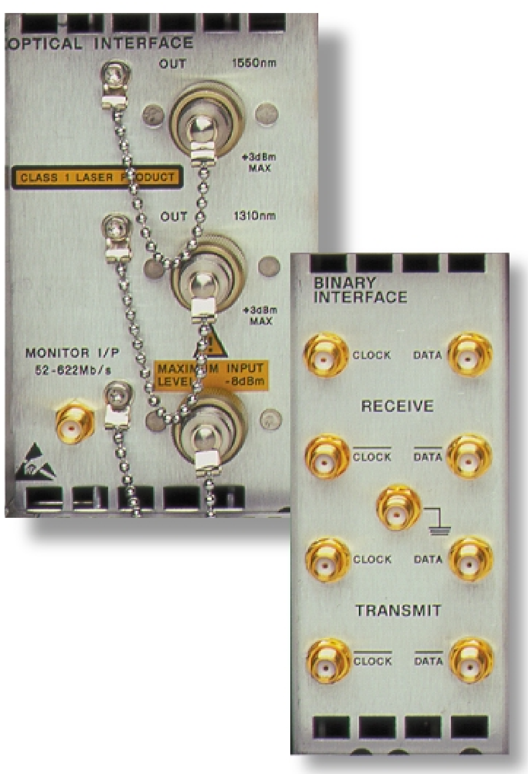
Interfacing the OmniBER 725 communications performance analyzer to optical transceivers

Product note



The optical transceiver industry can be quite confusing. There are a huge variety of components and modules, being built by a range of manufacturers, which all require testing.

To increase throughput and identify faulty components quicker, testing of components is essential. The OmniBER 725 can be used to test all sorts of optical transceivers.

This product note discusses the OmniBER 725 interface capabilities and techniques to overcome problems interfacing to a wide range of components and modules.

Agilent Technologies

Advantages of differential interfaces

Differential interfaces offer superior noise immunity because the devices amplify the difference between the signals. Assuming that any noise is coupled onto both inputs in the same way, then the perceived voltage difference of any noise will always be zero and therefore rejected. As a result, many modern devices have differential inputs.

By offering differential clock and data (inputs and outputs), the OmniBER 725 can test these devices quicker and with greater reliability. Both inputs of a device can be tested at the same time, (rather than having to test each input separately) removing uncertainty in the measurement and the need to reconfigure and reconnect the device to test the other input.

Single ended devices

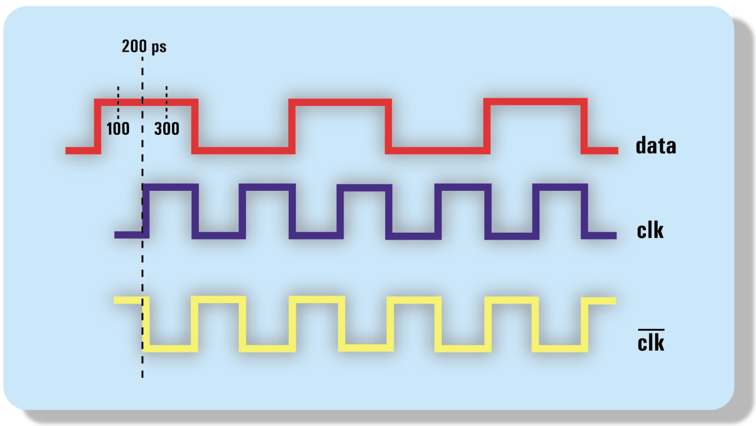
Devices with single inputs can also be tested with the OmniBER 725. With the appropriate termination single ended devices can be tested with either of the differential outputs. SMA 50 ohm terminators, included with the OmniBER 725 (Agilent 0955-1135) should simply be screwed onto the unused inputs and outputs.

Phase shifting

Whatever type of device you are testing—to ensure correct data transfer—it is important to make sure the data and clock are in within tolerable phase. Signals can be out of phase for several reasons, including cables/PCB tracks of different lengths.

Note: Phase tolerance is often referred to as clock and data skew.

The clock period of a 2.5 Gb/s data stream is 400 ps; hence the ideal data signal period is 800 ps. To ensure accurate data transfer the rising edge of the clock signal should be 200 ps +/- 100 ps, after the rising edge of the data signal. If the data is out of phase more than +/-100 ps, data may be lost.



Several methods can be used to bring the clock and data within the phase tolerance limits.

These are
- Inversion of clock/data polarity
- Ensure cables lengths are matched
- Passive adapters
- External phase shift devices

Simply inverting the polarity of clock or data signals may bring the signals within the tolerable skew. If the signals are still outside the phase tolerance limits, it is useful to check that the cable lengths are matched. Where possible, cables should be of equal length. The OmniBER 725 provides the ability to invert clock and data signal.

To help match cable lengths, passive adapters can be attached to the either end of the cables. Small screw-in devices are available from Suhner

- 33 SMA-50-0-1/111 NE (creates 100 ps phase shift at 2.5 GHz)
- 33 SMA-50-0-51/199 NE (creates 50 ps phase shift at 2.5 GHz)

These alter the cable length and hence shift the phase between the clock and the data.

If these techniques are not sufficient to bring the data and clock back within the required phase range, external variable phase shifters may be used. For example use a PDL-10A or PDL-30A from Colby Instruments.

Voltage level shifting

ECL and PECL devices (for example) use voltage references which are different to the OmniBER. These types of devices can still be tested with the help of voltage shifting (bias tee) and terminating devices.

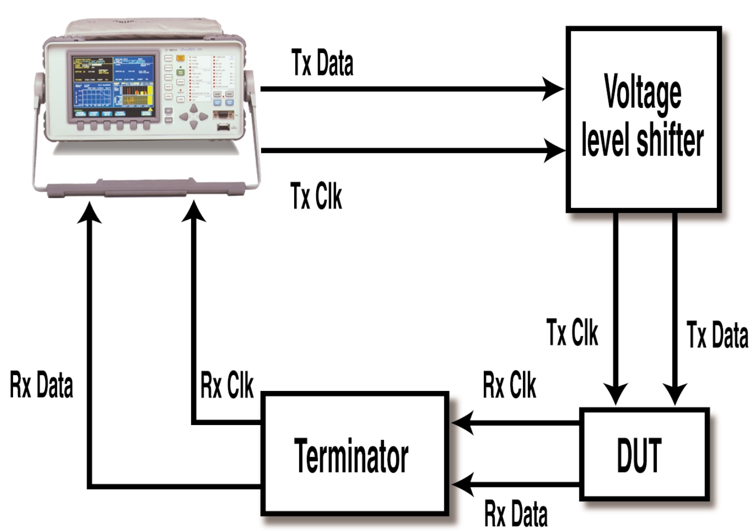
	Voltage reference
OmniBER	0V
ECL devices	-1.3V
PECL devices	+3.7V

Firstly, before applying a voltage to such a device, the output of the OmniBER 725 (referenced at 0V) must be shifted to the reference required by the device under test.

The output from the device under test them needs to be terminated appropriately, before being connected to the OmniBER 725. For example to terminate the output from an ECL device, use an Agilent 10086A.

Agilent 10086A

Voltage level shifting - example set-up



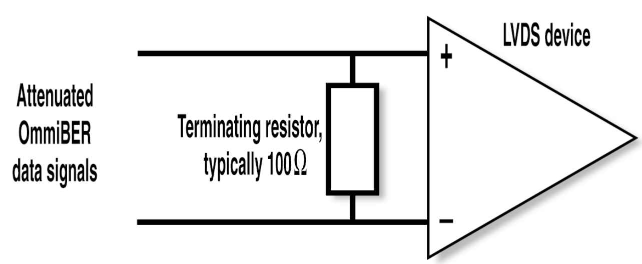
Low voltage differential signaling (LVDS)

Low voltage differential signal (LVDS) is becoming ever more popular for high-speed data transfer. Using a voltage swing of around 300mV, LVDS offers high-speed throughput, low power consumption, noise control and low cost.

To allow equipment utilizing this new technology to be tested, OmniBER output voltage levels need to be reduced. Attentuators (typically 6dB) can be fitted to the outputs of the OmniBER to reduce the voltage range (to 300mV for LVDS). Devices such as the Agilent 8493A/B coaxial connectors can be used to provide the necessary attenuation.

The cables carrying LVDS signals need to be properly terminated to avoid signal reflections. These reflections can cause interference with subsequent signals. Proper termination will also reduce unwanted electromagnetic emissions. A terminating resistor matched to the cable differential impedance should be connected between inputs of the LVDS devices under test. Typically, 100Ω resistors are used.

There may be some instances when a voltage reference of 0V is inappropriate for a LVDS device. In these cases, voltage shifting should be employed as described in the previous section.

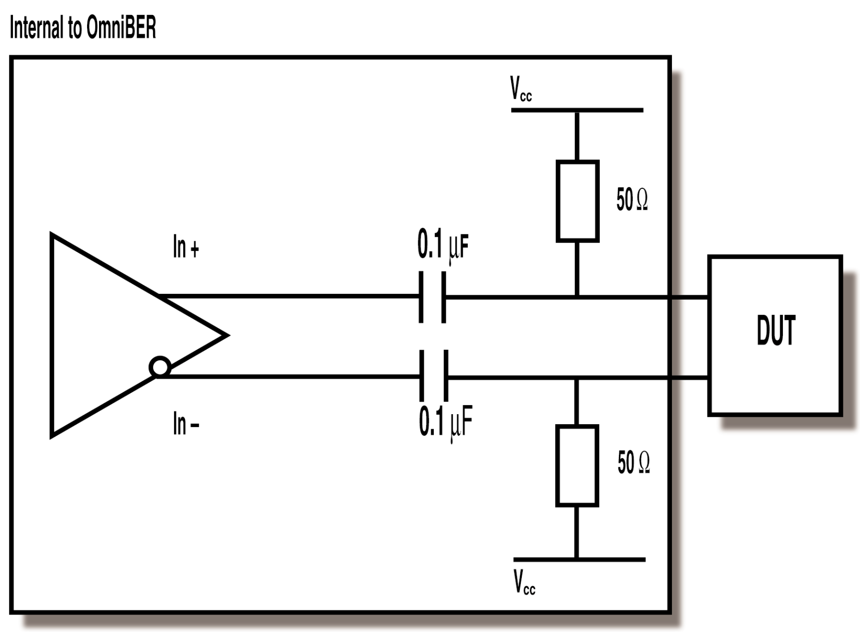


ac coupling

When Transmitters and Receivers are ac coupled, dc voltages will be rejected i.e. the number of consecutive 1s and 0s is limited.

A 'blocking' capacitor, which will only allow ac voltages is the basis of ac coupling. The capacitor will charge and discharge respectively as 1s and 0s are transmitted/received. After the first few similar bits the capacitor will drift to a fully charged state and block any further similar bits, hence dc voltages.

Often to reduce the hazards of power supply shorting, electrical shock or damage to circuits when testing components, external resistors and capacitors are required for protection. To simplify test configurations the OmniBER 725 not only has ac coupling but also built-in resistors, removing the need for such extra hardware in a test set-up.



In summary – OmniBER 725 interfaces

Techniques described in this solution note allow the OmniBER 725 to test a wide range of component and module types.

Differential interfaces are provided offering testing less sensitive to ESD and EMC, with increased signal to noise ratio for today's modern differential input devices. This doesn't stop you testing single ended devices with the OmniBER 725. With the correct termination, single ended devices can be tested just as easily and quickly.

Clock polarity inversion helps combat unwanted phase shifting. The OmniBER 725 has the capability to invert clock or data signals individually, or both at the same time. This polarity inversion capability allows you to obtain the correct phase relationship, or alter the polarity of a signal as necessary for testing.

If clock inversion is not enough to bring the phase of the data pulse and the clock pulse within the tolerable skew, it is important to check the length of any cables are matched within a test jig. Differences in length can be combated by screwing passive adapters onto the end of cables, which will alter phase by 50 or 100ps. Alternatively, external phase shift devices can be used.

Devices with different voltage references requirements such as ECL and PECL can be tested with the OmniBER 725, by shifting the output voltage and being careful to terminate the output signals from the device before feeding back into the OmniBER 725.

Another new technology (becoming more popular for it's low noise, low power characteristics) is LVDS. By attenuating the output of OmniBER 725, LVDS devices can be tested. It is important to terminate the cables properly, to avoid problems such as signal reflection and EMC, using a resistor fitted between the device inputs.

These solutions all help the OmniBER 725 to be as flexible as today's optical and electrical devices are varied.

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Agilent Technologies manufactures the OmniBER 725 communications performance analyzer under a quality system approved to the international standard ISO 9001 plus TickIT (BSI Registration Certificate No FM 10987).

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