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ELMEC DSB – Digital Signal Balancer

Enabling High Speed Data Transmission Technologies

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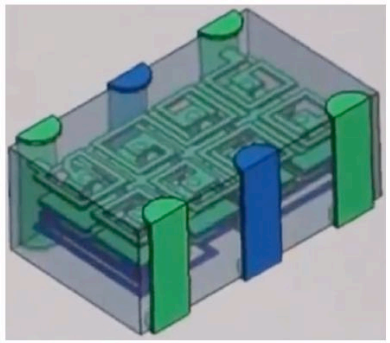
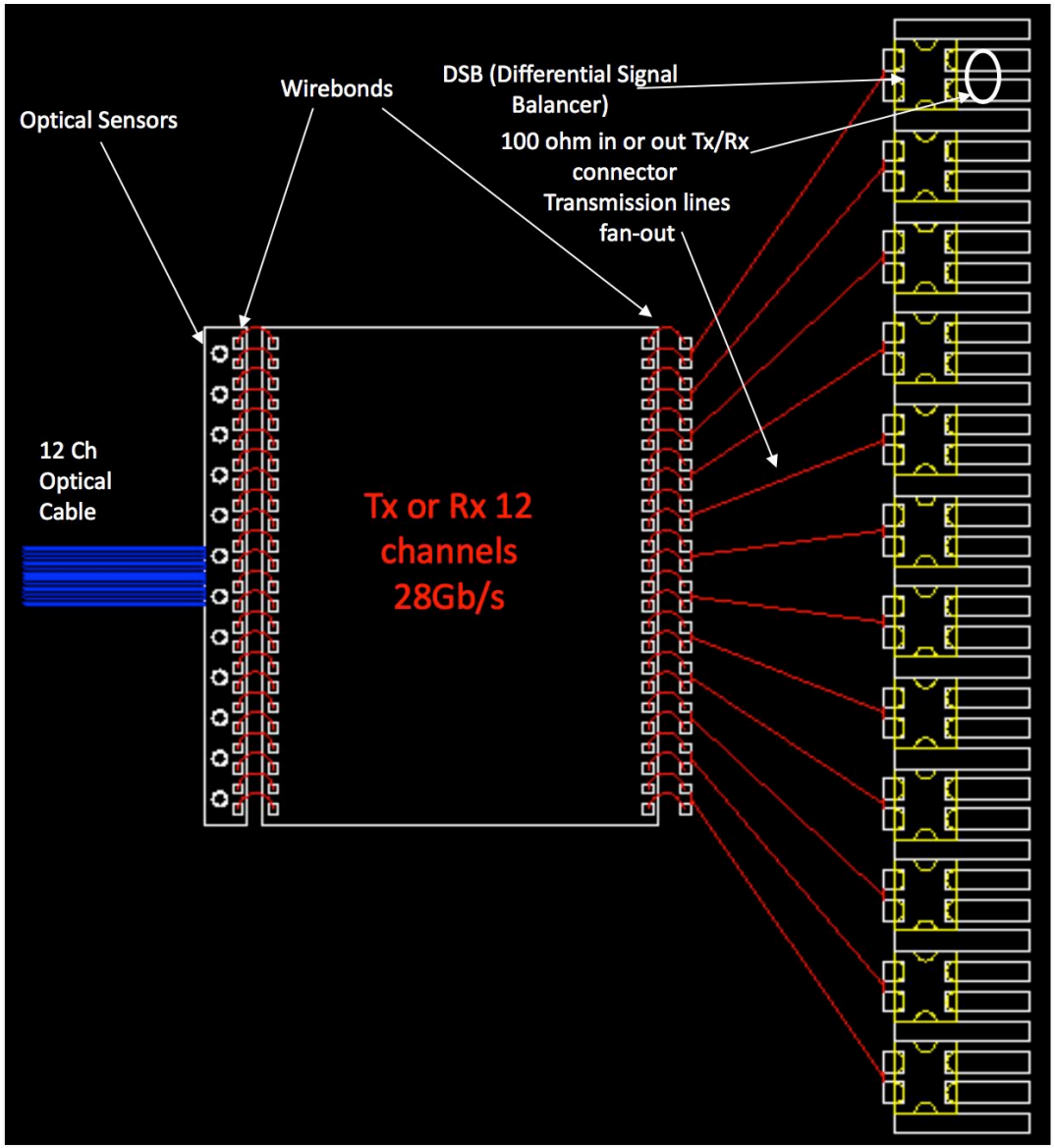
- ELMEC Corporation developed and manufactured delay line products since early 1980
- Currently ELMEC is the only reliable supplier supporting precision delay line worldwide
- A delay line is a broadband low pass filter specifically designed to provide a very precise delay time to digital signals with minimum attenuation
- With many years of delay line design experience and proprietary manufacturing technologies ELMEC developed a new product, derived from delay line, which we call DSB or Differential Signal Balancer

DSB (Differential Signal balancer)

- Mounted in line with a differential transmission line in between specific parts of a system or interconnects the DSB brings the following benefits:
  - Significant improvement of signal skew and balance
  - Reduces high frequency common noise up to -20dB
  - Drastically reduces common mode noise input reflections
  - Visible eye pattern improvements
  - Improves overall signal integrity, much better signal to noise
  - Significant reduction of noise emissions, excellent EMI performance of the circuit overall





Active Optical Cable (AOC) Challenges at 14 to 28Gb/s channel data speed DSB can address:

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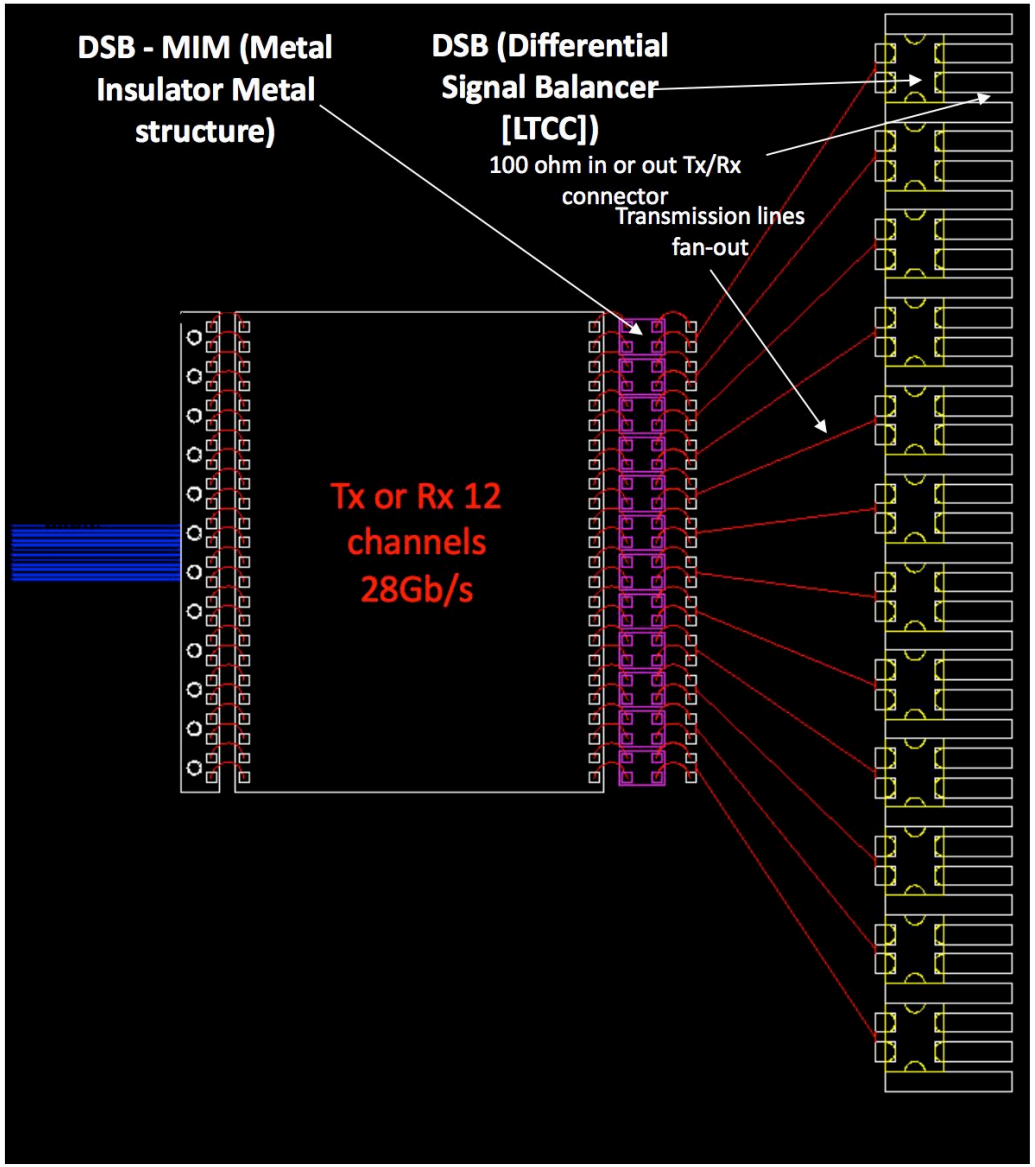
- Typical AOC architecture is shown at left. Not particularly related to any company actual construction
- Wire bonds – mismatch, unwanted reflections, noise, jitter
- Transmission lines fan-out – mismatch, unwanted reflections, noise, jitter, skew/signal unbalance
- PCB – fiberglass material uneven dielectric constant and transmission line precision hard to control
- Tx or Rx – biggest contributor to noise and crosstalk + all of the above
- Higher data speed requires higher signal current
- All of the above combined can chip into signal power budget up to making the system unreliable



Active Optical Cable (AOC) Challenges at 14 to 28Gb/s channel data speed DSB can address

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- DSB at the RX output connector may be sufficient to drastically improve the performance. Small size LTCC structure, small enough to accommodate the transmission line size is available now CDLA08R
- A DSB MIM structure will have the best impact if installed right next to the Tx chip or integrated into the silicon (active size 0.1mmX0.1mm)

CDLA08R DATA SHEET (1ST SAMPLE)

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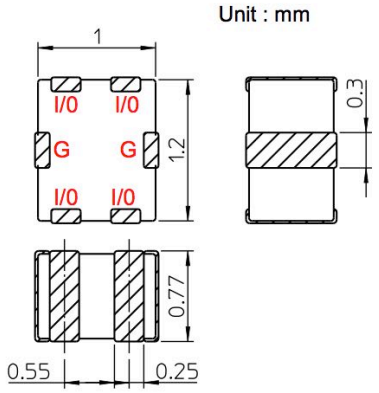
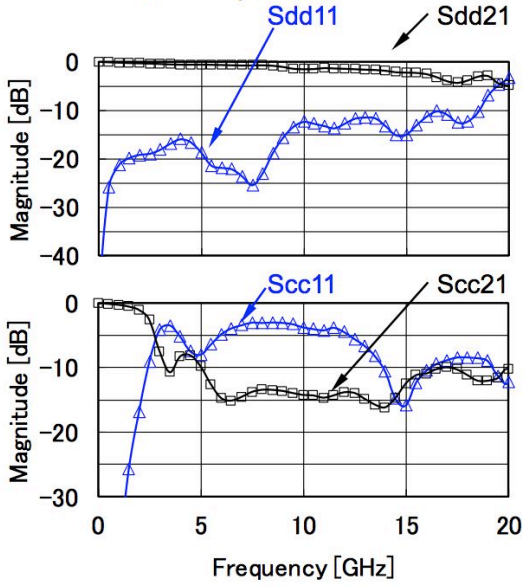
- Outer Dimensions

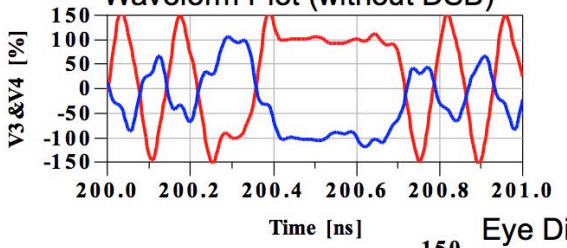


Frequency Characteristics

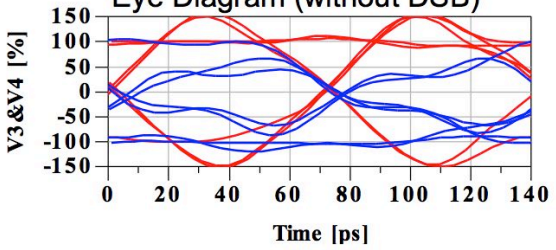


Estimated Eye Diagram (14Gb/s, 20ps Skew)

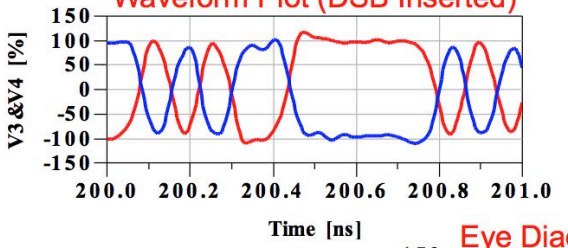
Waveform Plot (without DSB)



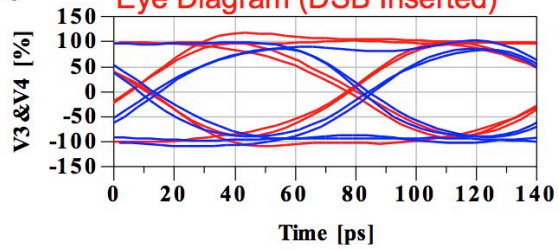
Eye Diagram (without DSB)



Waveform Plot (DSB Inserted)



Eye Diagram (DSB Inserted)



■Characteristics Example (Removing Multiple Reflection)

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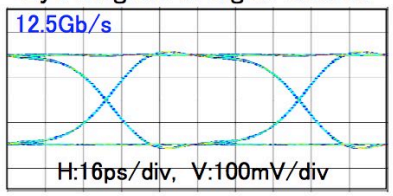
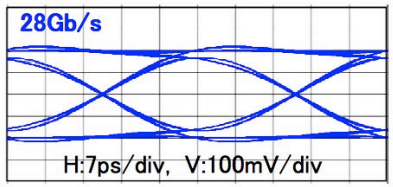
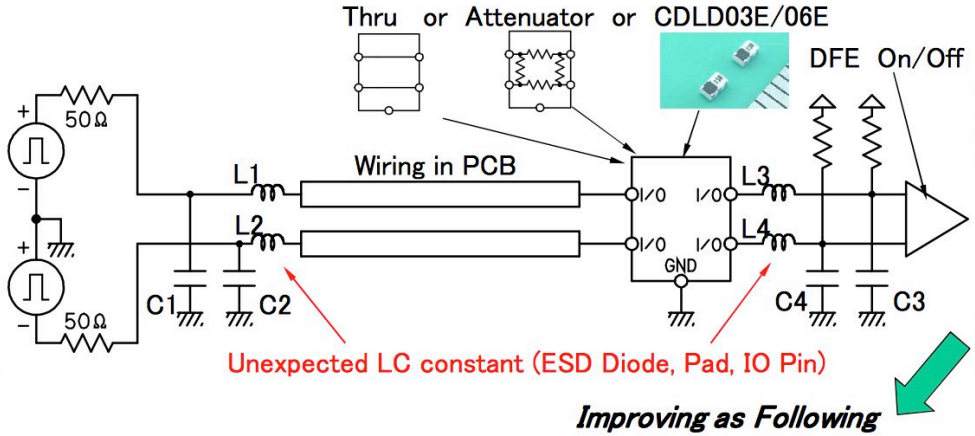
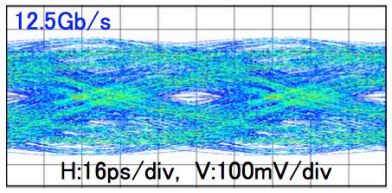
Eye Diagram of signal Source

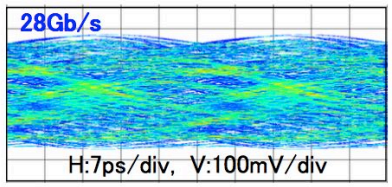




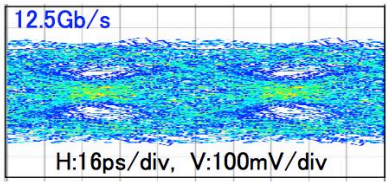
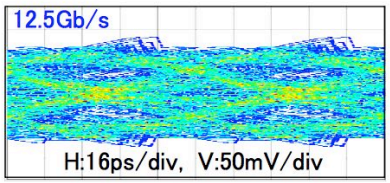
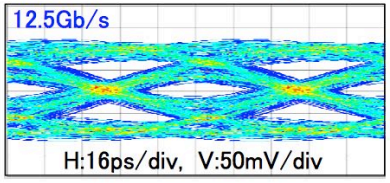
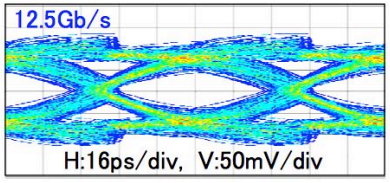


Eye Diagram Distorted due to Muiliple Reflection

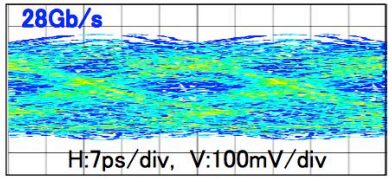
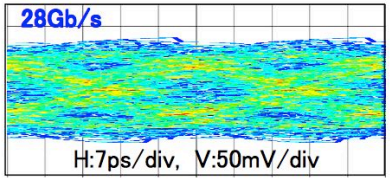
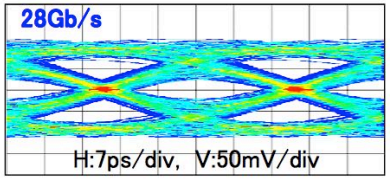
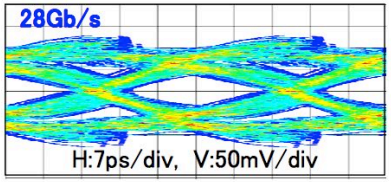




12.5Gb/s, Unbalanced LC(L1/L2=2nH/1nH, C1/C2=2pF/1pF, L3/L4=1nH/2nH, C3/C4=1pF/2pF)

Thru with DFE	6dB Attenuator with DFE	CDLD06E Only	CDLD06E With DFE
			

28Gb/s, Unbalanced LC(L1/L2=0.75nH/0.25nH, C1/C2=0.75pF/0.25pF, L3/L4=0.25nH/0.75nH, C3/C4=0.25pF/0.75pF)

Thru with DFE	6dB Attenuator with DFE	CDLD03E Only	CDLD03E With DFE
			

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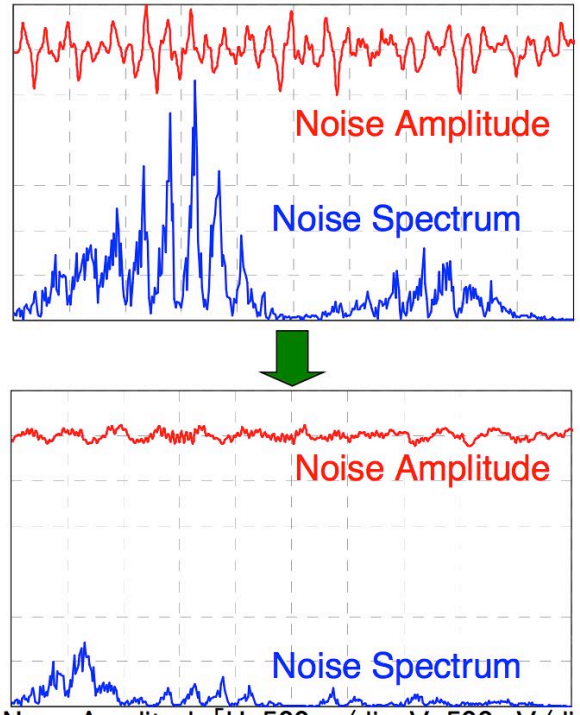
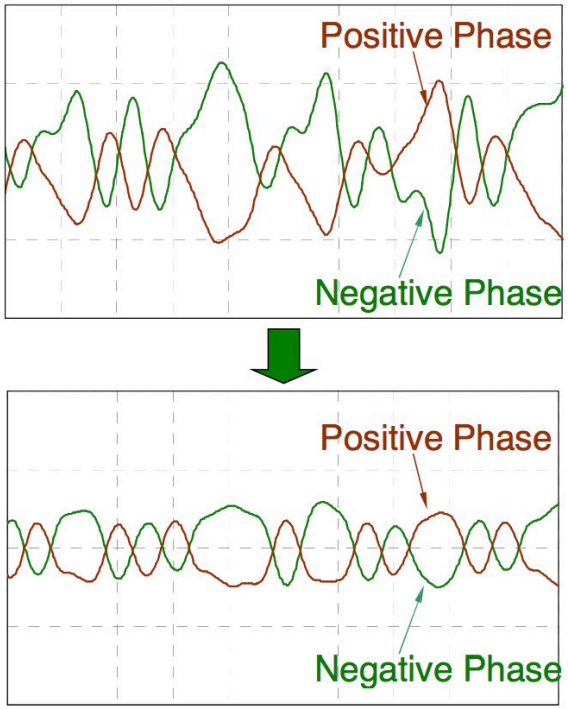
■Characteristics Example (Removing Common-mode-noise, Improving differential balance)

Removing Common-mode noise of 10Gb/s



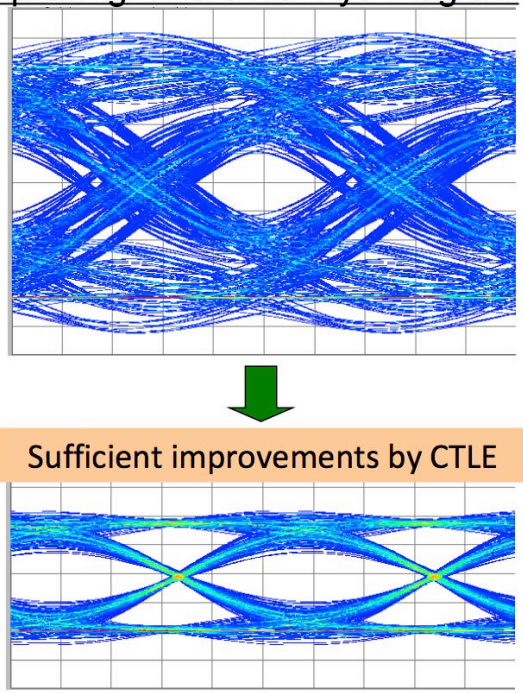
Nose Amplitude[H:500ps/div, V:500mV/div]
Noise Spectrum[H:2GHz/div, V:10mV/div]

Improving Differeintial Balance of



[H:200ps/div, V:500mV/div]

Improving Differential Eye Diagram



Sufficient improvements by CTLE

[H:20ps/div, V:50mV/div]

AOC Market status 2016

- Increasing bandwidth requirements and huge data center deployments are likely to drive the active optical cable market. The adoption of emerging technologies such as Software-defined networking (SDN) and network-function virtualization (NFV) among others are expected to impact the growth of the active optical cable market.
- The active optical cable market is estimated to exhibit high growth till 2022. The overall market is expected to reach USD 3.43 Billion by 2022, at a CAGR of 27.1% between 2016 and 2022.
- Data center is expected to lead the end user application of the active optical cable market. The growing demand for active optical cable in data center, worldwide is one of the key drivers of the market. The data center market also needs a broad portfolio of fiber optic modules to connect servers, switches, and storage, which is accomplished by active optical cable. Therefore, increase in the deployment of data center is a key driver of active optical cable market.
- Ethernet and InfiniBand protocol are highly used protocols among others. Are scalable and supports quality of service (QOS) as well as it is highly efficient among other protocols. The interface of these protocols in commercial applications such as server and supercomputers are playing a key role in the market growth. It is also a path showing that future USB will use AOC.
- ELMEC DSB is position as a key element enabling AOC engines to work reliably