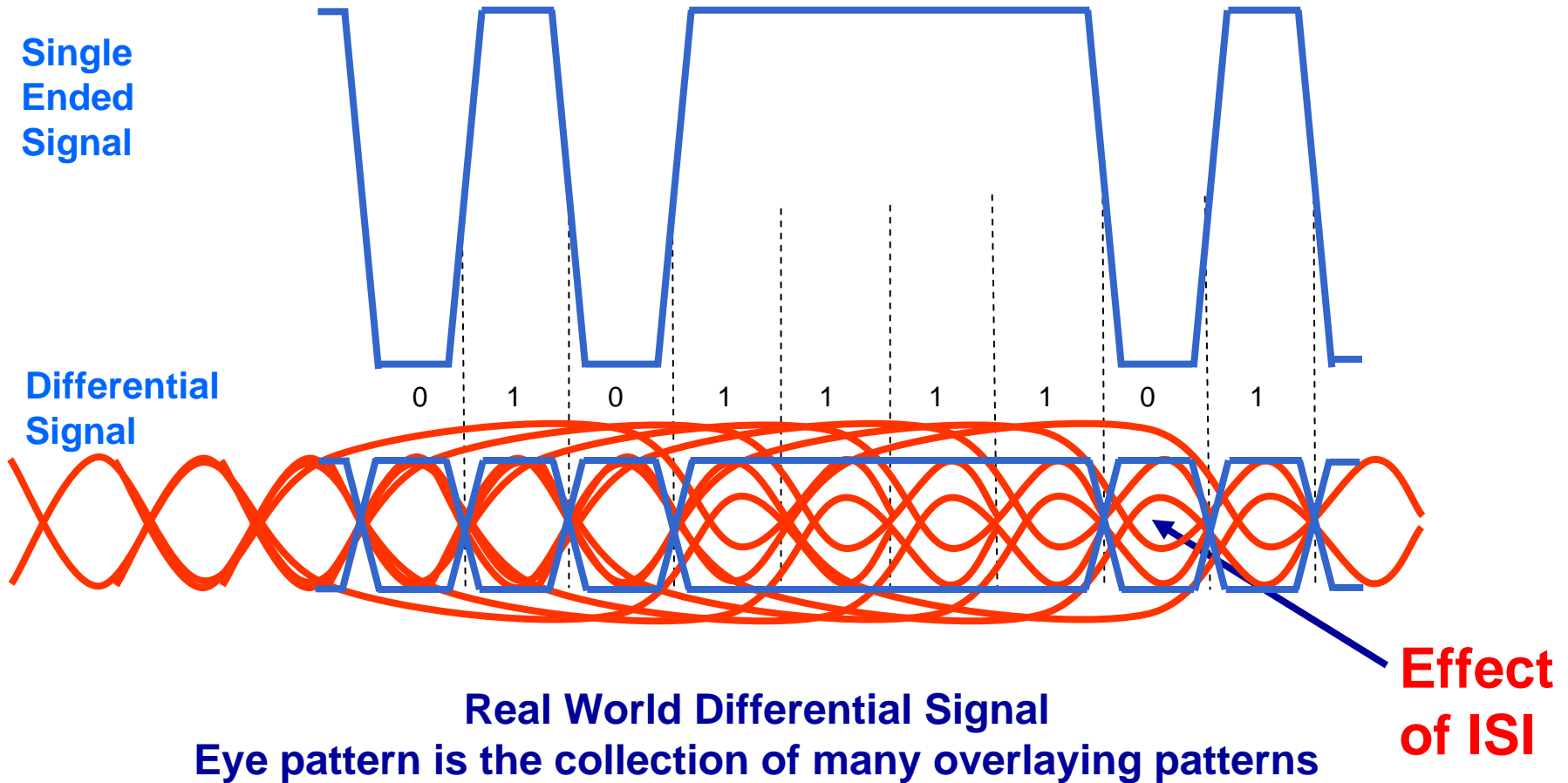
>85% Efficient (24/28) and embeds the clock

Oversample I2S for Audio transport

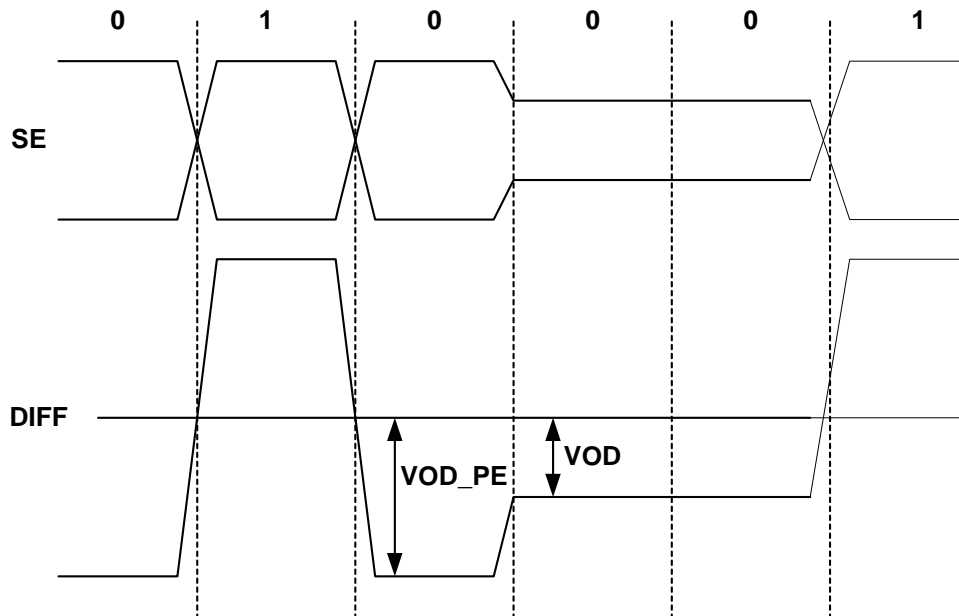


Why Signal Conditioning?

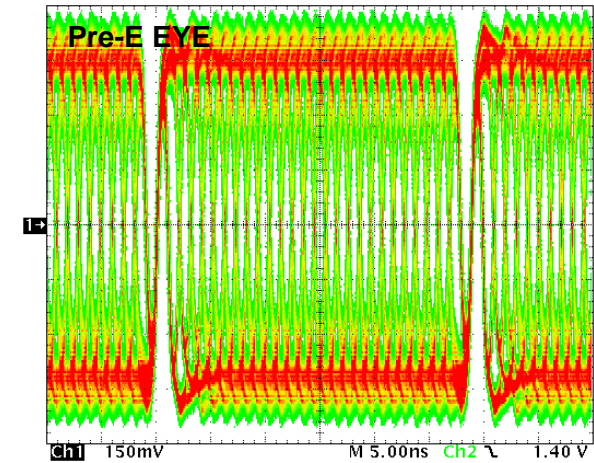
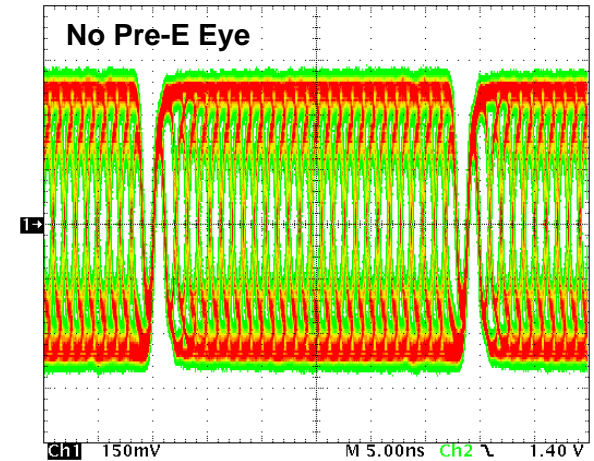
Inter Symbol Interference (ISI) and LOSS



Pre-Emphasis Signal Conditioning

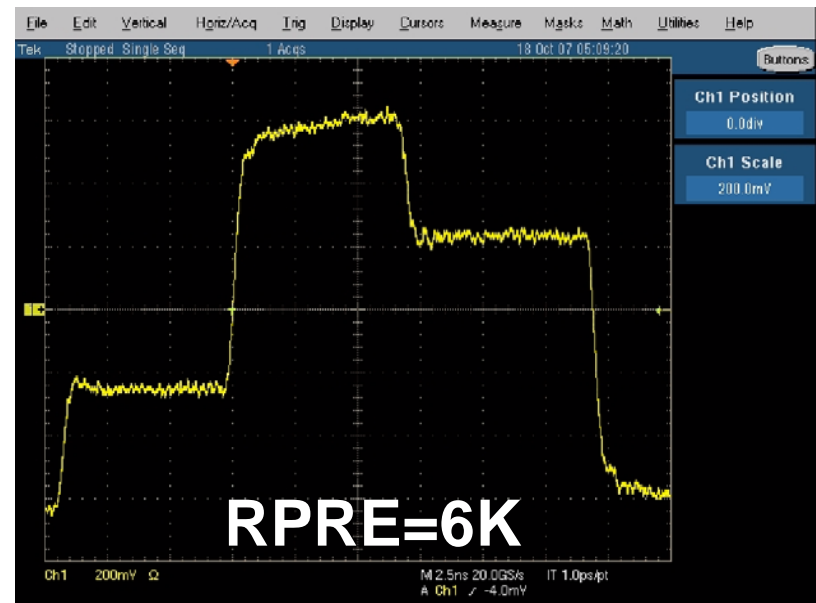


- 1-bit Pre-Emphasis Waveforms (SE & Diff – above)
- 010001 Example Data Pattern (above)
- Duration of Pre-E is 1 bit time
- Amplitude is controlled by RPRE resistor
- Typical 'EYE' at 1Gbps (10m) shown on the right –
 - Note trigger on TCLK in to sync to the embedded clock edge – with Pre-E, you get less jitter, and more amplitude margin.



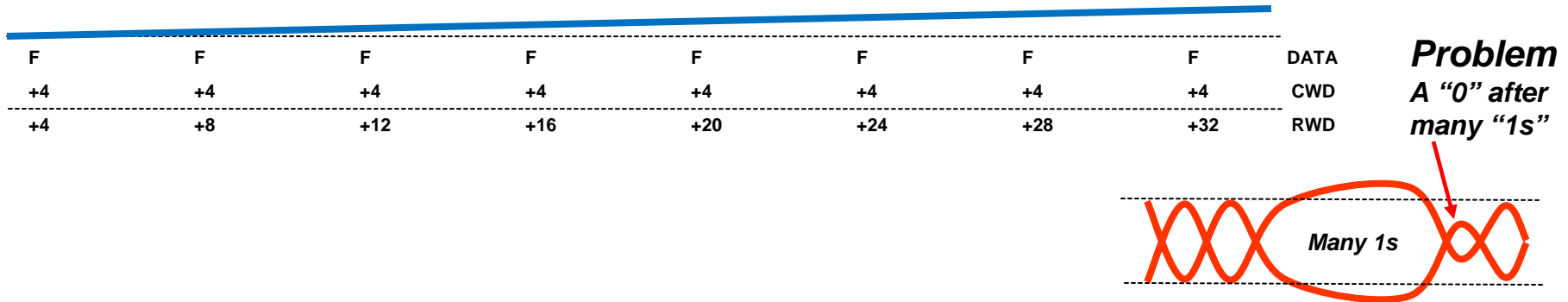
1-bit Pre-Emphasis Driver (cont.)

- 1 bit Pre-Emphasis (DS90UR241)
- RPRE sets the amplitude, 1 full bit time duration
- Pattern shown: 0110
- Plus: Better Signal Quality, Length
- Minus: additional power, larger signal

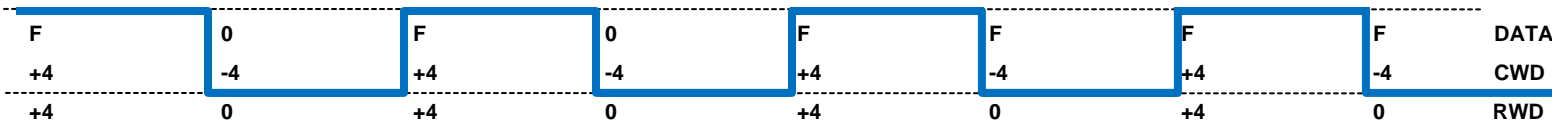


DC Balancing (Sending many 1s or 0s)

No DC Balancing



DC Balancing



- Improved Signal Quality, Less EMI
- Supports AC Coupling, Fault Tolerant
- Low Overhead (DCA/DCB bits)

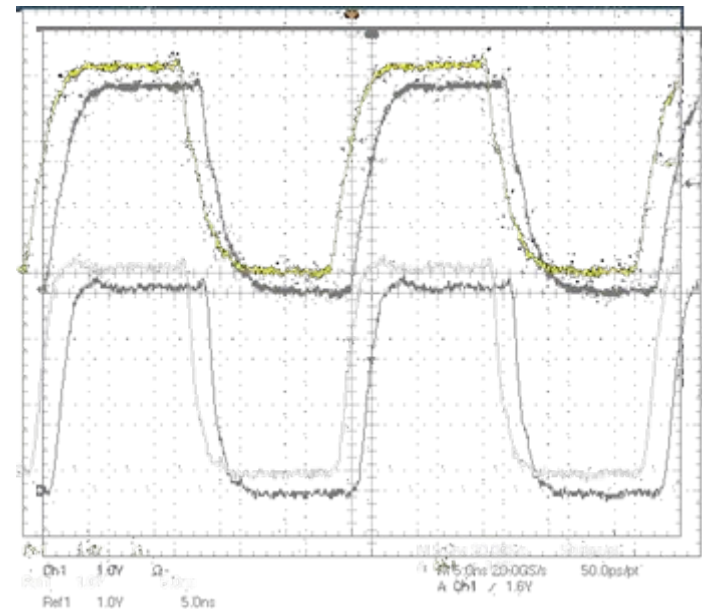


Randomize – Balance - Scramble

- **Balance – controls running word disparity**
 - Supports AC coupling
- **Randomize – combines data stream with a PRBS7**
 - Ensures transitions, randomizes beats
- **Scramble – bit location changes on a clock to clock basis**
 - Beat elimination
- **Improved Signal Quality and Less EMI**

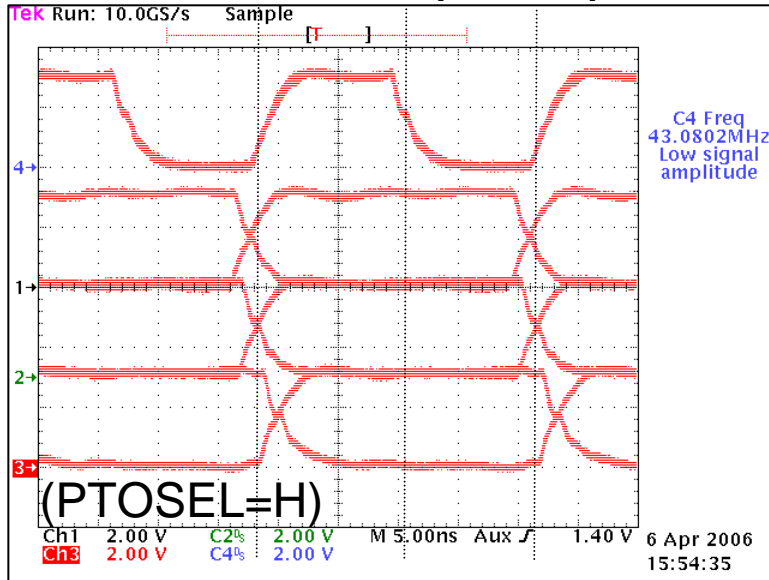
EMI Minimizer Features

- **LVDS I/O – current mode, low swing**
- **RBS – reduces pathological patterns**
- **PTO – Reduces SSO Noise / EMI (2 options)**
- **SLEW – 2mA / 4mA drive option**
 - Soft edges for less noise
- **SSC compatible**

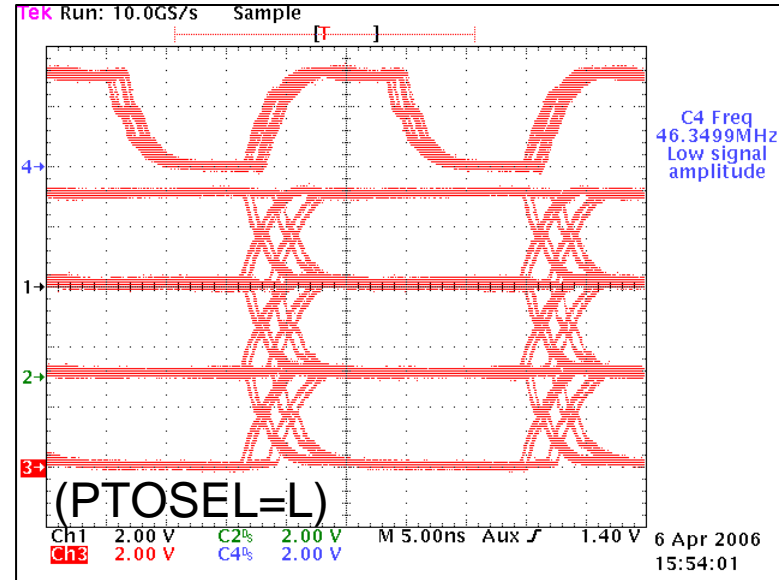


DES Dynamically Staggered Parallel Outputs with Spread Spectrum Clocking

Fixed PTO (F-PTO)



Frequency Spread PTO (FS-PTO)

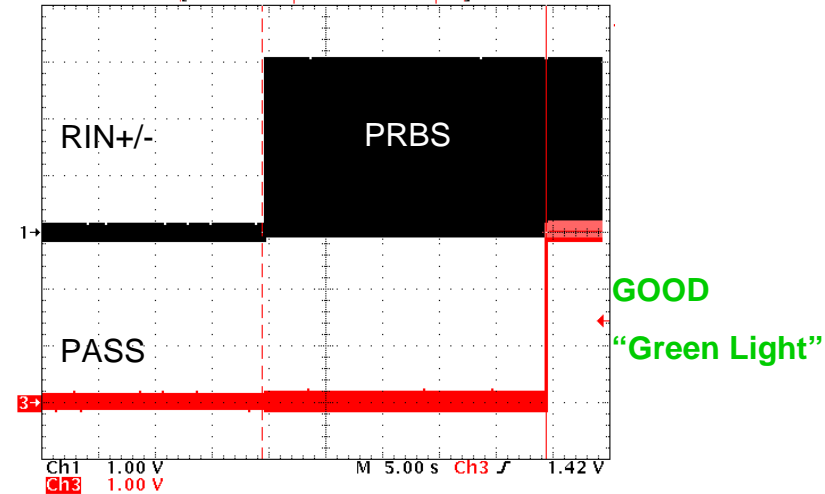


- Limit the number of outputs switching at a time
- Additional frequency spreading option
- Less noise on the power supply

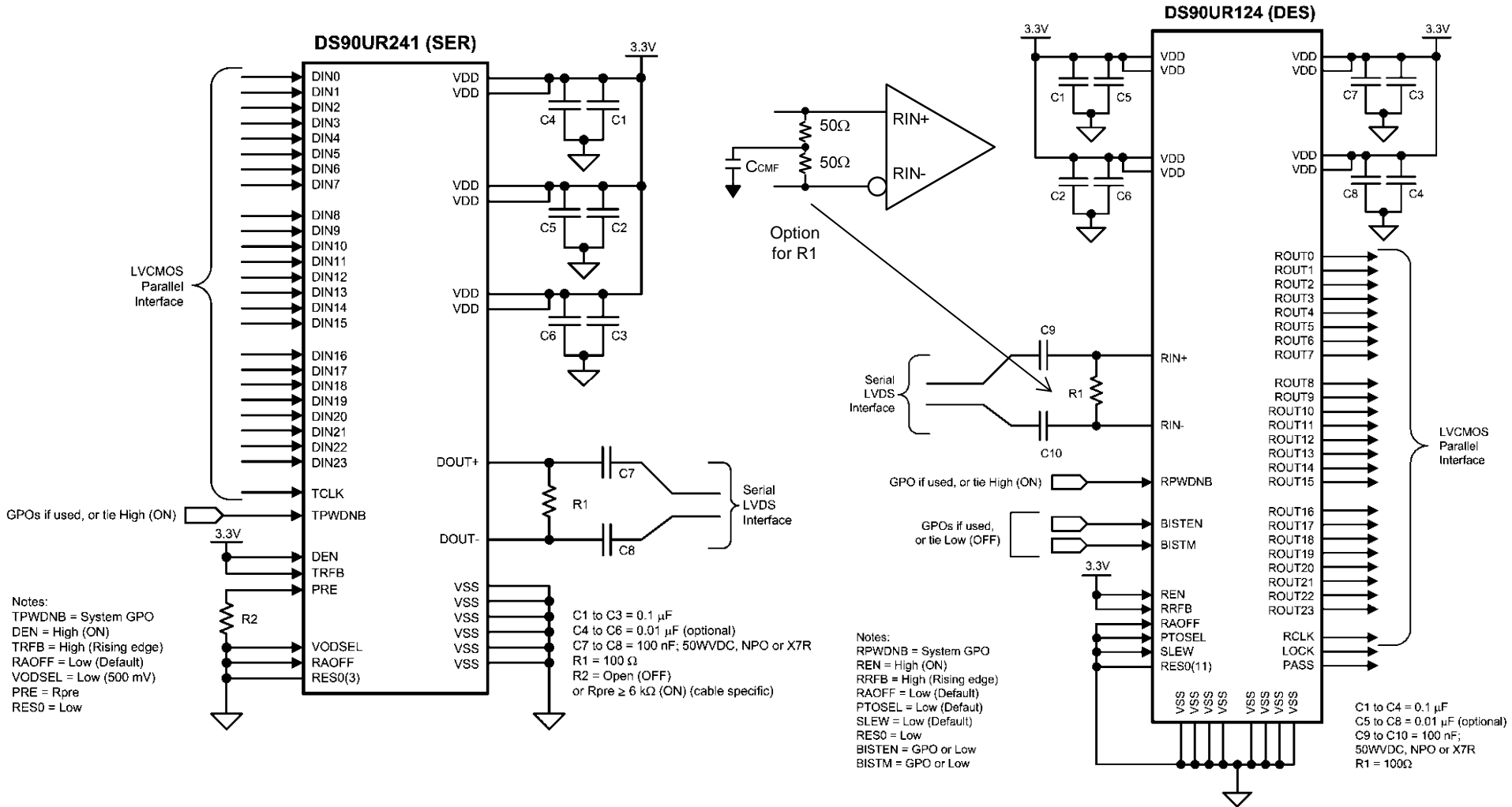
Built In Self Test (BIST) MODE



- **Factory Test**
 - Functional
 - EMI / cable testing /
- **System Start Up**
 - Link Check
- **Diagnostics**
 - Problem locator / system check
- **BIST MODE – Verifies the link & reports the result!**
 - Provides a PASS output pin on the DES
 - Advises that error rate is less than 1×10^{-9}
 - Can count errors on data bus



Schematic View (See Datasheet)



System Benefits

- **Sleep Mode**
 - Power down the SER or DES to save power.
- **SigCon (VODSEL, PRE)**
 - Advanced Signal Conditioning to extend the reach.
- **TRFB & RRFB Pin**
 - Compatibility with a wide range of Hosts and Targets.
- **RA OFF (C mode)**
 - Backwards compatible mode with DS90C241 / DS90C124.
- **RX LOCK Pin**
 - Link status pin.
- **Random Lock – No REF Clock needed!**
 - Save cost by not needing expensive REF Clocks.





DS90UR124/241Q Advantages



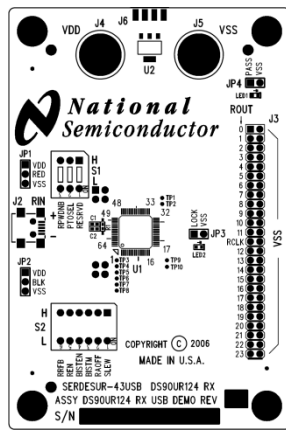
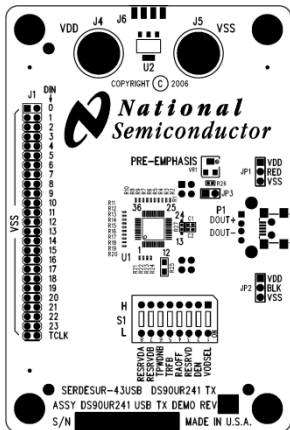
- **Single Pair Video Interconnect**
- **Supports 18 bit color + control + Aux / GPIO**
- **Signal Conditioning / 10 meter support**
- **Low EMI**
- **BIST mode**
- **Proven, Reliable & Robust**

- **Roadmap to 24 bit color, higher resolutions, advanced features, embedded control and more!**

Design Collateral



- **DS90UR241/124 Datasheet:** <http://www.national.com/pf/DS/DS90UR241.html>
- **FPD-Link II Application Notes:**
 - **AN-1807** <http://www.national.com/an/AN/AN-1807.pdf>
 - **AN-1826, AN-1898, AN-1909**
- **Evaluation Board: SERDESUR-43USB**
See: http://www.national.com/apnotes/FPD-LinkII-EmbeddedClockLVDS_v3.html



FPD-Link II AEC Family



- **DS90C241 / DS90C124**
 - Popular for lower clock rate apps and Camera applications
- **DS90UR241 / DS90UR124**
 - Popular in Display applications
 - Backward compatibility mode with DS90C241/124
- **DS99R421 (SER w/ FPD-Link in)**
 - Use with FPD-Link_out Graphic Hosts
 - Lower EMI due to LVDS input bus (vs. LVCMOS)
- **Coming Soon Next Gen!**
 - More features, faster, higher resolutions, less wires, and much more!

National's Automotive Family

Energy-Efficient Analog Products



The image features five National Semiconductor chips floating above a wireframe model of a red car. The chips are labeled: LM5118, LM26003, LM48100Q, LM3423, and DS90UR124Q. The car model has glowing points and lines, suggesting a digital or energy-efficient design.

- Safety
- Powertrain
- LED Lighting
- Infotainment

For More Information

- **FPD-Link II SER DS90UR241 Product Folder**
 - <http://www.national.com/pf/DS/DS90UR241.html>
- **FPD-Link II DES DS90UR124 Product Folder**
 - <http://www.national.com/pf/DS/DS90UR124.html>
- **Displays Feature Site**
 - <http://www.national.com/analog/displays>
- **Automotive Feature Site**
 - <http://www.national.com/analog/automotive>
- **AECQ Feature Site**
 - <http://www.national.com/analog/automotive/aecq>



Contact Information

- **Alex Tan**
 - HSDP Marketing
 - Alexander.Tan@nsc.com
 - +1 408 721- 5561
- **John Goldie**
 - HSDP Applications
 - John.Goldie@nsc.com
 - +1 408 721-2075
- **Susan Poniatowski**
 - HSDP Applications
 - Susan.Poniatowski@nsc.com
 - +1 408 721-3921



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