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## Communication Engineering

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### Radio Engineering

4070                Radio Board

### Communications

4280                Modulation Board

4281                Demodulation Board

### Transmission Technology

4282                Transmitter Board

4283                Receiver Board

4284                Coaxial Board

### Module System

4075                Filter and Oscillator Circuits

### Fibre Optics Training System

4290                Transmitter Board

4291                Receiver Board

4290.70            Laser Module

4185                Optical Bench

### Analog Modulation Technology

4250                Phase-Locked-Loop (PLL)

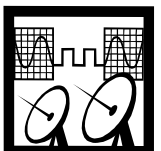
### Digital Technology

3855                Interface Training Board

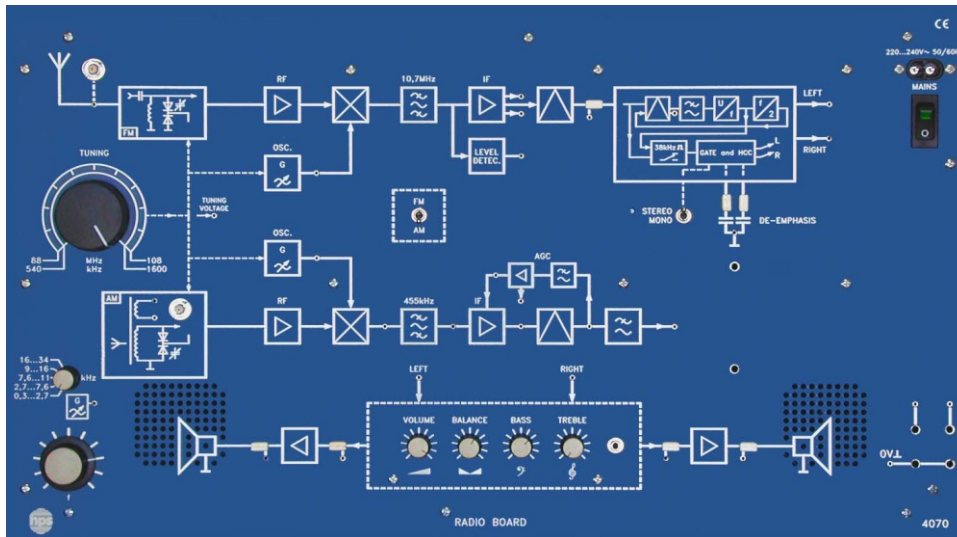
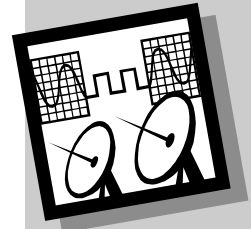
### Software

009034EVDE      COMwin

009038EVDE      LPTwin







**RADIO BOARD**

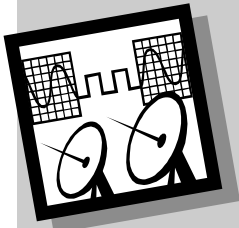
Type 4070

Front view of the  
RADIO BOARD

- Complete radio trainer in one Board
- All the important signals tappable at measuring points
- With built-in AM and FM tuner
- With stereo decoder and integrated loudspeakers
- With built-in sinewave generator
- Also available in the handy hps box
- Plug-in field for FM/AM Transmitter (Type 4070.2)

### Possible experiments with the RADIO BOARD

- Experiment with the Tone Control
- Experiments with the AM
  - Generation of an AM Signal with the FM/AM Transmitter
  - Measuring the AM Antenna Signal
  - Determination of the Oscillator Frequency
  - Measurements at the AM Mixer
  - Measurements at the IF Stage and at the Demodulator
  - Automatic Gain Control AGC
- Experiments with the FM
  - Measuring the Adjustable Oscillator Frequency
  - Measurements in the IF Stage
  - Measuring at the Demodulator Output with Mono Reception
  - Measuring at the Demodulator Output at Stereo Reception
  - Measurements in the Stereo Decoder
  - Behaviour with and without DE-Emphasis



## RADIO BOARD

Type 4070

### Accessories Recommended

- Set of Accessories (Type 4070.1), consisting of connecting leads (2 mm) and plugs (2 mm)
- FM/AM Transmitter (Type 4070.2)

### FM / AM Transmitter (Type 4070.2)



The „FM/AM Transmitter“ is a module for generation of a FM and AM signal.

#### Technical data

- Modulation input:  
 $U_{e\ ss} = 700\text{ mV}$
- Modulation output:  
AM signal: carrier 1 MHz  
FM signal: carrier 100 MHz
- Supply voltage: 9 V DC
- Dimensions / weights  
75 x 56 x 35 mm (w x h x d);  
weight: approx. 0.1 kg

Subject to technical modifications.

## Communications / Radio Engineering

### Technical Data

#### Mains connection

- Mains voltage:  
230 V AC / 115 V AC (110 V AC); 50 ... 60 Hz; 10 VA

#### AM unit

- Ferrite antenna at the input circuit
- Frequency range: 540 ... 1600 kHz, tunable by LC input circuit, consisting of capacitance diodes
- HF amplifier
- Oscillator for generating the IF frequency by means of a mixer, oscillator frequency: approx. 900 Hz ... 2 MHz
- IF circuit with filter (455 kHz), IF amplifier and AGC

#### FM unit

- Antenna input for throw antenna
- Input circuit with LC element, tunable with capacitance diodes
- Frequency range: 88 ... 108 MHz
- HF amplifier
- Oscillator for generating the IF frequency by means of a mixer
- IF amplifier with level detector output
- Demodulator for generating the MPX signal
- PLL demodulator with mono/stereo switching and deemphasis inputs

#### Sound adjuster

- 2 inputs: right channel / left channel
- Adjustable: volume, treble, bass and balance

#### 2 AF amplifiers

- Output power: 3 W

#### Sinewave generator

- 5 frequency ranges: 300 Hz ... 34 kHz, stepless adjustable
- Output voltage:  $U_{pp} = 500\text{ mV}$

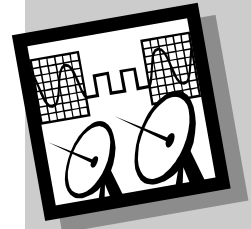
#### Mechanical data

The front panel of the RADIO BOARD is made of 5 mm thick Laminate, matt blue in colour with white engraving representing the built-in function groups. The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table. The RADIO BOARD can be converted into a portable training unit by simply screwing it into a Box: All the experiments can be conducted directly in the Box. Dust-free storage and protection against transport damages are further advantages of the Box version.

#### Dimensions and weights

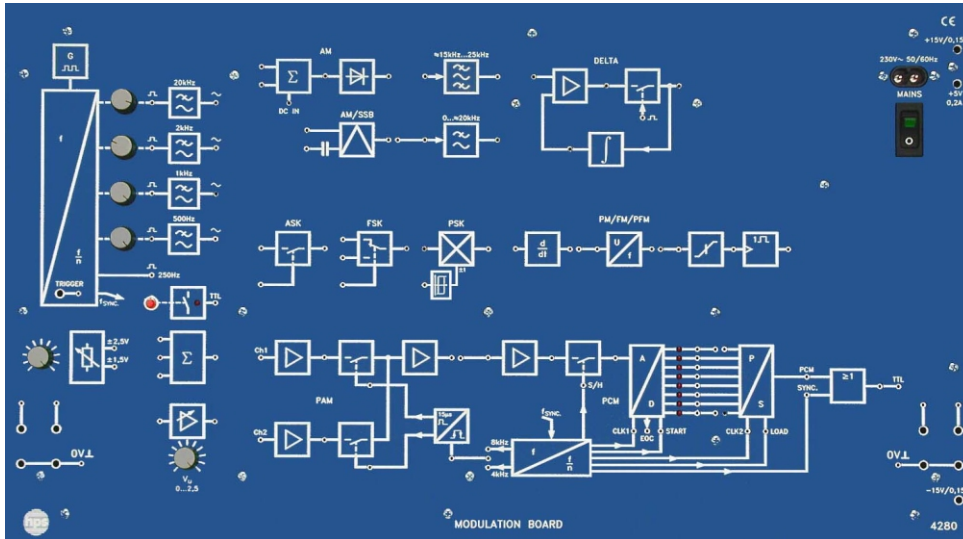
- RADIO BOARD (Type 4070):  
532 x 297 x 110 mm (w x h x d); weight: 3.2 kg
- Box version, consisting of:  
RADIO BOARD (Type 4070) and Box (Type 4070.20):  
580 x 450 x 155 mm; total weight: 6.4 kg

## Communications



### MODULATION BOARD

Type 4280



Front view of the MODULATION BOARD

- All the important modulations on one Board
- Experiment setup time reduced to a minimum
- Built-in signal source (short-circuit-proof)
- Integrated clock generator with synchronised carrier and modulation  
Frequencies to provide static oscilloscope images
- Expandable with the DEMODULATION BOARD

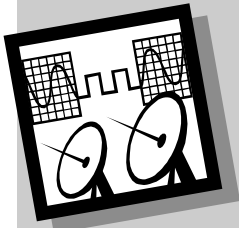
With the MODULATION BOARD, hps SystemTechnik offers a training and demonstration system for the major analog and digital modulation techniques. Its use in the whole field of communications technology begins with simple modulation techniques and extends to PAM / PCM technology.

The following modulation techniques can be studied with the MODULATION BOARD:

- Amplitude Modulation (AM)
- Single Sideband Modulation (SSB)
- Frequency Modulation (FM)
- Phase Modulation (PM)
- Pulse Amplitude Modulation (PAM)
- Pulse Code Modulation (PCM)
- Pulse Frequency Modulation (PFM)
- Pulse Phase Modulation (PPM)
- Delta Modulation (DM)
- Amplitude Shift Keying (ASK)
- Frequency Shift Keying (FSK)
- Phase Shift Keying (PSK)

The Board is divided into two sections. The first section contains the following function groups:

- Clock generator (quartz-controlled) with frequency dividers for generating the carrier and modulation signals. The signals are therefore in synch and enable „frozen“ images to be displayed with the oscilloscope. They can be tapped as squarewave and sinewave signals and can be altered in amplitude. The clock generator also supplies a trigger signal, a switching signal for the delta modulator and a synchronised signal for the process control of the PCM modulator.
- Signal button, for simple examination of the digital modulation techniques, with electronic debounce and optical indication by an LED.
- DC voltage source, adjustable, for generating static, analog modulation signals.



## MODULATION BOARD

### Type 4280

- Summer, for adding up to 3 signals.
- Amplifier, variable gain, for matching external modulation signals such as from the microphone for example.

The second section of the MODULATION BOARD contains the modulators with all the necessary measuring points.

The MODULATION BOARD has a built-in power supply unit for the internal power supply. The  $\pm 15$  V and 5 V operating voltages for external devices can be tapped at additional jacks.

To conduct the experiments, the MODULATION BOARD is placed on a table or suspended in an hps rack for demonstration purposes.

## Communications

The MODULATION BOARD can be converted into a portable training unit by simply screwing it into a Box (Type 4280.20):

All the experiments can be conducted directly in the Box. Dust-free storage and protection against transport damages are further advantages of the Box version.

### Accessories Recommended

- Set of Accessories (Type 4280.1), consisting of connecting plugs and leads
- DEMODULATION BOARD (Type 4281)
- TRANSMITTER BOARD (Type 4282)
- RECEIVER BOARD (Type 4283)
- Experiment manual: „Modulation Techniques – Modulators“ (Type V 0130)

Subject to technical modifications.

## Technical Data

### Mains connection

- Voltage: 230 V AC / 115 V AC (110 V); 50...60 Hz; 50 VA

### DC voltage output (Short-circuit-proof)

- $\pm 15$  V / 0.15 A ; +5 V / 0.2 A;  
for connecting external devices

### Signal source

- Sinewave:  $U_{pp}$  5 V;  $f = 0.5 / 1 / 2 / 20$  kHz
- Squarewave:  $U_p$  5 V;  $f = 0.25 / 0.5 / 1 / 2 / 20$  kHz
- Trigger signal: 250 Hz

### Summer

- With three inputs, short-circuit-proof output

### DC voltage, adjustable

- 0 ... approx.  $\pm 2.5$  V
- 0 ... approx.  $\pm 1.5$  V

### Signal button

- With TTL output

### Amplifier, variable gain

- $V_u$  0 ... 2.5

### PAM / PCM

- Two channels
- AD converter; 8 bits with LED indicator. Bits  $2^0$  and  $2^7$  can be switched off.
- Frame frequency: approx. 16 kHz
- Sampling frequency: approx. 8 kHz

### AM

- $U_{in PP}$  5 V
- Bandpass: 15 ... 25 kHz / Low pass: 0 ... 20 kHz

### FM / PM / PFM

- $f_o = 20$  kHz /  $f_n = DC$  ... 3.4 kHz

### Adapter field

- Serves for adapting 4 mm to 2 mm connections and for plugging two adapters (BNC socket two 4 mm connectors)

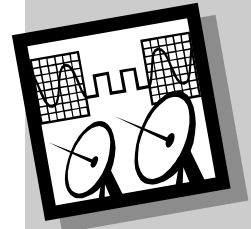
### Mechanical data

- The front panel of the MODULATION BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups. The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

### Dimensions and weights

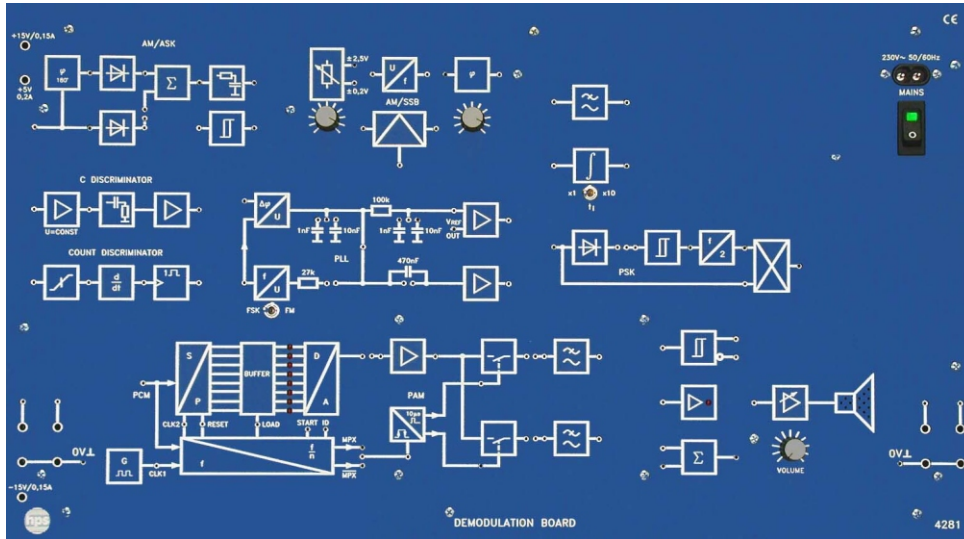
- Board version (Type 4280): 532 x 297 x 90 mm (w x h x d); weight: 3.6 kg
- Box version (Type 4280 and Type 4280.20): 580 x 450 x 155 mm; Weight: 6.8 kg

## Communications



### DEMODULATION BOARD

Type 4281



Front view of the DEMODULATION BOARD

- All the important demodulators on one Board
- For extending the range of experiments in connection with the MODULATION BOARD (Type 4280)
- Reduces experiment setup times to a minimum
- Built-in power supply (short-circuit-proof)
- Additional output jacks for power supply to other units

With the DEMODULATION BOARD, hps offers a training and demonstration system for extending the range of experiments in connection with the MODULATION BOARD (Type 4280).

All output signals of the MODULATION BOARD can be demodulated with the DEMODULATION BOARD.

Its application in the field of communications engineering begins with simple modulation techniques and extends

right up to PAM/PCM technology.

With the DEMODULATION BOARD the following modulation modes can be demodulated:

- **AM / SSB**  
Demodulation with envelope demodulator, coherent demodulation
- **FM**  
Demodulation with PLL, counting discriminator and C-discriminator

- **PM**  
Demodulation with FM demodulators and series-circuited integrator
- **PAM**  
Demodulation with dual channel demultiplexer
- **PCM**  
PCM demodulator
- **PFM**  
Demodulation with low pass
- **DM**  
Demodulation with integrator

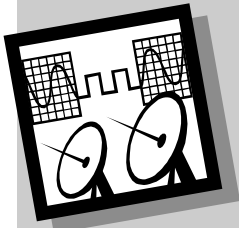
- **PSK**  
Demodulation with reference phase
- **FSK**  
Demodulation with PLL loop and Schmitt trigger
- **ASK**  
Demodulation with AM demodulators and series-circuited Schmitt trigger

The DEMODULATION BOARD contains a built-in power supply unit for internal power supply and is therefore electrically isolated from the MODULATION BOARD.

+/-15 V and +5 V can be tapped off at 4 mm jacks for supplying power to additionally connectable transmission paths and sources of interference between the modulator and the demodulator.

An audio frequency amplifier with loudspeaker is integrated in the Board for acoustic checking of the demodulated signals.





## DEMODULATION BOARD

Type 4281

To conduct the experiments, the DEMODULATION BOARD is placed on a table or suspended in an hps rack for demonstration purposes.

The DEMODULATION BOARD can be converted into a portable training unit by simply screwing it into a Box (Type 4281.20): All the experiments can be conducted directly in the Box. Dust-free storage and protection against transport damages are further advantages of the Box version.

### Mechanical Data

The front panel of the DEMODULATION BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups. The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

Subject to technical modifications.

## Communications

### Accessories Recommended

- Set of Accessories (Type 4280.1), consisting of connecting plugs and leads
- MODULATION BOARD (Type 4280)
- TRANSMITTER BOARD (Type 4282)
- RECEIVER BOARD (Type 4283)
- Experiment manual: „Demodulation Techniques – Demodulators“ (Type V 0131)

### Technical Data

#### Mains connection

- Voltage: 230 V AC / 115 V AC (110 V); 50 VA; 50 Hz ... 60 Hz

#### DC voltage output (short-circuit-proof)

- $\pm 15$  V / 0.15 A ;  $\pm 5$  V / 0.2 A;  
for connecting external devices

#### AM / ASK

- Half-wave and full-wave rectifiers, switchable, with additional RC wiring.  
A low pass can also be used alternatively to the RC wiring.

#### AM / SSB / PSK

- Coherent demodulation by multiplier
- Generator for carrier generation, adjustable frequency
- Phase shifter, adjustable

#### FM / PM / FSK

- Counting discriminator
- C-discriminator with constant voltage source

#### PAM / PCM

- Two channels
- DA converter, 8 bits with LED display
- Buffer memory
- Frame frequency: approx. 16 kHz
- Sampling frequency of the PAM: approx. 8 kHz,  
can be replugged to 4 kHz to prove the sampling theorem.
- The control signal for the demultiplexer can be inverted;  
this makes it possible to switch over the two channels.

#### PLL

- For demodulation of the FM and FSK

#### Integrator

- For phase modulation (PM) and delta modulation (DM)

#### Schmitt trigger

- For recovery of the digital signals in ASK, FSK and PSK

#### Low pass filter

- Bandwidth:  $f_g = 3.4$  kHz

#### Adapter field

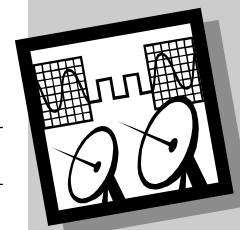
- Serves for adapting 4 mm to 2 mm connections and for plugging two adapters (BNC socket two 4 mm connectors)

#### Dimensions and weights

- Board version (Type 4281):  
532 x 297 x 90 mm (w x h x d); weight: 3.6 kg
- Box version (Type 4281 and Type 4281.20):  
580 x 450 x 155 mm; weight: 6.8 kg

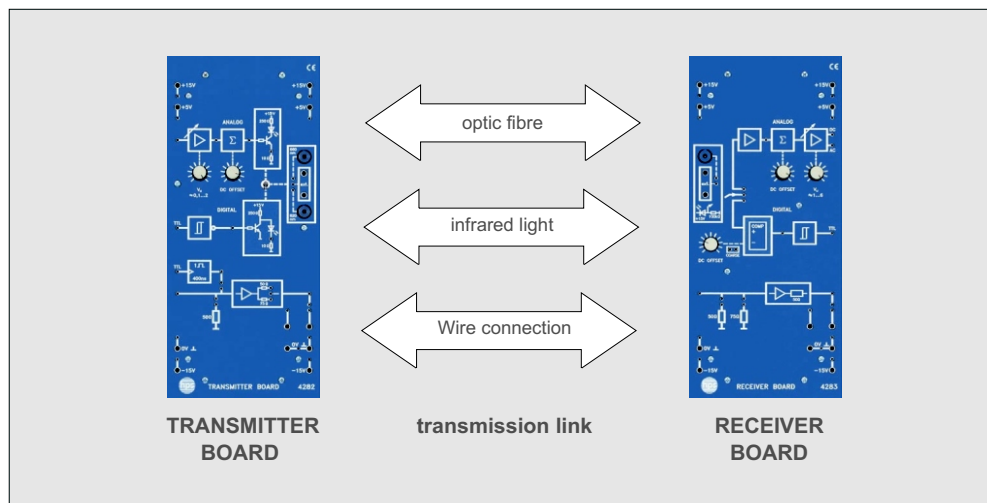


## Communications – Transmission Technology



### TRANSMITTER / RECEIVER BOARD

Type 4282 / 4283



- Universal training system for the transmission of signals with optical fibres, infrared link or connection line
- Can be used with the MODULATION BOARD and the DEMODULATION BOARD, as well as with other hps training systems
- Also very suitable to perform experiments with usual commercial generators and measuring instruments
- With analog and digital channel suitable for all fundamental experiments of the fibre optics technology
- With two built-in transmit diodes of different wavelengths
- Two amplifiers and different terminating resistors allow experiments with coaxial lines
- Can be extended with an Optical Bench and with the COAXIAL BOARD

The two Demonstration Boards

- **TRANSMITTER BOARD**
- **RECEIVER BOARD**

have been developed by hps SystemTechnik for experiments in transmission technology.

They allow to verify the differences between a signal transmission with optical

fibres, with an infrared link and with normal lines.

In detail the following experiments can be made:

- Setting of the operating point of transmit diodes
- Characteristics of transmit diodes
- Attenuation measuring of optical fibres of different length

- Sensibility to interference of different transmission links

- Transmission of TTL signals through optical fibres

Additional experiments

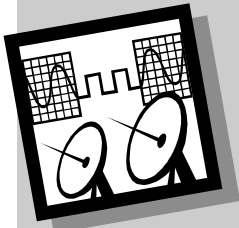
- With the Optical Bench
- Infrared transmission
- Transmission with lines, e. g. with the COAXIAL BOARD

### Function groups of the TRANSMITTER BOARD

- Analog amplifier for fibre optic transmission, with adjustable gain and setting of the operating point
- TTL channel with Schmitt trigger and matching circuit for the transmit diode
- 1 transmit diode, red
- 1 transmit diode, infrared
- Transmission field for additional transmit diode
- Line driver with different, additionally connectable output resistors

### Function groups of the RECEIVER BOARD

- Fibre optic receive diode, fixed
- Reception field for additional receive diode
- Analog amplifier, DC offset and gain adjustable
- TTL channel, composed of a comparator with adjustable operating threshold and subsequent Schmitt trigger
- Amplifier with additionally connectable input resistors



## TRANSMITTER / RECEIVER BOARD

Type 4282 / 4283

### Mechanical Data

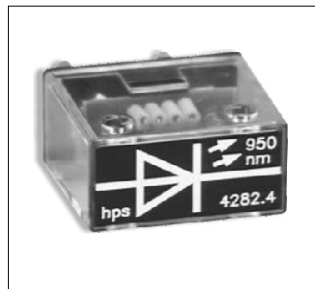
The front panel of the Boards is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups. The rear of the Boards is protected with a grey plastic cover. Its shape allows the Boards to be placed at an ergonomically favourable angle for example on a table.

To conduct the experiments, the TRANSMITTER BOARD and the RECEIVER BOARD are placed on a table or suspended in an hps rack for demonstration purposes.

### Accessories Recommended

- MODULATION BOARD (Type 4280)
- DEMODULATION BOARD (Type 4281)
- COAXIAL BOARD (Type 4284)

- Plastic Fibres of different lengths without plug:  
0.5 m (Type 4282.20)  
5 m (Type 4282.21)  
20 m (Type 4282.23)
- Optical Bench (Type 4185) with two Plastic Fibres (Type 4282.18) without plug
- Connecting plugs and leads



- IR Transmit Module (Type 4282.4)



- IR Receive Module (Type 4283.4)

Subject to technical modifications.

## Communications – Transmission Technology

### Technical Data

#### TRANSMITTER BOARD (Type 4282)

##### Fibre optic transmission

- 1 LED: 660 nm, red
- 1 LED: 820 nm, infrared
- External LED: pluggable  
(e. g. infrared plug-in module for wireless transmission)

##### Analog transmission

- Amplifier:  $V_U$  = approx. 0.1...2
- DC offset: adjustable with potentiometer
- Frequency range: approx. 0 ... 80 kHz

##### Digital transmission

- TTL input: Schmitt trigger; matching circuit for transmit diode
- Transmission rate: max. 200 kHz

##### Amplifier

- Input resistor: 50  $\Omega$ ; connectable with 2 mm plug
- Output resistors: 50  $\Omega$ ; 75  $\Omega$ ; connectable with 2 mm plug
- Frequency range: approx. 0 ... 5 MHz

##### Other

- Operating voltage and current:  
+15 V; -15 V (150 mA); +5 V (50 mA)
- Dimensions/weight: 133 x 297 x 110 mm (w x d x h)/0.7 kg

#### RECEIVER BOARD (Type 4283)

##### Fibre optic transmission

- Receive diode: SFH 202, fixed
- External receive diode: pluggable  
(e. g. for wireless transmission)

##### Analog transmission

- DC offset: adjustable with potentiometer
- Amplifier:  $V_U$  = approx. 1 ... 6
- Frequency range: approx. 0 ... 80 kHz

##### Digital transmission

- Comparator and Schmitt trigger with TTL output
- Transmission rate: max. 200 kHz

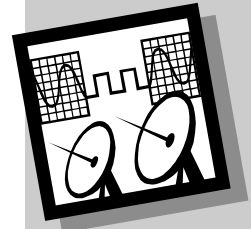
##### Amplifier

- Input resistor: 37.5  $\Omega$ ; 50  $\Omega$ ; 75  $\Omega$ ; 150  $\Omega$ , connectable with 2 mm plug
- Output resistor: 50  $\Omega$
- Frequency range: approx. 0 ... 5 MHz

##### Other

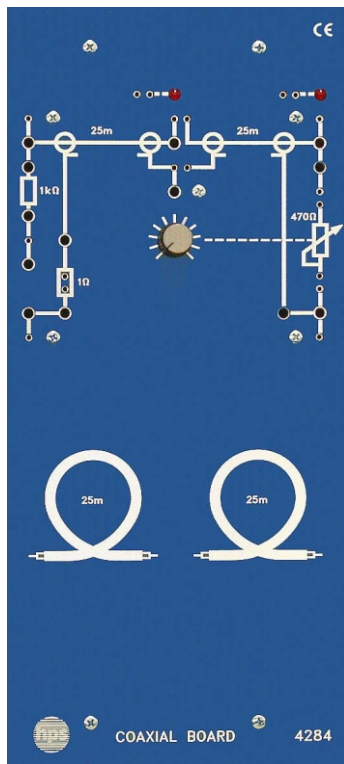
- Operating voltage and current:  
+15 V; -15 V (50 mA); +5 V (50 mA)
- Dimensions/weight: 133 x 297 x 110 mm (w x d x h)/0.7 kg

## Communications – Transmission Technology



### COAXIAL BOARD

Type 4284



COAXIAL BOARD (Type 4284)

- Training Board for experiments with a screened line
- Line length 50 m, divided in 2 x 25 m
- With incorporated LEDs for demonstration of standing waves in a line
- Incorporated terminating resistor, adjustable
- Several COAXIAL BOARDS can be connected one after the other to simulate longer Lines

### Technical Data

- Length of the coaxial line: 50 m, divided in 2 x 25 m
- Inductance: 0.4  $\mu\text{H}/\text{m}$
- Capacity: 100  $\text{pF}/\text{m}$
- Resistance: 300  $\Omega/\text{km}$  +/- 60
- Characteristic impedance: 50  $\Omega$  +/- 2
- Terminating resistor: 0 ... 470  $\Omega$ , continuously adjustable
- Shunt: 1  $\Omega$ , for current measuring
- 2 LEDs to verify standing waves
- 1 k  $\Omega$  dropping resistor for simulation of mismatches

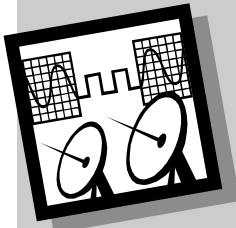
With the COAXIAL BOARD hps SystemTechnik offers a screened line which allows to impressively prove all regularities of electric lines in experiments in the following fields:

- **Communications technology**
- **Transmission technology**
- **Electric energy transmission**
- **Data transmission**

The following experiments can be performed with the COAXIAL BOARD:

- Evaluation of the electric data of a line
- Attenuation characteristic of a line
- Frequency dependence of a line
- Input resistance of a line (no-load, short-circuit, matched)
- Transit times and phase displacements on a line

- Standing waves on a line
- Transmission behaviour of a line
- Error detection
- Pulse behaviour (transit time, reflection)



## COAXIAL BOARD

**Type 4284**

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## Communications – Transmission Technology

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### Mechanical Data

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The front panel of the COAXIAL BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving.

The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

To conduct the experiments, the COAXIAL BOARD is placed on a table or suspended in an hps rack for demonstration purposes.

Dimensions and weight:

- 133 x 297 x 110 mm  
(w x h x d)
- Weight: 1.25 kg

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### Accessories Recommended

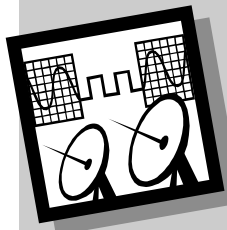
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- Experiment manual: „Experiments with Screened Lines“ (Type V 0135)
- Oscilloscope
- Function generator
- Multimeter
- Connecting plugs and leads

Subject to technical modifications.







## Module System Filter and Oscillator Circuits

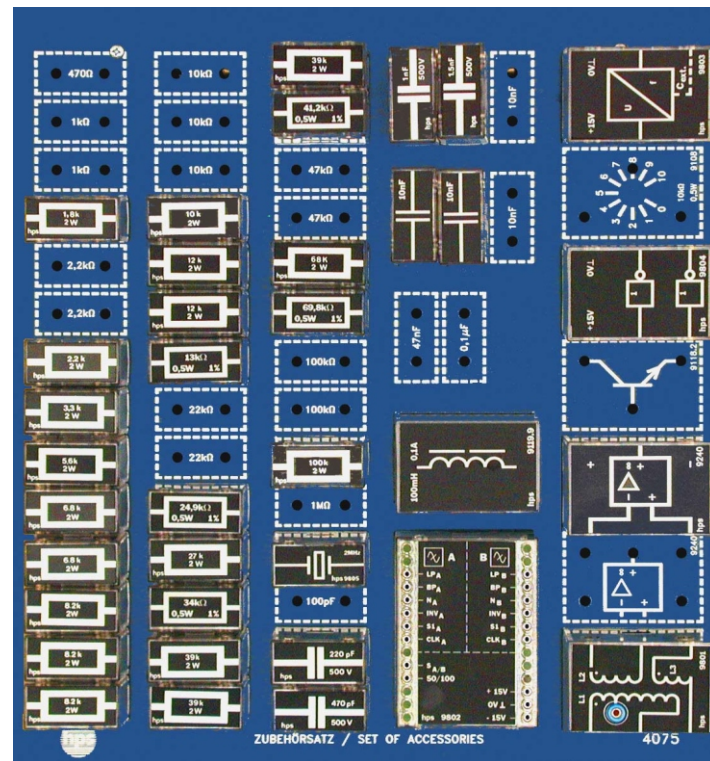
### Series 4075

The modules are plugged to a storage board.

The respective slots are labelled with the appropriate symbols.

## Communications

### 1 set of modules (Type 4075)



## Technical data for the modules of the Filter and Oscillator Circuits

### Mechanical data

The module housings consist of a top part made of a rugged transparent plastic and a rugged bottom part made of black, glass-fibre reinforced plastic. The top and bottom parts are joined by two snap locks which enable the housing to be opened quickly and easily.

Up to 6 lamella plugs for wiring and plugging the modules into the boards are located in the bottom of the housing depending on the type.

White printed circuit symbols indicate the module functions.

### Other technical data

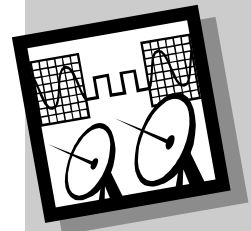
- Housing dimensions: 56 x 75 x 35 mm / 38 x 56 x 35 mm / 38 x 19 x 35 mm (w x d x h)
- Plug diameter: 4 mm (arranged in a 19 mm grid)

### Storage board for the modules

- 5 mm thick laminated board, blue in colour with white engraving
- Dimensions: 266 x 297 x 130 mm (w x d x h) / weight: 2 kg (with modules)

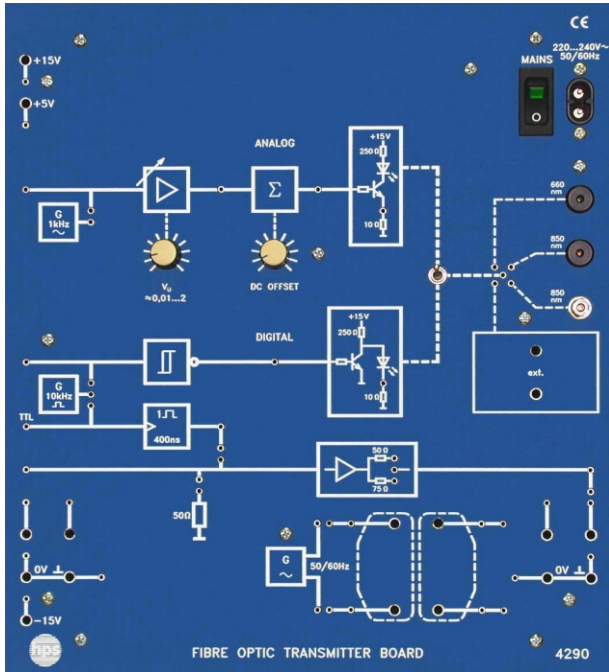
Subject to technical modifications

## Communications – Transmission Technology

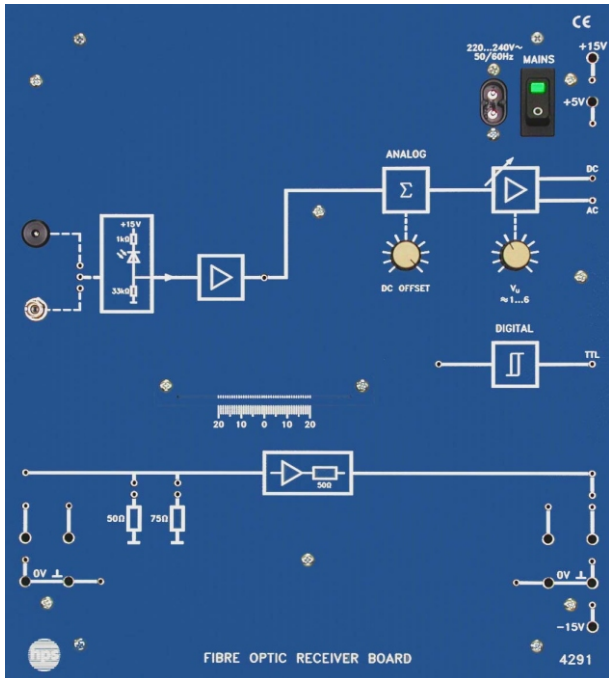


### Training System Fibre Optics

Type 4290  
Type 4291



Fibre Optic Transmitter Board (Type 4290)



Fibre Optic Receiver Board (Type 4291)

- For plastic and glass fibres
- With built-in transmit diodes in different wavelengths of the light
- Characteristic recording and attenuation measurement also possible with DC voltages
- Coupling attenuations can be simulated directly on the Receiver Board
- All necessary power supplies and generators on Board
- Additional experiments With laser diode

Essential components of the Fibre Optics Training System:

- **Fibre Optic Transmitter Board**  
with integrated transmit diodes, built-in sinewave generator (1 kHz), pulse generator and squarewave generator (10 kHz)
- **Fibre Optic Receiver Board**  
with integrated receive diodes
- **Optic Fibres**  
plastic and glass fibres

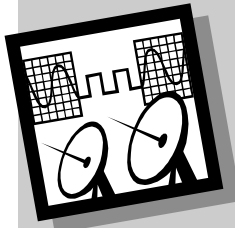
A variety of types of Optic Fibres to be connected to the transmitter and receiver are available as transmission media.

The system therefore offers the possibility of various Optic Fibres and thus setting up a variety of fibre optic transmission lines to investigate the influence of the individual transmission parameters in experiments.

A laser diode makes it possible to compare the performance characteristics of such diodes with those of conventional LEDs.

The Fibre Optics Training System from hps SystemTechnik offers a comprehensive program for conducting experiments in the field of opto-electronic communications. The training system is suitable for both demonstrations and practical experiments.





## Training System Fibre Optics

Type 4290  
Type 4291

The training system and the accompanying experiment manual: „Fibre optics“ (Type V 0134) have been designed to impressively demonstrate the advantages of this technique over conventional transmission media.

### Subjects dealt with in the experiments section of the experiment manual

- Experiments on fibre optics with plastic fibre
- Characteristics of transmit diodes
- Attenuation of plastic fibres and connectors
- Transmission of TTL signals
- Immunity to interference of the optical fibre
- Experiments on optic fibre with glass fibre
- Measurement of propagation time
- Experiments in fibre optics with a laser diode

### Mechanical data

The front panel of the Boards is made of 5 mm thick laminate, matt blue in colour with white printing representing the built-in function groups.  
The rear of the Boards is protected with a grey plastic cover. Its shape allows the Boards to be placed at an ergonomically favourable angle for example on a table.

### Dimensions / weight

- Fibre Optic Transmitter Board:  
266 x 297 x 110 mm (w x h x d) / approx. 1.9 kg
- Fibre Optic Receiver Board:  
266 x 297 x 110 mm (w x h x d) / approx. 2.0 kg

## Communications – Transmission Technology

### Technical Data

#### Fibre Optic Transmitter Board (Type 4290)

##### Inputs(via 2 mm jacks)

- 1 analog / 1 digital

##### Optical outputs

- 660 nm / 850 nm (plastic fibre)
- 850 nm (glass fibre, ST-standard)

##### Electrical output (via 2 mm jacks)

- With preceding driver circuit for connecting a two-wire line or coaxial cable for comparative measurements on a fibre optic transmission path
- Output impedance: 50  $\Omega$  ; 75  $\Omega$

##### Function groups

- Sinewave generator:  $f = 1 \text{ kHz}$ ;  $u_{pp} = 3 \text{ V}$
- Squarewave generator:  $f = 10 \text{ kHz}$  (TTL)
- Pulse generator: impulse duration 400 ns
- Patch field and power supply for plug-in transformer to simulate interferences
- Patch field for Laser Module

#### Fibre Optic Receiver Board (Type 4291)

##### Optical input

- Plastic fibre / Glass fibre

##### Electrical input (2 mm jacks)

- For connecting a two-wire line or coaxial cable for comparative measurements
- Input impedance: 50  $\Omega$  ; 75  $\Omega$

##### Output amplifier

- Voltage gain: 1 ... 6 (adjustable)
- DC offset: +0,5 V... -5,5 V (adjustable)

##### Outputs(2 mm jacks)

- DC:  $V_{out} = 0 \dots \pm 8 \text{ V}$
- AC:  $V_{out pp} = 0 \dots 16 \text{ V}$
- TTL: with Schmitt trigger; fan-out = 10;

##### Adjustable fibre coupler

- For simulation of attenuation

### Common Technical Data

#### Mains connection

- Voltage: 230 V AC; 50 ... 60 Hz; 20 VA

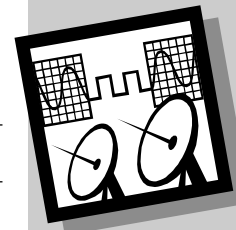
#### Power supply output (for external Extensions)

- +15 V / -15 V / +5 V (0,3 A)

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## Communications – Transmission Technology

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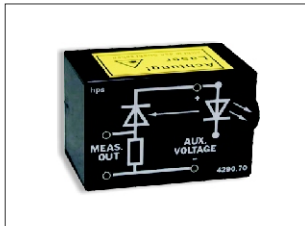
### Training System Fibre Optics

Type 4290  
Type 4291

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### Laser Module (Type 4290.70)

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The Laser Module can be plugged into the patch field of the Fibre Optic Transmitter Board. It is used in conjunction with the plastic fibres.

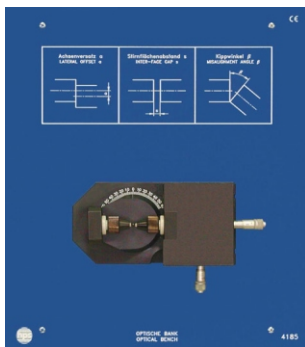
With the integrated monitor diode it is possible to measure the transmitted light. The wave length of the laser diode is 670 nm.

Housing dimensions / weight:  
57 x 38 x 35 mm (w x d x h) / 50 g

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### Optical Bench (Type 4185)

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The Optical Bench is used to simulate faults that can occur on fibre optic links or at fibre optic connections and which lead to increased attenuation: inter-face gap, lateral offset, angular offset.

It is suitable for accepting optical fibres with a diameter of approx. 1 mm.

The Optical Bench is mounted on a standard hps Board and can be placed on a table or suspended in an hps rack for demonstration purposes. The rear of the Board is protected with a grey plastic cover.

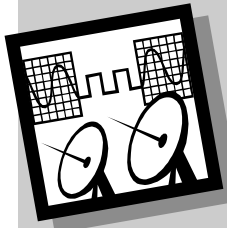
- Dimensions:  
266 x 297 x 130 mm  
(w x h x d)
- Weight: approx. 1.8 kg

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### Necessary Accessories

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- Set of Accessories (Type 4290.1), consisting of:
  - Plastic fibres: 20 m, 5 m and 0,5 m
  - Glass fibres: 20 m and 1 m
  - Optical coupling for glass fibres
  - Connecting plugs, 2 mm (12 piece)
  - Coils: N = 900 and N = 100
  - Tape-wound core (pair)
  - Connecting lines, 2 mm (8 piece)
- Multimeter



## Training System Fibre Optics

Type 4290  
Type 4291

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## Communications – Transmission Technology

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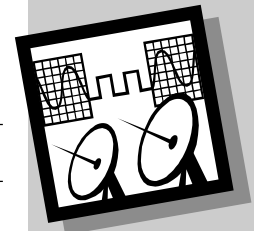
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### Accessories Recommended, for conducting experiments in fibre optics

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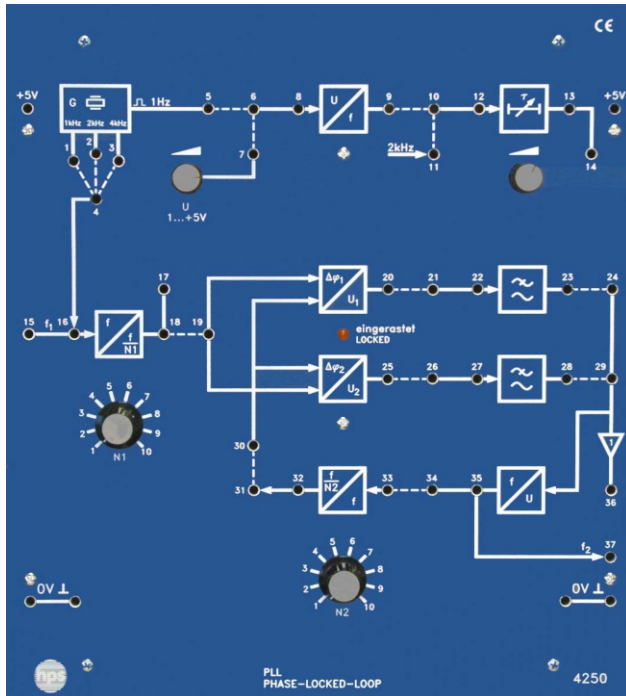
- Experiment manual „Fibre optics“ (Type V 0134)
- COAXIAL BOARD (Type 4284)
- Optical power meter
- Oscilloscope

Subject to technical modifications.



## Phase-Locked-Loop (PLL)

Type 4250



- Universal training system on the subject of PLL
- All function blocks of the PLL circuit are equipped with test jacks and can be decoupled
- Generators, frequency dividers and phase shifter integrated in the Board
- Low demand on additional measuring equipment
- With detailed experiment descriptions

The frequencies in the Phase-Locked Loop are in the AF range so that a problem-free measuring technique can be applied and no great demands need to be made on additional measuring equipment (oscilloscope, multimeter, frequency meter).

The inputs and outputs of the individual function blocks are equipped with 4 mm jacks as test points. Individual blocks (components) can be decoupled with 4 mm connecting plugs from the overall complex if necessary, in order to conduct individual measurements.

A separate manual „Phase-Locked Loop“ (Type V 0068) describes and analyses the individual experiments in detail in the Experiments and Solutions sections in addition to providing the fundamentals of PLL.

With the Phase-Locked Loop (PLL) training system, hps SystemTechnik offers a concept for practical teaching of the function and application possibilities of this technology.

PLL systems are being used in electronics for a wide range of applications such as:

- Frequency synthesis (e. g. setting radio and TV channels including channel search and memory – fixed frequencies)
- Accurate motor speed control (e. g. CD players)
- Phase shifter

- Modulation and demodulation (AM, FM, PM, FSK)
- Stereo decoder and PAL decoder (TV)
- Pulse synchronous operation and much more

The hps training system on PLL is designed didactically in such a way that the theoretical contexts can be presented clearly and comprehensibly.

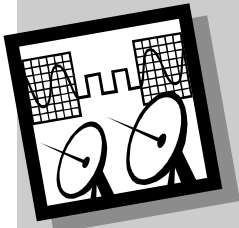
It consists of the following components:

- 2 different phase detector types (comparators)
- 2 loop filters, low-pass characteristic

- Voltage-controlled oscillator (VCO)
- 2 digital frequency dividers, divider factor adjustable from 1 ... 10

The Phase-Locked Loop Board contains additional auxiliary equipment for conducting tests and experiments:

- Crystal-stable squarewave generator for reference frequencies
- Variable squarewave generator for the generation of input frequencies
- Phase shifter for examining the phase detectors



## Phase-Locked-Loop (PLL)

### Type 4250

#### Accessories Recommended

- Experiment manual: „Phase-Locked Loop“ (Type V 0068)
- Power supply unit (e. g. 5 V SUPPLY BOARD, Type 1002.3)
- Oscilloscope
- Multimeter (standard)
- Frequency meter
- Connecting plugs and leads

## Communications

### Technical Data

#### Squarewave generator (crystal-stable)

- Frequency: 1 Hz; 1 kHz; 2 kHz; 4 kHz

#### DC voltage source

- Voltage: 1 V ... 5 V (adjustable with potentiometer)

#### Voltage-controlled oscillator

- Input voltage: 0 ... +5 V
- Output voltage: +5 V (symmetrical squarewave)
- Output frequency: approx. 20 Hz ... 6 kHz

#### Comparator (phase detector)

- Type I: phase sensitive (XOR)
- Type II: phase and frequency sensitive (JK flip-flops with charging pump via tristate)

#### Low pass (loop filter)

- Type I: RC low pass (approx. 300 Hz)
- Type II: R/RC low pass (approx. 3 Hz)

#### 2 frequency dividers

- Factor:  $N_1$  and  $N_2 = 1 ... 10$  (adjustable with rotary switch)

#### Phase shifter

- $= -7^\circ ... -230^\circ$  or  $+7^\circ ... +230^\circ$  (adjustable with potentiometer); referred to 2 kHz

#### Other

- Operating voltage and current: +5 V DC/150 mA (through external power supply)
- LED for displaying lock-in state of the PLL circuit
- Measuring amplifier (impedance converter)

#### Mechanical data

- The front panel of the Phase-Locked Loop is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups.
- The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

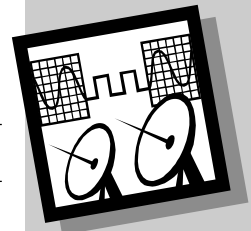
#### Dimensions

- 266 x 297 x 95 mm (w x h x d)

#### Weight

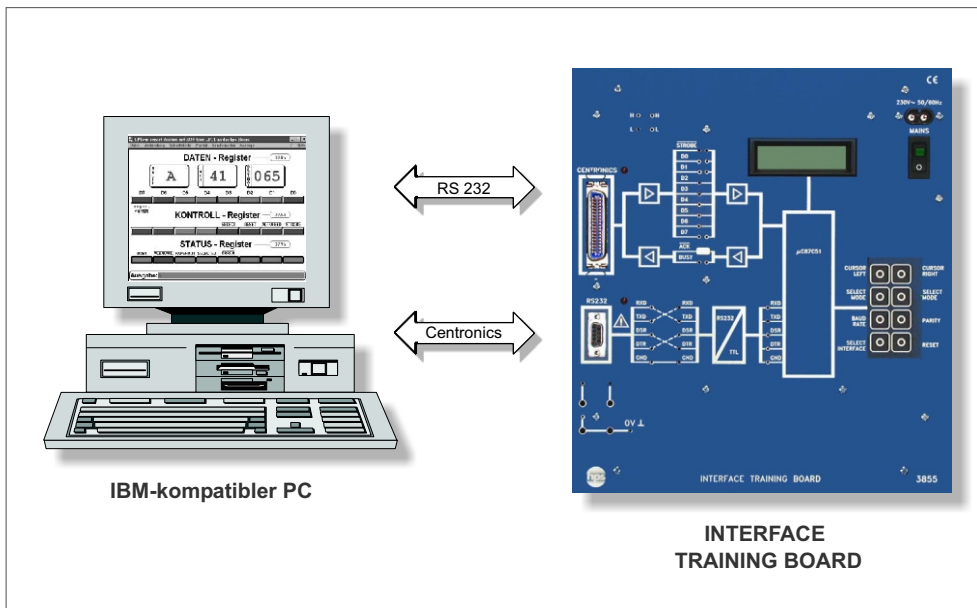
- 1.3 kg

Subject to technical modifications.



### INTERFACE TRAINING BOARD

Type 3855



- Training unit for serial and parallel interfaces
- For direct connection to any PC with RS 232 and Centronics interfaces
- Important signals of both interfaces can be tapped externally at measuring points
- Can be used on a table or in a demonstration rack
- Windows software
- With software and experiment manual
- Fault simulation

The INTERFACE TRAINING BOARD has been designed for teaching practical knowledge of parallel and serial interfaces.

The user can connect the training system directly to any commercially available PC through the integrated RS 232 or Centronics interfaces. No additional equipment is required.

The unit contains the following function groups:

- Microcontroller

- Input keyboard
- LC display
- Level converter, RS 232/TTL
- Power supply unit

All the signals of both interfaces can be tapped at integrated measuring points. The measuring points of the Centronics interface are decoupled for safety reasons.

The characters transmitted by the PC are displayed in ASCII Code.

At the same time the values of these characters are displayed in hexadecimal, decimal or binary form.

The most important signal lines can be disconnected for error simulation.

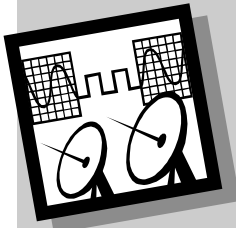
The measurements can be made with a storage oscilloscope or a logic analyser.

### Software

- Windows software: „COMwin / LPTwin“, light-version (Type PC 3855.1)

### Experiment manual

- „Experiments in Interface Technology with COMwin/ LPTwin“ (Type V 0155.1)



## INTERFACE TRAINING BOARD

Type 3855

### Subjects dealt with in the manuals:

#### Theory section

- Structure of interfaces with RS 232 and Centronics as examples
- Data transmission possibilities: serial, parallel
- Transmission format

#### Experiments section

- Installation of software and commissioning of the INTERFACE TRAINING BOARD
- Signal designations and their meanings
- Connector pin assignment
- Level conditions
- Time display of signals and their evaluation
- Determining the baud rate
- Data security technique with parity bit
- Troubleshooting in case of interrupted or interchanged lines

## Communications / Digital Technology

### PC requirements

- IBM-compatible PC, CPU: 80386/40 MHz and upwards, working memory:  $\geq 4$  MB RAM, operating system for the PC: Windows version 3.1 and upwards or Windows 95/98, colour monitor and graphic card (VGA), mouse, free serial and parallel interface

### Accessories Included

- Serial interface cable, 9-pin (Sub-D), length: 2 m
- Parallel interface cable Sub-D (25-pin)/Centronics (36-pin), length: 1.8 m

### Accessories Recommended

- Storage oscilloscope or
- Logic analyser

### Technical Data

#### Mains connection

- Voltage:  
230 V AC / 115 V (110 V) AC; approx. 2.5 VA; 50 ... 60 Hz

#### TTL outputs

- 2 outputs with LOW level
- 2 outputs with HIGH level

#### Interface RS 232

- Serial interface RS 232 for connection to the PC
- With level converter for converting the RS 232 level to TTL level

#### Interface Centronics

- Parallel interface Centronics for connection to the PC

#### Microcontroller

- Type 87C51

#### LC display

- LCD module, 2 lines of 16 characters each

#### Input keyboard

- Membrane keyboard with 8 keys for setting: interface (RS 232 and Centronics), display (HEX, DEC, BIN), parity (even, odd), baud rate (4800 Bd/9600 Bd)

#### Test jacks (2 mm)

All the lines necessary for the interfaces are fed out as test jacks (short-circuit-proof). Various lines can be disconnected to simulate errors.

#### Adapter field

The adapter field adapts 4 mm to 2 mm connections.

#### Mechanical design

The front panel of the INTERFACE TRAINING BOARD is made of 5 mm thick laminate, matt blue in colour with white engraving representing the built-in function groups. The rear of the Board is protected with a grey plastic cover. Its shape allows the Board to be placed at an ergonomically favourable angle for example on a table.

#### Dimensions and weight

Dimensions: 266 x 297 x 100 mm (w x h x d);  
weight: 1.8 kg

Subject to technical modifications.



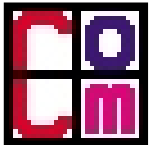


**SystemTechnik**

# COMMUNICATIONS INTERFACE TECHNIQUE

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E-Mail: [export@hps-systemtechnik.com](mailto:export@hps-systemtechnik.com)



## COMwin

The simulation software for the serial interface

(Type 009034 EVDE)

With **COMwin** you can ...

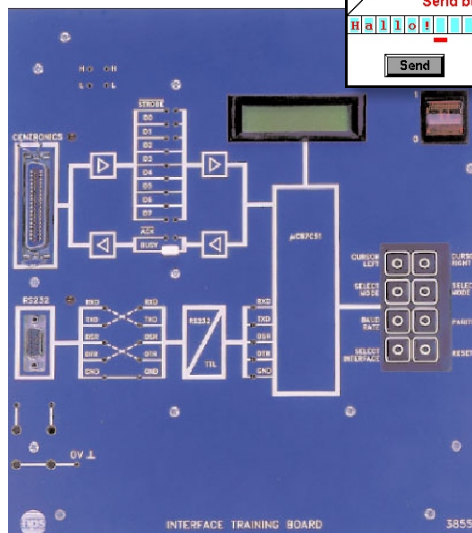
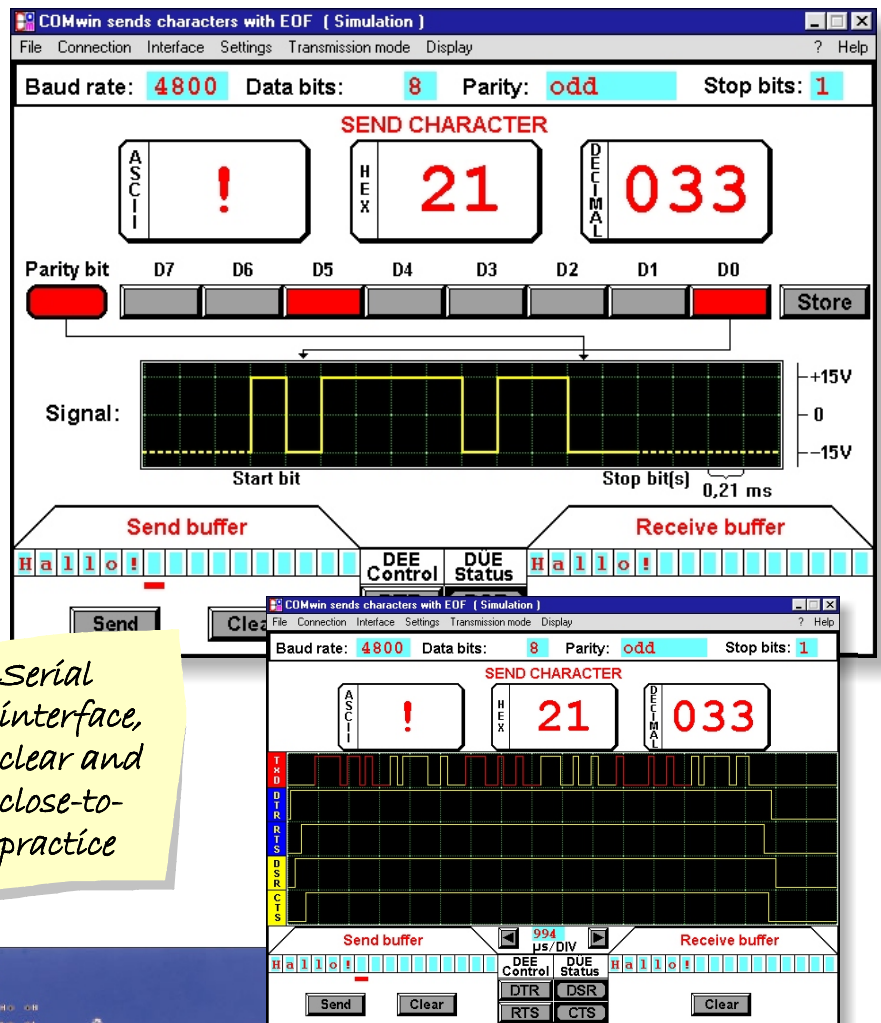
- ... observe and change a transmission signal.
- ... observe the effect of transmission parameters such as data length, parity and stop bits.
- ... send characters, character strings or control signals via the serial interface, e. g. to the INTERFACE TRAINING BOARD from hps SystemTechnik to a PC, a printer or a modem.
- ... change or observe the control and status signals.
- ... display and print the hand-shake protocol as a timing diagram.
- ... simulate the transmission of characters and character strings.

Option - INTERFACE TRAINING BOARD (Type 3855):

- Training system for the serial and parallel interface
- Error simulation
- With detailed experiments Manual

### System Requirements:

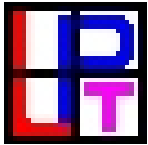
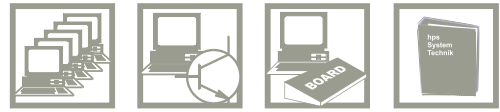
- PC with Windows® Software
- Hard disk: 10 MB free
- RAM: 4 MB
- CD ROM drive
- SVGA graphic card (800 x 600)





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## LPTwin

The simulation software for the parallel interface

(Type 009038 EVDE)

With **LPTwin** you can ...

... observe and change the register contents of a parallel interface.

... send characters, character strings or control signals via the parallel interface, e.g. to the INTERFACE TRAINING BOARD from hps SystemTechnik, a printer or a simulated printer.

... observe the effect of different printer messages such as OFF-LINE, Paper Empty etc.

... display and print the handshake protocol as a timing diagram.

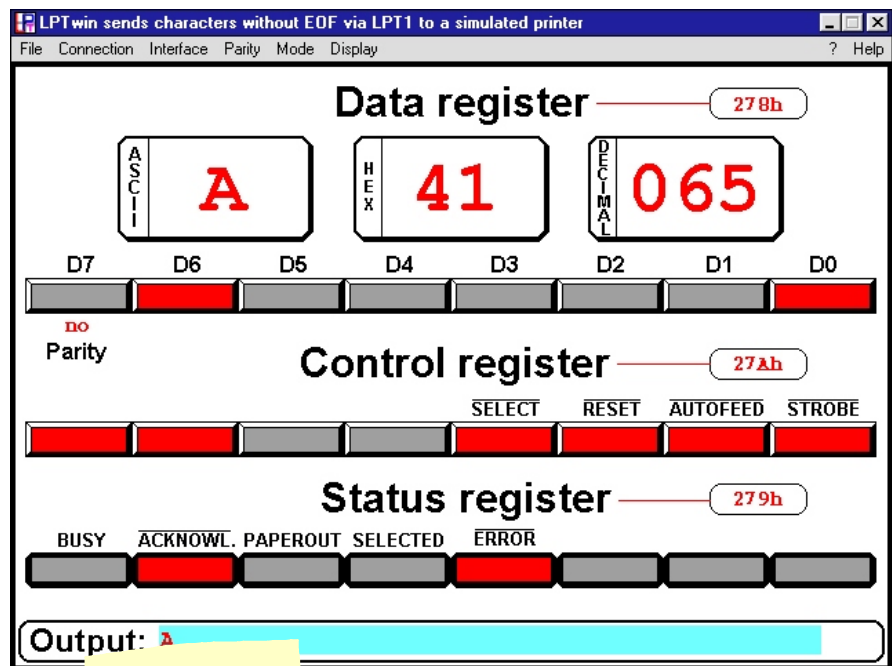
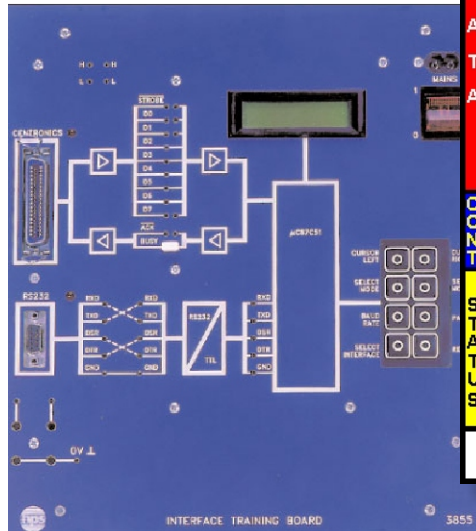
... simulate the handshake protocol.

Option - INTERFACE TRAINING BOARD (Type 3855):

- Training system for the serial and parallel interface
- Error simulation
- With detailed experiments manual

### System Requirements:

- PC with Windows® Software
- Hard disk: 10 MB free
- RAM: 4 MB
- CD ROM drive
- SVGA graphic card (800 x 600)
- free parallel interface



Parallel interface, clear and close-to-practice

