Techno World

Even Higher Speed and Lower Power Consumption Achieved

Optical Communication ICs

CXB1549Q

- **Single 3.3-V power supply laser diode driver**

CXB1573R/CXB1577R

- **Single 3.3/5.0-V power supply Gigabit Ethernet post-amplifier**

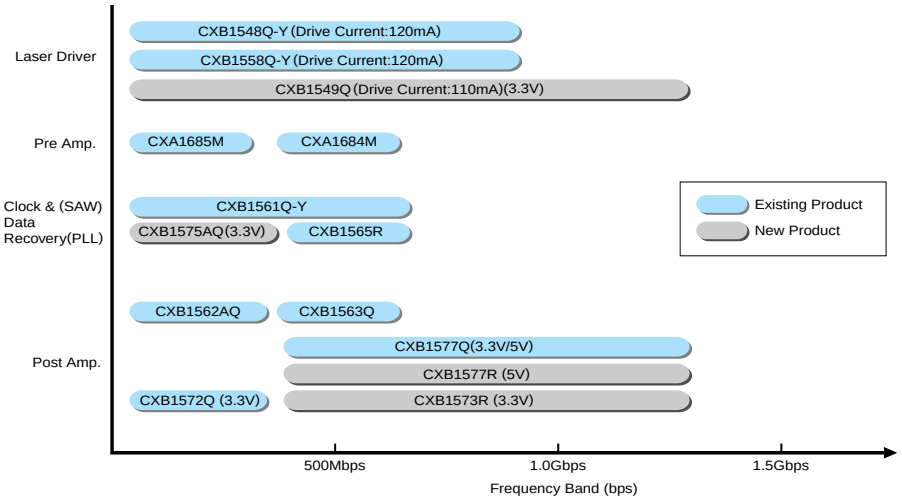
CXB1575AQ

- **Single 3.3-V power supply SDH/SONET (STM-1/OC-3) clock and data recovery IC**

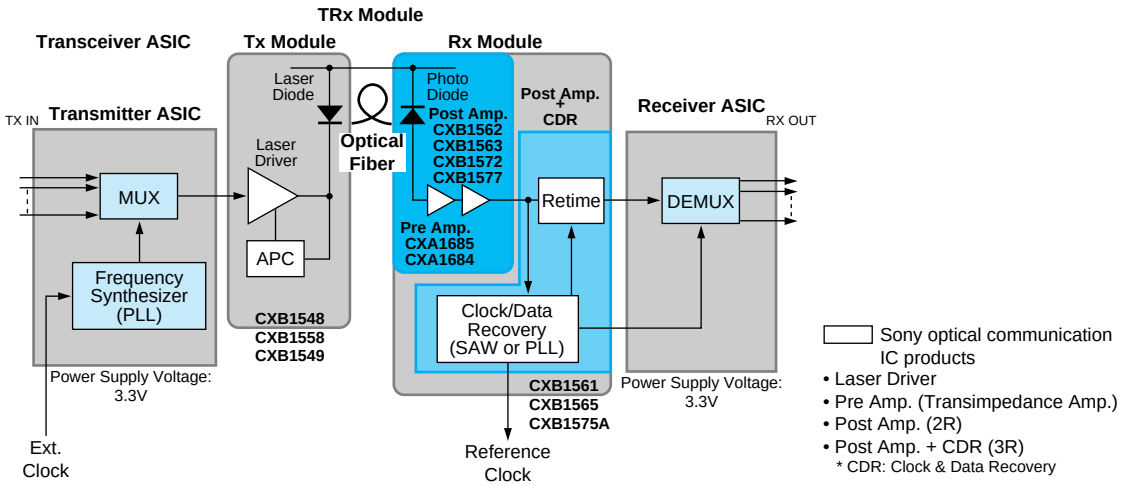
As more and more data communication systems are adopting optical technology, further advances are being made in achieving lower operating voltages and further miniaturization in the conversion modules which are required to convert electrical signals to optical signals and optical signals to electrical signals. Furthermore, now that the Gigabit Ethernet has been standardized, there are increasing demands for higher speeds and larger capacities in data transmission systems.

To respond to these needs for higher speeds and lower voltages in data communication systems, Sony has developed 3.3-V ICs that support Gigabit Ethernets and is providing a new product line in this area. (See figure 1.)

This article introduces four new products, the CXB1549Q transmission laser driver that supports single 3.3-V power supply Gigabit Ethernets, the CXB1573R (3.3 V) and CXB1577R (5 V) receiver post-amplifiers that support Gigabit Ethernets, and the CXB1575AQ clock and data recovery IC that supports SDH/SONET (STM-1/OC-3) and ATM (155 Mbps) systems. All four of these products are provided in miniature plastic packages. These products support the miniaturization of optical modules not with chip mounting but with package mounting. (See figure 2.)



■ Figure 1 Sony Optical Communication Product Line



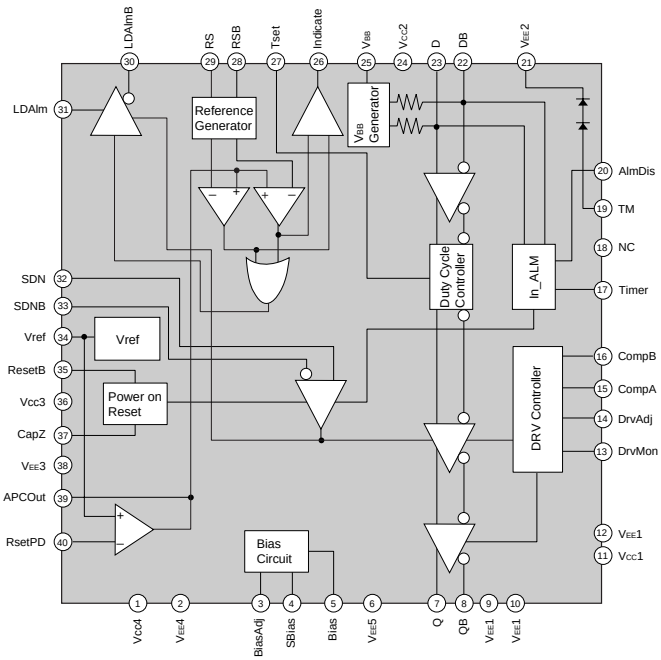
■ Figure 2 Typical Optical Communication Module Structure

1.25 Gbps Laser Driver CXB1549Q

The CXB1549Q is a laser diode driver IC for optical communication systems. Figure 3 shows the IC's block diagram and figure 4 shows its output waveforms. This IC can be used in Gigabit Ethernets (1.25 Gbps), SDH/SONET (STM-4/OC-12), Fibre Channel (531 Mbps/1.06 Gbps), and ATM (622 Mbps) systems. Furthermore, this device features functions for preventing degradation of the laser diode, including a power-on-reset, laser alarm and shutdown, and input alarm detector (active detection) functions. It also provides an APC (automatic power control) function that follows the optical power characteristics and provides a fixed optical power output, and a variable output duty function for correcting the laser diode's optical delay.

The CXB1549Q is provided in a miniature 40-pin plastic QFP (package size: 9 × 9 mm including leads) with superlative economics.

Although previous laser diode driver ICs required a supply voltage of about 5 V to maintain the laser diode's forward bias voltage, this IC adopts a new technique for setting up the output current, and is able to achieve single 3.3-V power supply operation and low power consumption (about 200 mW in shutdown mode). This allows this device to be packaged in a miniature plastic package. Since this device can be DC connected to a wide range of laser diodes, even though it is single 3.3-V power supply device, the output pins output a modulation current with a maximum of 50 mA when VCC is 2 V, and the bias current, which has a maximum of 60 mA, is controlled by the APC circuit. Thus the CXB1549Q can support a wide range of laser diodes in applications such as Gigabit Ethernets and Fibre Channel systems, and can contribute to reduced module power consumption.

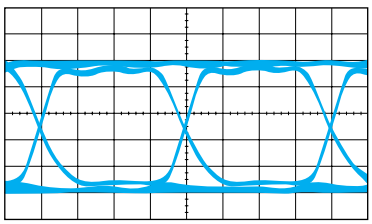


■ Figure 3 CXB1549Q Block Diagram

[Electrical]

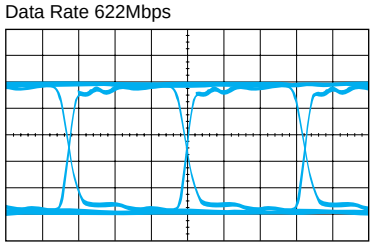
VCC = 0V , VEE = –3.3V , RL = 25Ω , Ta = 27°C
IQ = 30mA , Single input , Pattern = PRBS2^{23}–1

Data Rate 1.25Gbps



Ch.1 :150mV/div, Offset: –300mV
Bandwidth: 20.0GHz
Time Base : 200ps/div

Data Rate 622Mbps

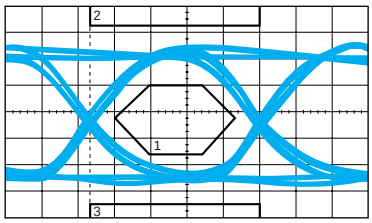


Ch.1:150mV/div, Offset: –300mV
Bandwidth: 20.0GHz
Time Base:500ps/div

[Optical]

VCC = 0V , VEE = –3.3V , FP–LD (λ = 1330nm)
Ta = 27°C , Single Input , Pattern = PRBS2^{23}–1

Data Rate 1.06Gbps
Filter (Cut Off 700Mbps), Mask: FC1063



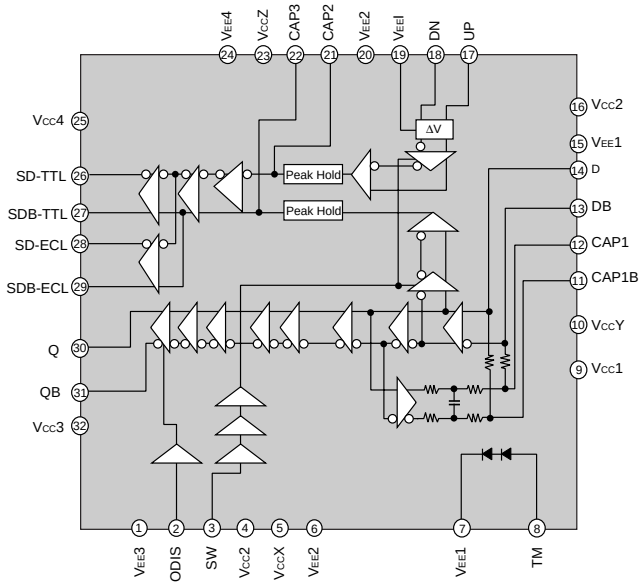
Ch.2 :5.0mV/div, Offset: 12.8mV
Bandwidth: 12.4GHz
Time Base:200ps/div

■ Figure 4 CXB1549Q Output Waveforms

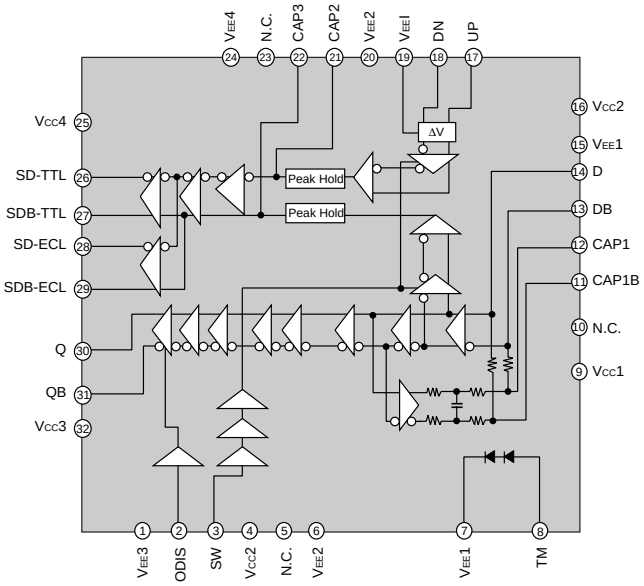
1.25 Gbps Post-Amplifier CXB1573R/CXB1577R

In most systems, “two R” modules are used as the optical communication modules in Gigabit Ethernet and Fibre Channel systems. The CXB1573R and the CXB1577R are ICs that integrate in a single chip the “two R” functions, namely amplification of extremely weak signals (Reshaping) and output of data signals at ECL levels (Regenerating). These ICs provide both an output disable function and a signal detection function (at both ECL and TTL output levels) and can achieve the low power consumption of about 165 mW (CXB1573R at 3.3 V). Thus we were able to package these products in an extremely economical 32-pin miniature plastic molded package with a package size of 7 × 7 mm including leads.

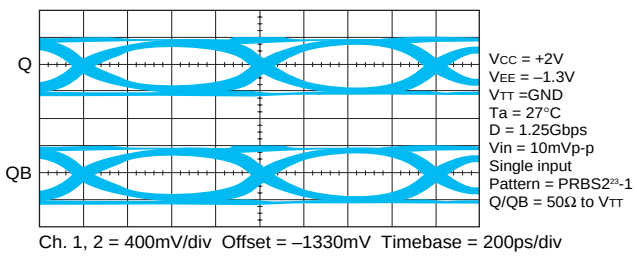
The CXB1573R supports 3.3-V power supply systems and the CXB1577R supports 5-V power supply systems, and the two chips are mutually pin compatible. These ICs support 622 Mbps with the SDG/SONET standard, 531 Mbps or 1.06 Gbps with the Fibre Channel standard, and 1.25 Gbps with the Gigabit Ethernet standard. The main amplifier block, which amplifies weak signals, adopts differential amplifiers in all stages and provides a gain of 60 dB or better. In addition, this IC achieves superlative minimum identification input voltage characteristics due to the adoption of a DC feedback circuit. With a single-ended input, this IC provides the superlative minimum input sensitivity characteristics of 4 mVp-p (@10^{-10} BER, single-ended input). The signal detection circuit includes a hysteresis function to provide stable signal detection. The detection level can be set with an external resistor.



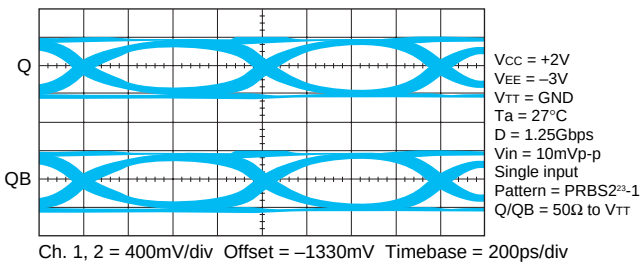
■ Figure 5 CXB1573R Block Diagram



■ Figure 7 CXB1577R Block Diagram



■ Figure 6 CXB1573R Output Waveforms



■ Figure 8 CXB1577R Output Waveforms

Clock and Data Recovery for 155-Mbps Systems CXB1575AQ

The CXB1575AQ is a clock and data recovery IC that conforms to the ITU-T G.958 Type A jitter specifications. Figure 9 shows the block diagram and figure 10 shows the output waveforms. This IC integrates, on a single chip, the "three R" functions used in optical communication, namely Reshaping, Regenerating, and Retiming. The CXB1575AQ can be used in SDH/SONET (STM-1/OC-3) and ATM (155 Mbps) systems. As an option, the chip product version of this IC can also support SONET OC-1 systems. An auto offset canceler circuit is adopted in the post-amplifier, and it can provide the extremely high identification sensitivity of 1.5 mVp-p (single ended) @10^{-10} BER. The CXB1575AQ also includes a built-in signal detection circuit, and can issue a signal interrupted alarm when the signal amplitude becomes smaller than a value set by the user. It is also possible to stop clock and data output in synchronization with the alarm output when this state occurs by using the squelch function.

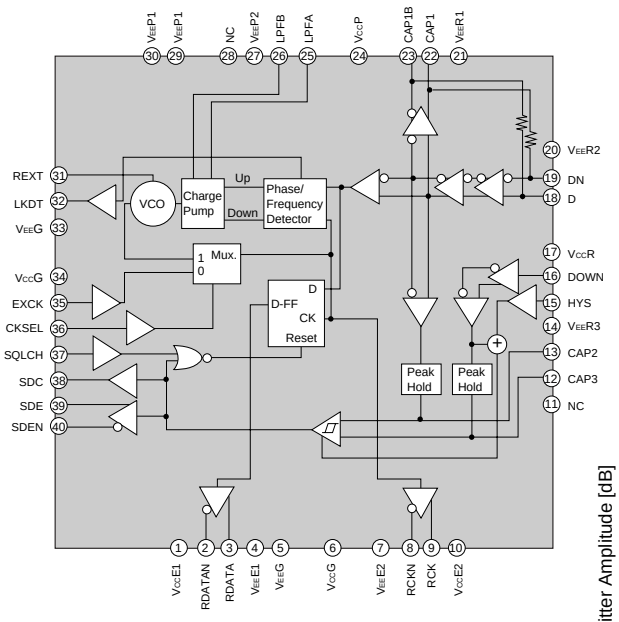
The clock recovery block uses a PLL circuit and achieves lower costs and reduced mounting areas than the earlier CDR circuits that used a SAW filter. Additionally, neither an external reference clock nor a preamble pattern is required.

Although SDH/SONET systems must meet stringent jitter standards, this IC meets all the requirements of the ITU-T G.958 jitter standards. This chip leads the industry in reducing the power-supply voltage to 3.3 V, and as a result can implement this functionality while consuming a mere 300 mW (typical). (See figures 11 and 12.)

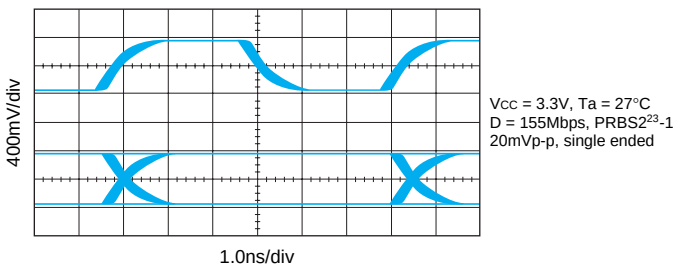
Future Developments

We expect the demand for systems that use optical fiber as their transmission path to increase in proportion to the high speed, high bandwidth, and low noise of that technology due to the expected further expansion of the internet and to demands for increased performance in corporate internal LANs. Furthermore, in the audio and video areas, where Sony is particularly strong, we have already implemented MD and other systems that use optical fiber, and optical fiber is seen as a powerful candidate for connecting and integrating personal computers and other information-processing equipment with audio and video equipment such as DVD, MD, digital cameras, TV, and audio systems.

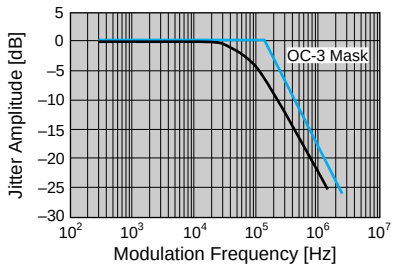
While the most important points will remain high speed, low power, and low cost, Sony, as can be seen from these products, is applying its unique semiconductor process and circuit technologies to the development of reliable gigabit communication ICs using plastic packages and a 3.3-V power-supply voltage. Sony is committed to striving for higher speeds, lower power, and lower cost to contribute to the expansion of the optical communication market.



■ Figure 9 CXB1575AQ Block Diagram

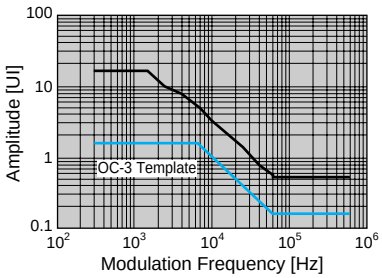


■ Figure 10 CXB1575AQ Output Waveforms



VCC = 3.3V, Ta = 27°C
D = 155Mbps, PRBS2^{23}-1
20mVp-p, Single-ended

■ Figure 11 Jitter Transfer



VCC = 3.3V, Ta = 27°C
D = 155Mbps, PRBS2^{23}-1
20mVp-p, Single-ended
Threshold = 1E–10

■ Figure 12 Jitter Tolerance