

# Leseprobe

**Christiani**

est.1931

Christian Kemper · Hermann Wellers

Vocational training

## Principles of electrical engineering

Part 1: Electrical engineering



Trainer

Dr.-Ing. Paul Christiani GmbH & Co. KG  
[www.christiani.de](http://www.christiani.de)

Christian Kemper · Hermann Wellers

**Vocational training –**

# **Principles of electrical engineering**

Section: Trainer manual (content, methods, scheduling)

1st edition 2018

Dr.-Ing. Paul Christiani GmbH & Co. KG

## Preface

All information provided in this trainer manual should be viewed as proposals.

Although all exercises have been planned and performed by trainees, which is one way in which the specified times were determined, it is of course left to the trainers responsible to determine how best to use the methods proposed, the slides offered and the respective timeframe based on their actual study group. All of this can only be done on a case-by-case basis once "on site".

It is also down to the trainer to determine whether the forms offered or internal company forms should be used, which can for example prove particularly prudent in the case of test and measurement reports.

This vocational training includes basic knowledge and skills that are always conveyed at the start of the training.

The question is then whether the trainees are already capable of performing electrical tests as per DIN VDE 0701-0702 or DIN VDE 0100-600 at this time.

An indispensable prerequisite for performing tests of this kind is knowledge of the technological backgrounds, which cannot always be assumed at this time. Trainers must therefore reach a decision on this for their respective groups. It is no problem to remove this topic from the schedule and assessment so that it can be addressed at a later stage.

The tests as per DIN VDE 0701-0702 are described in the textbook, insofar as they are relevant for performing the exercises.

With regard to the tests as per DIN VDE 0100-600, we make reference to the dedicated vocational training on

*Commissioning as per DIN VDE 0100-600.*

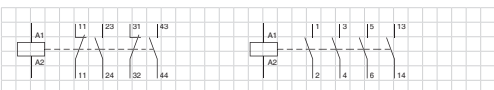
A conscious decision was taken to omit reference identifiers in the practical exercises, as it should be left to the trainers to decide whether the identification as per DIN EN 81346-2 should be performed using only the main class or both the main class and sub-class.

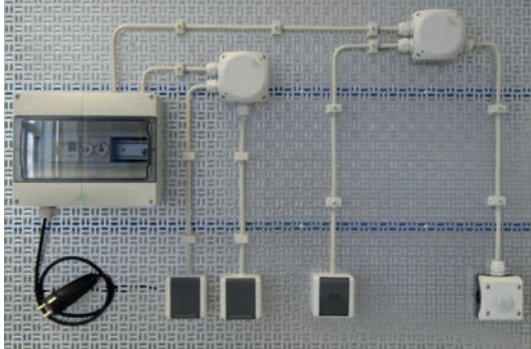
It is important to note that you can find the slides, solutions to the exercises, forms and further useful media for your work in the MOLA<sup>1)</sup> app.

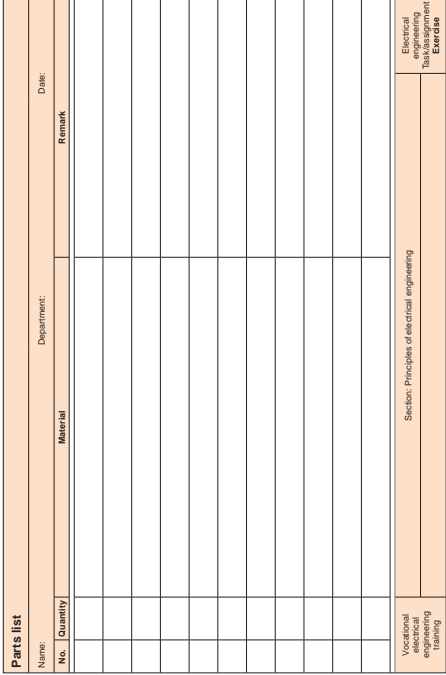
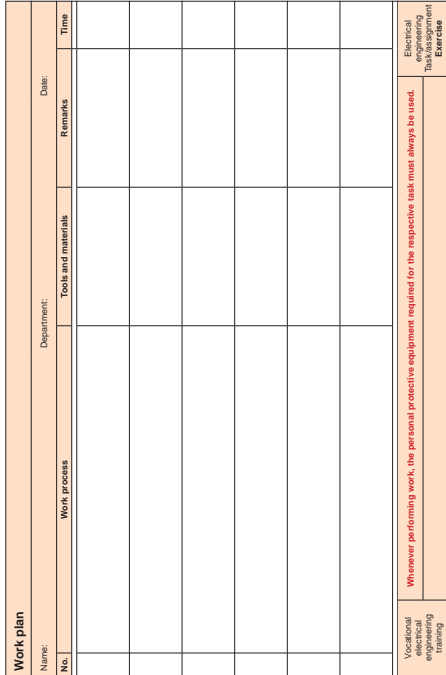
<sup>1)</sup> MOLA: My Own Learning App

Time (min)	Goals – Content – Schedule – Notes	Media
	<p><b>Possible procedure for an exercise</b></p> <p>The trainer holds a special instructional discussion with the trainees to prepare for the respective exercise.</p> <p>Both the theoretical backgrounds of the exercise and the key aspects of their practical execution are discussed in detail here. It seems prudent to do this within the scope of a specialist discussion with the trainees, during which they can demonstrate their prior knowledge.</p> <p>The textbook can also be used to draw up the theoretical backgrounds. It is left to the discretion of the trainers to determine whether they hand out this textbook to the trainees or pass on the information in the form of a presentation. The media required for this are included in the additional digital information.</p> <div style="border: 1px solid orange; padding: 2px;"> <span style="float: left;">Electromagnetic switches, relays</span> <span style="float: right;">145</span> </div> <div> <h3>21 Electromagnetic switches</h3> <p>These are switchgear that comprise a <i>coil and fitted switching contacts</i>. These switchgear are typically characterised by one <i>control circuit</i> and one <i>load circuit</i> (main circuit), which are <i>galvanically isolated</i> from one another.</p> <p>A relatively <i>low control current</i> can switch a relatively <i>high load current</i>. The values given in Fig. 1 are specimen values.</p> <div> </div> <p style="text-align: center;">1 Principle of electromagnetic switches</p> <p>Common types of electromagnetic switches are <i>relays</i> and <i>contactors</i>.</p> <p><i>Relays</i> are essentially used for switching in <i>low power</i> applications. They employ <i>single interruption contacts</i> and are generally designed to handle <i>low switching voltages</i>.</p> <p><i>Contactors</i> are used for switching in <i>medium and high power</i> applications. They employ <i>double interruption contacts</i>.</p> <div> <p style="text-align: center;">2 Contacts</p> </div> <h4>21.1 Relays</h4> <p>Voltages of up to 250 V, currents of up to approximately 10 A, coil voltages of 1.5 V to 30 V. The coil current creates a magnetic field, which moves the contact piece against a spring force. The contact is returned through spring force.</p> <p>Use, for example, for <i>galvanic isolation</i> between the power unit and electronic part of a control system: A 24 V DC PLC output activates a 24 V DC relay; the relay switches 230 V AC.</p> <div> <p style="text-align: center;">3 Relays</p> </div> <div style="background-color: #f9a825; padding: 5px;"> <p><b>Galvanic isolation</b> No electrically conductive connection (via conductor).</p> <p><b>Relays</b> Reference indicator K</p> </div> <p style="text-align: right; font-size: small;">© Christiani</p> </div>	<p>Presentation</p> <p>Technical discussion</p> <p>Textbook</p> <p>Additional digital information</p> <p>Practical illustrative material</p>
	<p>Trainer manual</p> <p>Principles of electrical engineering</p>	<p>Electrical engineering</p>

Time (min)	Goals – Content – Schedule – Notes	Media						
	<p>The trainees are provided with notepads to ensure that relevant information from the presentation or the technical discussion can be recorded in writing.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; margin: 0;">Notes</p> <div style="border: 1px solid black; height: 350px; width: 100%; background-color: #f0f0f0;"></div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 33%; padding: 2px;">Sheet:</td> <td style="width: 33%; padding: 2px;">Last name:</td> <td style="width: 33%; padding: 2px;">Date:</td> </tr> <tr> <td></td> <td style="padding: 2px;">Department:</td> <td></td> </tr> </table> </div> <p>These notepads can be used in various ways. For example, they can also be used to sketch out the circuits to be developed.</p> <p>There is no limit on the number of notepads, as they too form part of the additional digital information.</p>	Sheet:	Last name:	Date:		Department:		<p style="text-align: center; vertical-align: middle;">Notepad</p>
Sheet:	Last name:	Date:						
	Department:							
	<p>Trainer manual</p> <p>Principles of electrical engineering</p>	<p>Electrical engineering</p>						

Time (min)	Goals – Content – Schedule – Notes	Media																		
	<p>The trainees are then given the control questions to work through.                      The trainer reaches the decision as to whether these tasks should be performed by the participants alone or working in groups.</p> <div style="border: 1px solid black; padding: 5px;"> <p><b>Control questions</b></p> <p>Name: _____ Department: _____ Date: _____</p> <p><b>6.</b> What kind of contactor is this?</p>  <p><b>7.</b> What is the code number of the contactor shown?</p> <table border="1"> <tr> <td><input type="radio"/> A1</td> <td><input type="radio"/> A2</td> </tr> <tr> <td><input type="radio"/> 1</td> <td><input type="radio"/> 3</td> </tr> <tr> <td><input type="radio"/> 5</td> <td><input type="radio"/> 13</td> </tr> <tr> <td><input type="radio"/> 21</td> <td><input type="radio"/> 33</td> </tr> <tr> <td><input type="radio"/> 43</td> <td></td> </tr> <tr> <td><input type="radio"/> 14</td> <td><input type="radio"/> 22</td> </tr> <tr> <td><input type="radio"/> 34</td> <td><input type="radio"/> 44</td> </tr> <tr> <td><input type="radio"/> 2</td> <td><input type="radio"/> 4</td> </tr> <tr> <td><input type="radio"/> 6</td> <td></td> </tr> </table> <p><b>8.</b> Can a contactor with coil voltage of 24 V AC be used in a 24 V DC control circuit?</p> </div>	<input type="radio"/> A1	<input type="radio"/> A2	<input type="radio"/> 1	<input type="radio"/> 3	<input type="radio"/> 5	<input type="radio"/> 13	<input type="radio"/> 21	<input type="radio"/> 33	<input type="radio"/> 43		<input type="radio"/> 14	<input type="radio"/> 22	<input type="radio"/> 34	<input type="radio"/> 44	<input type="radio"/> 2	<input type="radio"/> 4	<input type="radio"/> 6		<p>Control questions</p>
<input type="radio"/> A1	<input type="radio"/> A2																			
<input type="radio"/> 1	<input type="radio"/> 3																			
<input type="radio"/> 5	<input type="radio"/> 13																			
<input type="radio"/> 21	<input type="radio"/> 33																			
<input type="radio"/> 43																				
<input type="radio"/> 14	<input type="radio"/> 22																			
<input type="radio"/> 34	<input type="radio"/> 44																			
<input type="radio"/> 2	<input type="radio"/> 4																			
<input type="radio"/> 6																				
	<p>Trainer manual</p> <p>Principles of electrical engineering</p>	<p>Electrical engineering</p>																		

Time (min)	Goals – Content – Schedule – Notes	Media				
	<p>The trainees now complete the exercise.</p> <div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center; font-weight: bold; font-size: small;">Exercise 6: ON/OFF switch with separate power outlet circuit</p> <p><b>Task/assignment</b></p> <ul style="list-style-type: none"> <li>■ Draw up the circuit and functional analysis.</li> <li>■ Draw up a parts list and work plan.</li> <li>■ Assemble the circuit as per the specifications.</li> <li>■ Perform the necessary tests and log the results.</li> <li>■ Put the circuit into operation.</li> </ul>  <p><b>Note</b> The figure is not to scale. The precise mounting dimensions are based on the perforated plate being used. The distributor is not a part of the task. It is used as power supply for the exercise.</p> <table border="1" style="width: 100%; font-size: x-small;"> <tr> <td style="width: 60%;">ON/OFF switch with separate power outlet circuit</td> <td>Task/assignment</td> </tr> <tr> <td>Principles of electrical engineering</td> <td>Exercise 6</td> </tr> </table> <p style="text-align: right; font-size: x-small;">E 6-1</p> </div> <p>Each exercise unit comes with a parts list and a work plan. Since these plans need to be supplemented or drafted in full for various exercises, further forms are available for completion by hand.</p>	ON/OFF switch with separate power outlet circuit	Task/assignment	Principles of electrical engineering	Exercise 6	<p>Task Possibly circuit diagram Parts list Work plan</p>
ON/OFF switch with separate power outlet circuit	Task/assignment					
Principles of electrical engineering	Exercise 6					
	<p><b>Trainer manual</b></p> <p>Principles of electrical engineering</p>	<p><b>Electrical engineering</b></p>				

Time (min)	Goals – Content – Schedule – Notes	Media
	<p>Parts list form</p>  <p>Work plan form</p> 	<p>Parts list form Handed out as necessary</p> <p>Work plan form Handed out as necessary</p>
	<p>Trainer manual</p> <p>Principles of electrical engineering</p>	<p>Electrical engineering</p>