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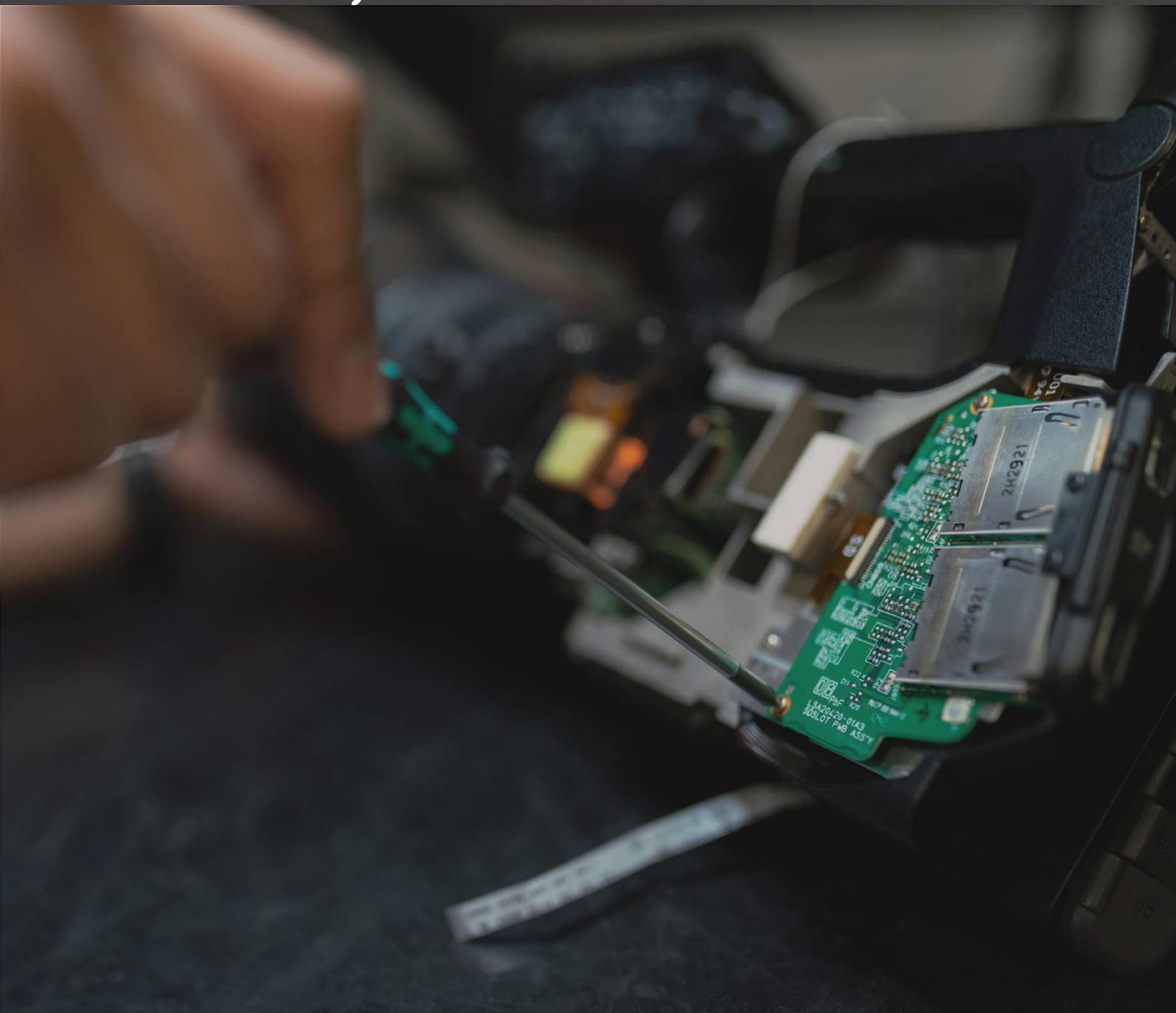
TRAINING PLAN

SOMATICA, MATERIALS & SOLUTIONS



This document is a result of the project:

BUILDING THE VOCATIONAL TRAINING OF THE FUTURE: COMPANIES AND EDUCATIONAL CENTERS FACING THE CHALLENGE OF THE ORGANIZATION AND INTEGRATION OF A MORE INCLUSIVE AND DIGITAL VET

This project has been funded with support from the European Commission.

Co-funded by
the European Union

Programming and monitoring notebook of the training plan

Student:

Educational center:

Empresa: SOMATICA, MATERIALS & SOLUTIONS

Training start date:

Co-funded by the European Union

PART 1	**TRAINING PLAN**		
2nd year	SOMATICA, MATERIALS & SOLUTIONS		
Training degree/specialization course/professional certificate	Electrical and Automatic Installations Technician		
Student		Email:	Telephone
Training Center		Email:	
Tutor at the training centre		Email:	Telephone
Tutor in the company		Email:	Telephone
Particular features			
In-house training period	Calendar/Schedule/Period		
Total hours			

Learning outcomes in in-house training periods			
Professional Module	Code	Learning Outcomes	Evaluation criteria

Electronics	0233	Ra1 Recognizes combinational logic circuits by determining their characteristics and applications	a) Different numbering systems and codes have been used. b) The fundamental logical functions used in digital electronic circuits have been described. c) The logic circuits have been represented by the appropriate symbology. d) The basic combinational functions have been interpreted. e) The components and functional blocks have been identified. f) Circuits have been assembled or simulated. g) The operation of the circuits has been verified. h) The different families of integrated and their application have been identified.
		Ra2 Recognizes sequential logic circuits by determining their characteristics and applications	a) Differences between combinational and sequential circuits have been described. b) Differences between synchronous and asynchronous systems have been described. c) The components and

			functional blocks have been identified. d) The appropriate logical measurement instruments have been used. e) Circuits have been set up or simulated. f) The operation of sequential basic circuits has been verified. g) Real applications of circuits with sequential logic devices have been described.
		Ra3 Recognizes rectification and filtering circuits by determining their characteristics and applications	a) The different components have been recognized. b) The parameters and magnitudes that characterize circuits with passive components have been described. c) The appropriate measuring instruments (multimeter and oscilloscope, among others) have been used. d) The components have been related to the symbols that appear in the diagrams. e) The

			types of rectifiers and filters have been described. f) Circuits have been assembled or simulated. g) The parameters and electrical characteristics of the components of the systems have been obtained. h) The real applications of this type of circuits have been described.
		Ra 4 Recognizes power sources by determining their characteristics and applications.	a) The differences between switched and non-switched sources have been described. b) The operation of the different blocks that make up the complete power supply systems has been described. c) The most relevant characteristics provided by the manufacturers have been identified. d) The different configurations of integrated regulatory circuits have been described. e) The appropriate measuring instruments

			(multimeter and oscilloscope, among others) have been used. f) The real applications have been described. g) The operation of switched sources has been verified. h) Real applications of switching power supplies have been described.
		Ra 5 Recognizes amplifier circuits by determining their characteristics and applications	a) Different types of amplifier circuits have been described. b) The parameters and characteristics of the different amplifier circuits have been described. c) The components have been identified with the symbols that appear in the diagrams. d) Circuits have been set up or simulated. e) Its operation has been verified. f) The appropriate measuring instruments have been used. g) Real applications of amplifier circuits have been described.

		Ra 6 Recognizes power electronic systems by verifying their characteristics and operation	a) The elements of the electronic power systems have been recognized. b) The function of each block of the system has been identified. c) The most relevant characteristics of the components have been listed. d) Circuits have been set up or simulated. e) The functioning of the components (thyristor, diac, triac, among others) has been verified. f) The appropriate measuring instruments have been used. g) The most significant signals have been visualized. h) Real applications of controlled feeding systems have been described.
		Ra 7 Recognizes timing and oscillation circuits by verifying their characteristics and operation.	a) The components of the timing and oscillation circuits with integrated devices have been recognized.

			b) The operation of timers and oscillators has been described. c) The operation of the timing circuits has been verified. d) The operation of the oscillator circuits has been verified. e) The appropriate measuring instruments have been used. f) Circuits have been assembled or simulated. g) The most significant signals have been visualized. h) Real applications of circuits with integrated timing and oscillation devices have been described.

Signed: Tutor in the company	Signed: Student	Signed: Tutor at the training centre

PART 2.- Workplace. Overview		
Task Title: Simulation, design and probing of an electronic circuit	**Folder/Server**:	**Date**:

Short Description

An electronic system is typically built by assembling many circuits, each representing a small component of the entire device. Therefore, in this case, we will be simulating, building, probing, and designing a possible PCB for filtering circuits, which receive a sinusoidal input signal and output the filtered signal at the other end of the circuit. A target application could be a sensor output signal that has a sinusoidal response, which is intended to be read by an analog-to-digital converter (ADC), here the sensor information is stored at a known frequency. However, sometimes the signal is contaminated by noise from many sources, such as sensor material components, network noise, or neighboring devices. Therefore, an interface circuit must be applied between the sensor and the respective ADC, which will provide digital control with the information provided by the sensor. During this course, the project to be carried out will follow three main events:

- Selection and simulation of filtering circuits;
- Construction and probing of breadboard circuits with DC power from the amplifier, signal generation and oscilloscope measurement;
- PCB design of the circuits used;

Ending with a small report, where students must write an essay on filtering electrical signals, what types of filters exist and what each one is used for. In addition, a proper prior understanding of how noisy signals are the result of a sum of many polluting frequencies must be carried out.

Area of the company or project in which it is framed:

This project is part of the area of development of keyboards and keyboards for the

industry, *Somatica, Materials & Solutions*. *Somatica* is a technology-based company, created in 2007 as a spin-off of the University of Minho, Department of Physics. The main objective was to develop electroactive materials to produce sensors and actuators. A few years later the company began to dedicate itself to the development and commercialization of

keyboards and keyboards for all industries, using different materials and technologies, as well as developing electronic human-machine interfaces (HMIs).

Objectives

Following this workshop, students are expected to learn how to prepare to organize and simulate a simple filtering circuit design by adjusting passive components such as resistors and capacitor values, and topology and testing automated tools to acquire circuit information.

Hypotheses, solutions that can be anticipated and expected results (to be filled in by the student)

Equipment / Machinery

- Micro-Cap 12 simulator software (https://archive.org/details/mc12cd_202110).
- Software de PCB KiKad (https://www.kicad.org/download/).
- Breadboard with single-line KIT cables per group.
- Library of through-hole resistors and capacitors.
- LM741 with DIP package (https://pt.mouser.com/ProductDetail/Texas-Instruments/LM741CNNOPB?qs=QbsRYf82W3Gt6%252BDX6%252BuAjw%3D%3D).
- At least one oscilloscope with probes (which will be used by each group at the same time, preferably one per group).
- At least one signal generator (to be used by each group at a time, preferably one per group).
- At least one bipolar DC +-15V source (to be used by each group at a time, preferably one per group).

Elements of occupational risk prevention

Upon arrival at the company, the student will be provided with the company's occupational risk prevention manual.

Waste management.

At Somatica we have implemented a recycling program based on:

- Proper waste management through recycling bins (paper, plastic, organic).
- Recycling electrical and electronic equipment (toner cartridges and printer ink, dead batteries) through local businesses and programs. In the case of Somática, recycling is carried out through the containers of ELECTRÃO – Associação de Gestão de Resíduos.

Available procedures (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder indicating here the name or reference of the file) *Include pages as needed*

PART 2.- Workplace. Conceptual issues.
Explain the concepts clearly and concisely and solve the exercises collected in the following cells.
Question 1. What is an electronic circuit simulation and what is it used for?
Question 2. Find information about the KiCAD design tool. Explain its functions and features.
Question 3. Find information about the Micro-Cap 12 Spice simulation. Explain its functions and features.
Question 4. Look for information about VPP. What should you consider when designing one?
Question 5. Discuss the methods for validating the results of a circuit simulation and explain them.
Question 6. It describes the process for designing an electronic circuit.
Question 7. Find information about circuit construction in "Breadboard". Explain what it is and its characteristics.

Question 8. Look for information about polarity or non-polarity of capacitors, explain what it is and its characteristics.
Question 9. Find information about the values of the color codes of the resistors, explain what it is and its characteristics.
Question 10. Look for information about common electrical points. Explain what it is and its characteristics.
Question 11. Find information about LM741 datasheet analysis. Explain what it is and its characteristics.
Question 12. Find information about DC power supply. Explain what it is and its characteristics.
Question 13. Find information about manipulating the signal generator and oscilloscope. Explain what it is and its characteristics.
Question 14. What is an oscilloscope and what is it used for in electronics? Describe its main components

Bibliographic search: *Include in this cell the reference where you have studied these concepts, it can be a website or a chapter of a textbook or some notes from a subject of your training center.*	Think and write very briefly how you have decided on one type of bibliographic source or another

PART 2.- Workplace. Technical Information.
Look for the following data or technical characteristics.
Question 1. Describes how to connect an oscilloscope to display the output signal from a signal generator configured in sine mode.
Question 2. During a measurement, you notice a distorted signal on the oscilloscope. What adjustments could you make to get a clearer and more accurate visualization of the signal?
Question 3. You have a resistance with colored bands: brown, black, red and gold. What is its value and tolerance?
Question 4. If you need a 220-ohm resistor with a tolerance of 10%, what colors should you look for in the bands of a resistor?
Question 5. Describes the procedure for testing a non-polarized capacitor using a multimeter. What values would you expect to get?

Question 6. You have a number of capacitors with different colors and sizes. Explain how you would determine which ones are polarized and which are not without using any measuring instruments.
Question 7. The electronic circuit does not work as it should. You think the cause of the problem is a polarized capacitor that's wired upside down. Explain the steps you need to take to identify and correct the problem.
Question 8. Simulate a circuit with a microcontroller and multiple sensors using KiCad. Describe how you would integrate the components into the schematic and PCB, and how you would verify the communication between the microcontroller and the sensors.
Question 9. It explains how you would perform a complete KiCad design, including schematic, PCB design, bill of materials, and Gerber files. Describe the importance of each document and how to ensure they are complete and accurate before sending them to manufacturing.
Question 9. Explain how you would simulate an active filter circuit using an op-amp in Micro-Cap 12 Spice. Describe how you would adjust the filter components to meet the design specifications.

Bibliographic search: *Include in this cell the reference where you have studied these concepts, it can be a website or a chapter of a textbook or some notes from a subject of your training center.*	Think and write very briefly how you have decided on one type of bibliographic source or another

PART 2.- Workplace. Processing and storage and presentation of results.	
Do the following exercises.	
Exercise 1. An electronic circuit has been simulated using specialized software and voltage and current data has been collected at different points in the circuit over time. How would you graphically represent the evolution of voltage and current for detailed analysis? Describe what type of chart would be suitable and why.	
Exercise 2. You have performed several simulations with an electric motor control circuit and obtained performance data under different conditions (e.g. variations in input voltage). What techniques would you use to filter and process the data obtained in order to eliminate outliers or measurement errors?	
Exercise 3. During the simulation of a low-voltage circuit in a building, the following results are obtained: voltage levels at different points, voltage drops and overloads. How would you present these results to a customer, in a clear and understandable way?	
Exercise 4. You are designing a home automation system for lighting control in a home and you have carried out simulations to validate the circuit. The results include sensor response times and power consumption. How would you use these results to optimize system design? Describe the modifications you would make based on the data obtained and how you would store the results for future reference.	
Bibliographic search: *Include in this cell the reference where you have studied these concepts, it can be a website or a chapter of a textbook or some notes from a subject of your training center.*	Think and write very briefly how you have decided on one type of bibliographic source or another

PART 3.- Activities. **Task 01**		
Task Title: Design and simulation of circuits in Micro-Cap 12.	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file) *Include the pages you need*		

PART 3.- Task results 01		
Title: Design and simulation of circuits in Micro-Cap 12.	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 01		
Title: Design and simulation of circuits in Micro-Cap 12.	**Folder / server** *:	**Date:**
Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here)		

(add as many pages as needed, copying the entire table)

PART 3.- Analysis of the results of task 01		
Title: Design and simulation of circuits in Micro-Cap 12.	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		

PART 3.- Activities. Task 02		
Task Title: Building the Filter Circuit in "Breadboard".	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file) *Include the pages you need*		

PART 3.- Task results 02		
Title: Building the Filter Circuit in "Breadboard".	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 02		
Title: Building the Filter Circuit in "Breadboard".	**Folder / server** *:	**Date:**
Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*		
PART 3.- Analysis of the results of task 02		
Title: Building the Filter Circuit in "Breadboard".	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		

PART 3.- Activities. Task 03		
Task Title: Filter analysis by applying varying AC frequencies and voltage levels to the input, by reading the output with an oscilloscope.	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file) *Include the pages you need*		

PART 3.- Task results 03		
Title: Filter analysis by applying variable AC frequencies and voltage levels to the input, by reading the output with an oscilloscope.	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 03		
Title: Build the database	**Folder / server** *:	**Date:**

Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*

PART 3.- Analysis of the results of task 03		
Title: Filter analysis by applying variable AC frequencies and voltage levels to the input, by reading the output with an oscilloscope.	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		

PART 3.- Activities. Task 04		
Task Title: Cataloguing peak-to-peak voltage data for the construction of graphs in the final report and intersecting simulation results.	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file)		

Include the pages you need

PART 3.- Task results 04		
Title: Cataloguing Peak-to-Peak Voltage Data for Graph Construction in the Final Report and Intersecting Simulation Results.	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 04		
Title: Cataloguing Peak-to-Peak Voltage Data for Graph Construction in the Final Report and Intersecting Simulation Results.	**Folder / server** *:	**Date:**
Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*		
PART 3.- Analysis of the results of task 04		
Title: Cataloguing Peak-to-Peak Voltage Data for Graph Construction in the Final Report and Intersecting Simulation Results.	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**

Notes on conversations with the supervisor or other team members
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)

PART 3.- Activities. Task 05		
Task Title: KiCAD design of a PCB of its assigned filtered circuit with BNC connectors for input and output.	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file) *Include the pages you need*		

PART 3.- Task results 05		
Title: KiCAD design of a PCB of its assigned filtered circuit with BNC connectors for input and output.	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		

PART 3.- Results of task 05		
Title: KiCAD design of a PCB of its assigned filtered circuit with BNC connectors for input and output.	**Folder / server** *:	**Date:**
Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*		
PART 3.- Analysis of the results of task 05		
Title: KiCAD design of a PCB of its assigned filtered circuit with BNC connectors for input and output.	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		

PART 3.- Activities. Task 06		
Task Title: Preparation and delivery of the final report	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file)		

Include the pages you need

PART 3.- Task results 06		
Title: Preparation and delivery of the final report	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 06		
Title: Preparation and delivery of the final report	**Folder / server** *:	**Date:**
Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*		
PART 3.- Analysis of the results of task 06		
Title: Preparation and delivery of the final report	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		

PART 3.- Activities. Task 07		
Task Title: Preparation of the oral presentation of the final project.	**Folder / server** *:	**Date**:
Brief description		
The problem at hand.		
Hypotheses, solutions that can be anticipated, and expected results.		
Methodology and work plan:		
Initial information available (include a brief summary or notes of the documents already available, include the documents in annexes in the work folder, indicating here the name or reference of the file) *Include the pages you need*		

PART 3.- Task results 06		
Title: Preparation of oral presentation of the final project.	**Folder / server** :	**Date**:
Additional information obtained during the task: Alternative testing methodologies, sources in which to contrast the data obtained, etc. Include the related files as attachments in the folder, indicating here the name or reference of the file.		
Experimental protocol (if there is already a written protocol in the company, just indicates its reference; if not, briefly detail the steps of the experimental procedure)		
PART 3.- Results of task 06		
Title: Preparation of oral presentation of the final project.	**Folder / server** *:	**Date:**

Experimental results (if written by hand or printed by the device, photocopy or scan and copy them here as an image. Videos, photographic images, and other material will be added as attachments in the work folder, writing the name or reference of the file here) *(add as many pages as needed, copying the entire table)*		
PART 3.- Analysis of the results of task 06		
Title: Preparation of oral presentation of the final project.	**Folder / Server** *:	**Date:**
Assessment of the result: Assess the reproducibility of the assay; does it match what was expected? If so, what is the reason why a result very different from the one found was expected?		**Is the result accepted?**
Notes on conversations with the supervisor or other team members		
Conclusions (propose here the solution to the problem posed, but also the detailed conclusions about the task itself, about the experimental procedure, suggestions for new tests, etc.)		
PART 4.- Training content		
Explain the concepts clearly and concisely and solve the exercises collected in the following cells. The questions are sorted by topics related to the training outcomes we hope to achieve during your time at the company. Before you start writing, you'll need to look up information about the topic and study that information.		
Topic 01 (Module 0233: Electronics)	**Bibliographic search:** *Include in this cell the reference where you have studied this topic, it can*	

	be a web page or a chapter of a textbook or some notes of a subject from your training center. Think and write very briefly how you have decided on one type of bibliographic source or another
Explain the differences between AND, OR, and XOR logic gates on a combinational circuit. How could these types of logic doors be used in the implementation of an access control system, for example, in a home automation building?	
A binary counter is designed using flip-flops in a sequential logic circuit. Describe how it works and explain how you could apply this meter in an automated lighting control system in a building.	
Describes the operation of a full-wave rectification circuit and its importance in power supplies. What role does filtering play in this type of circuit and how does it influence the quality of the direct current obtained?	
Explains the differences between a linear and a switched power supply. What are the advantages and disadvantages of each in industrial applications?	
An op-amp is used in an instrumentation circuit. It explains how an op-amp works in both inverter and non-inverter amplifier configurations, and describes a concrete application where one of these amplifiers would be essential.	
An inverter is used to convert direct current (DC) to alternating current (AC) in a solar photovoltaic installation. It explains how an inverter works and describes its importance in the solar system. What characteristics should an inverter have to be efficient in this type of installation?	

A 555 timer in monostable configuration is used to control the ignition of a light for a set amount of time. It explains how this timer works and what parameters can be adjusted to modify the ignition time. In what other applications could this circuit be useful?	
PART 5.- Self-assessment	
The following questions are based on the evaluation criteria set out in the Royal Decree establishing the title of your training cycle. Think about whether what you have studied in relation to each question and the exercises you have done seems sufficient for you to master each of these aspects. Enter a comment to this effect in the box on the right.	
Evaluation criterion CA1 Can you confidently identify the components and functional blocks of combinational logic circuits?	
Evaluation criterion CA2 Do you feel able to identify the components and functional blocks of a sequential circuit?	
Evaluation criterion CA3 Do you know the real applications of rectification and filtering circuits? in the industry? Could you describe one?	
Evaluation criterion CA4 Do you have a good understanding of how the different building blocks that make up a complete feeding system work?	
Evaluation criterion CA5 Are you able to describe the different types of amplifier circuits that you have studied or assembled?	
Evaluation criterion CA6	

Do you recognize the key elements of a power electronics system (thyristor, diac, triac, etc.)?	
Evaluation criterion CA7 Do you have a good understanding of how timers and oscillators work? Can you explain how they work?	