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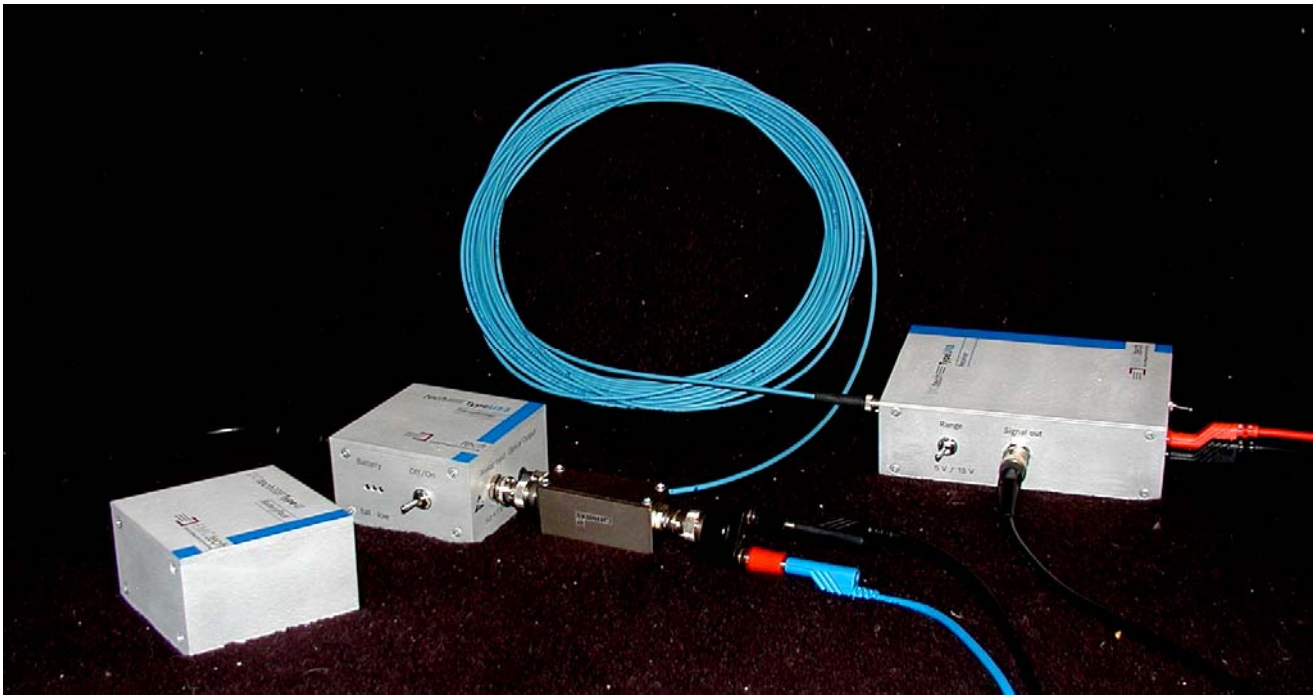
Digital optical transmission system DOtech Type U53: Operating instructions



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Use and principle of transmission

The measuring system is designed for non-reactive optical and digital transmission of analogue signals with a resolution of 8 bit and a maximum bandwidth of 10 MHz. It consists of a transmitter with a separate battery supply, of a low pass filter with combined divider for the signals to be measured; a 62.5/125µm multimode optical fiber and a receiver unit. The system is used in harsh electromagnetic environments like during susceptibility tests in EMC anechoic chambers, in TEM cells or striplines. It is immune against electromagnetic fields of high intensity above the specified transmission bandwidth.
The signal to be measured is filtered, sampled, digitized and transmitted via a broadband optical fibre link to the receiver circuit.
There, the digital data is reconverted into an analogue signal and is available at the signal output for evaluation through a load of high impedance like a digital oscilloscope. Figure 1 shows the measuring principle of the digital optical transmission system DOtech Type U53.

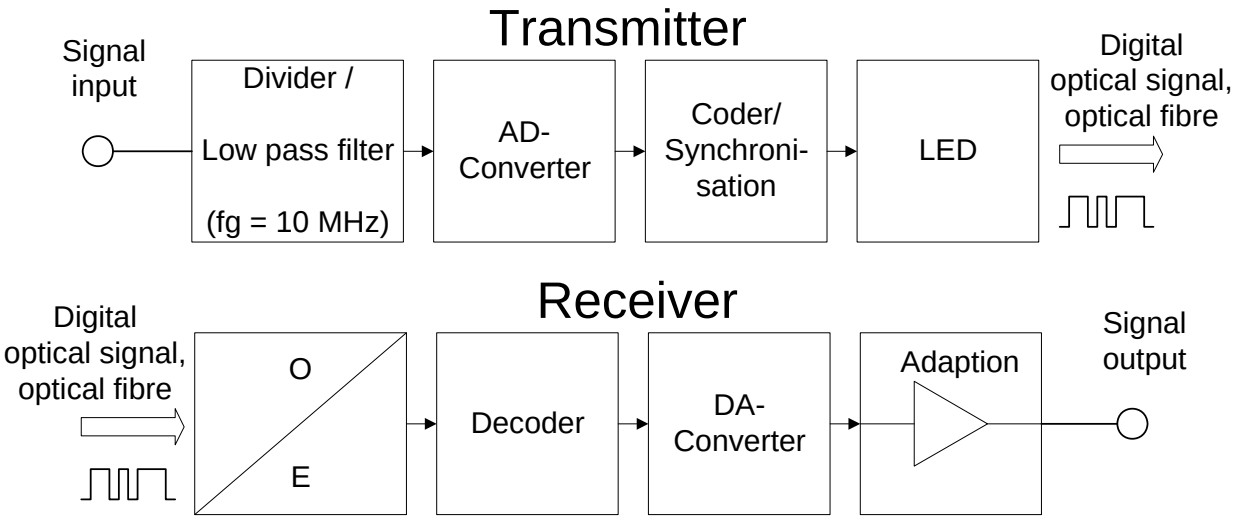

Figure 1: Measuring principle of the digital optical transmission system DOtech Type U53

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Structure and operation of the measuring system

With the high-speed transmission system DOtech Type U53, you purchased a high-grade and sensitive measuring system. By all means, pay attention to the following installation and operating instructions to avoid damage of the device(s).

Transmitter and receiver have to be installed in switched off state. During installation, no measuring signal should be connected to the transmitter.

To measure as accurately and precisely as possible, switch on the receiver and the transmitter at least 10 minutes before starting the measurement.

Because of the high current consumption of both the transmitter and the receiver during operation, the chassis can reach temperatures beyond 60°C. This should be taken into account when touching the receiver and the transmitter chassis!!

The power supply of the receiver has to be a potential free DC power supply. The ground of the analogue output signal and the supply ground of the receiver must never be connected together under any circumstances! The DC supply voltage of the receiver unit has to stay within the range 12 V to 13 V.

The maximum input voltages of the transmitter shown in the tables below must not be exceeded, in any case.

The transmitter has to be connected to the delivered battery pack and this battery pack and the designated coaxial cable should be used solely for that purpose. Be careful connecting the battery pack to the transmitter. The BNC-connector for the battery supply must not be exchanged with the BNC-connector of the analogue input signal.

Transmitter and receiver are connected to each other with an optical fibre of high bandwidth (62.5/125µm or 100/140µm fibre). For the measurement, the suitable divider/filter (compare table, page 11) has to be used at the input of the transmitter.

Be careful connecting the optical fibre to the mechanical sensitive optical transmitter and receiver units.

To start signal transmission, the receiver has to be switched on first. The suitable amplitude range has to be adjusted (compare table, page 11). In case the transmitter is not connected, switched off, or the trans-

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mitter supply voltage is low (voltage of the battery pack low), an undefined digital bit sequence appears at the receiver output. If the transmitter is switched on, the receiver is initialized and shows 0V with a not connected measuring signal. The following figures show the whole transmission system and its interconnections.

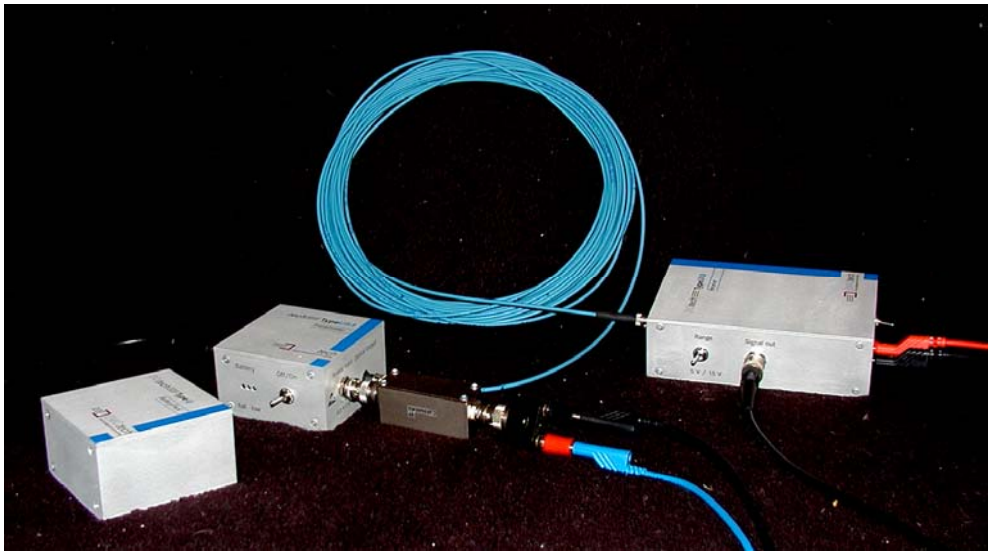

Figure 2: The complete digital optical transmission system DOtech Type U53

Figure 3: Transmitter unit

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Figure 4: Receiver unit

Figure 5: Low pass filter with integrated divider

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The operation- and display elements of the transmitter

Transmitter: Information and operating elements

Figure 6a: Transmitter view 1

Figure 6b: Transmitter view 2

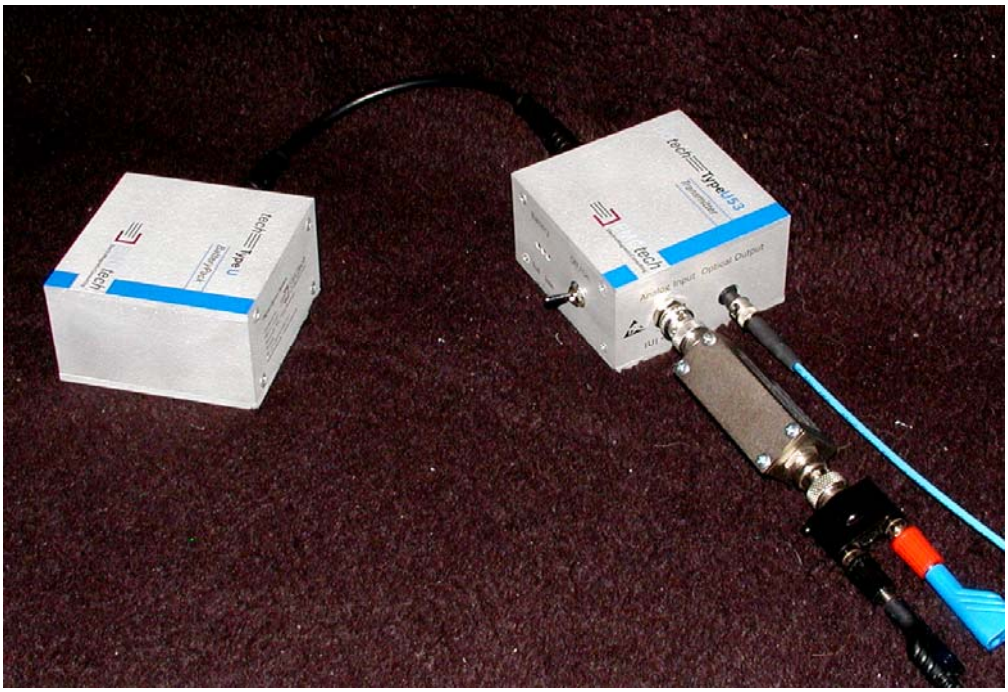

Figure 7: Connection of the transmitter to battery pack, optical fibre and low pass filter/divider

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The operation- and display elements of the transmitter unit (compare figure 6a, 6b and 7)

- ST-connector for multimode fibre (optical output)
- BNC-connector for the coaxial cable connecting the battery pack
- BNC-connector for the measuring signal/ low pass filter/divider
- Three LEDs to display the status of the battery pack. If only one or no LED is glowing, the battery pack has to be recharged
- Main switch

To begin with, the optical fibre and the battery pack have to be connected to the unit. The original battery pack has to be used solely. After switching on the transmitter, it must be connected to the suitable filter/divider (compare table, page 11) carrying the signal to be measured. The NiMH-battery pack should only be charged with the charger delivered.

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The operation- and display elements of the receiver

Receiver: Information and operating elements

Figure 8a: Front view of the receiver

Figure 8b: Backside view of the receiver

Figure 8c: Side 1

Figure 8d: Side 2

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Connection and operating elements of the receiver unit (compare figure 8a, 8b, 8c and 8d)

- ST-connector for multimode optical fibre (optical input)
- BNC-connector for the output
- Standard sockets for the battery supply
- Main switch with LED control
- Switch to select the output voltage range: 5 V or 15 V

Please make use of the proper measuring range as stated on the given table on page 11. The output can only be operated at a load of high impedance (R > 10 kΩ). In any case, the output must not be short circuited, because the receiver is not permanently short circuit proof.

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Adjustment of the measuring range, accuracy and test methods

The following table shows the adjustments to be used for the receiver and transmitter in different amplitude ranges, and handling references.

Structure	**Maximum permissible voltage at the input of the measuring divider**	**Maximum permissible voltage input at the transmitter's analogue input**	**Position of the receiver's measuring range/ Transmission factor U_{in}/U_{out}**	**Resolution/ Bit**	**Remark/ Handling references**
Coaxial filter with divider (1:1) and transmitter	|U| <= 1 V, bipolar	|U| < 1 V	5V/ 5:1	7.8 mV, converting to 1:1	Transmitter might be damaged for constant voltages exceeding |U| > 2 V at the divider's input
Coaxial filter with divider (1:5) and transmitter	|U| <= 5 V, bipolar	|U| < 1 V	5V/ 1:1	39 mV	Transmitter might be damaged for constant voltages exceeding |U| > 10 V at the divider's input
Coaxial filter with divider (1:15) and transmitter	|U| <= 15 V bipolar	|U| < 1 V	15V/ 1:1	117 mV	Transmitter might be damaged for constant voltages exceeding |U| > 30 V at the divider's input
Coaxial filter with divider (1:30) and transmitter	|U| <= 30 V, bipolar	|U| < 1 V	15V/ 1:2	234 mV	Transmitter might be damaged for constant voltages exceeding |U| > 60 V at the divider's input
Coaxial filter with divider (1:100) and transmitter (additional option)	|U| <=100 V, bipolar	|U| < 1 V	5V/ 1:20	781 mV, converting to 1:1	Transmitter might be damaged for constant voltages exceeding |U| > 200 V at the divider's input, constant voltages over 100 V should be avoided absolutely!

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Please take absolute attention on the following:

- ESD-immunity: because of the high transmission bandwidth of the transmitter, no protection with clamping diode circuits is possible. For this reason, take extra care of the transmitter's analogue-input and of the receiver's analogue output.
- The receiver is not permanently short-circuit proof. Therefore it can only be operated at a load of high impedance (R > 10 kΩ).
- The receiver's analogue ground is not allowed to be connected with the ground of the receiver's supply (U-)!
- The transmitter is not allowed to be used without coaxial filter/divider.
- Any other battery supply for the transmitter aside from the battery pack provided must be avoided!
- The receiver has to be operated with an external potential-free DC-power supply (U- <> ground signal!) with a voltage range between 12 V and 13 V.
- Exceeding the maximum permissible voltage on the analogue input of the transmitter must be avoided.. Permanent voltages |U| > 2V at the input (without divider) may cause damage of the transmitter.
- Verifying the voltage of the battery pack during charging is inevitable. The charger has to be removed at least after a charging time of seven hours, and the voltage of the battery pack has to be controlled after removing. The final charging voltage of the battery pack should exceed 6.7 V.
- The ground connection of the divider is galvanically connected to the ground of the transmitter's chassis.

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Example of a measuring range

Peak value of the voltage to be measured: 14V
Connect divider 1:15 to the transmitter (voltage |U| at the transmitter input < 1 V), switch amplitude measuring range of the receiver to 15 V, then the voltage to be measured is directly available at the receiver's output

Transmission accuracy under the influence of electromagnetic fields and test methods

To verify the immunity of the system against electromagnetic fields, the transmitter was tested under a stripline (1 MHz – 400 MHz) and with an antenna test set-up according to DIN ISO 11452-2 (200 – 1000 MHz).
At the transmitter's input, a 1.5 m and a 2 m long line were connected and the setup was tested both with isolated chassis and a chassis connected to the ground plane (stripline according to DIN ISO 40839). For the antenna measurements, equivalent field strength values were used (peak values are presented at the diagram below). Both horizontal and vertical polarization was used for antenna tests. Beside pure CW-signals, AM-signals with a modulation frequency of 50 Hz and 1 kHz (modulation degree m = 80 %) and GMSK-pulses were utilized. The peak value of the electric field strength $\hat{E}$ was at least 500 V/m within the whole frequency range and for all tests.
Aside from those tests, a high frequency current of 300 mA was injected by means of the BCI-closed-loop-method at different injection points. The worst case estimation of all measurements is shown at the following diagrams.

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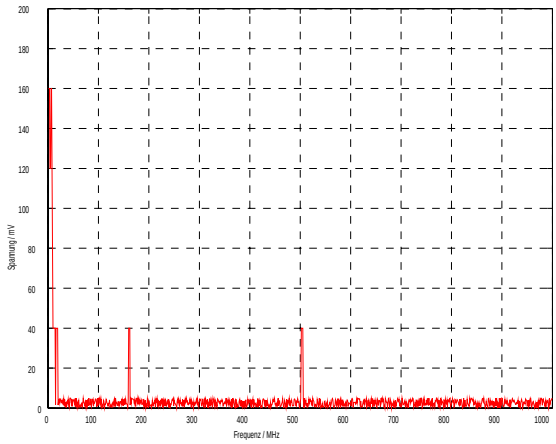

Figure 10a: Deviation of the received signal from the original signal to be measured caused by electromagnetic fields

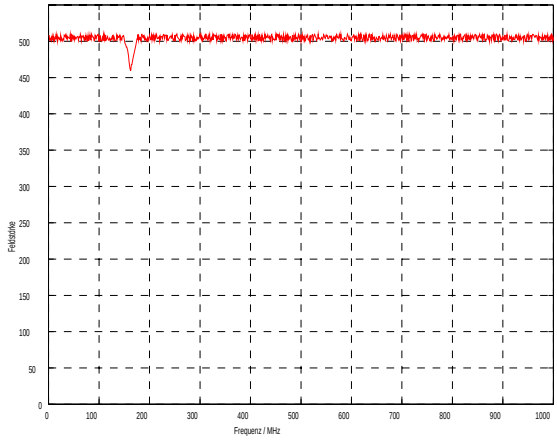

Figure 10b: Electrical field strength (peak value E_{peak}) used for the tests

The maximum deviation of the original signal from the received measuring signal is, for all measurements and over the whole frequency range, 40 mV (for frequencies > 60 MHz, measuring range 5V), which corresponds to one single-bit.

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Battery pack / charging

A battery pack is provided with the transmitter. To connect battery pack and transmitter, use only the suitable coaxial cable provided. The battery pack has to be charged with the charger ACS410. The charging process must be terminated at least after seven hours. The battery pack allows an operating time of the system of at least 4 hours. If only one or none of the display LEDs is glowing, the battery pack has to be recharged. Figure 11 demonstrates the connection of the battery pack to the transmitter.

Figure 11a: Battery pack

Figure 11b: Connection of the battery pack to the transmitter