



UNIVERSITAT  
POLITÈCNICA  
DE VALÈNCIA



INDUSTRIAL ENGINEERING MASTER THESIS

**STUDIO OF THE QUALITY OF THE  
ELECTRICAL ENERGY OF A MICROGRID  
WITH DISTRIBUTED GENERATION AND  
MODELLING OF THE SYSTEM IN  
MATLAB-SIMULINK**

AUTHOR: JUAN LUIS SORIANO RIBERA

SUPERVISOR: TOMAS DEVEIKIS

Academic year: 2020-21



**Kaunas University of Technology**  
Faculty of electrical and electronics engineering

**Studio of the quality of the electrical energy of a microgrid  
with distributed generation and modelling of the system in  
matlab-simulink**

Master's final thesis

---

**Juan Luis Soriano Ribera**  
Student

**Dr. Tomas Deveikis**  
Lecturer

---

**Kaunas, 2021**

## Table of contents

List of figures .....	3
List of tables .....	6
List of abbreviations and terms .....	7
Abstract.....	8
Introduction .....	9
1. Harmonics and power quality.....	10
1.1. Electric wave .....	10
1.1.1. Frequency .....	10
1.1.2. Amplitude.....	10
1.1.3. Form .....	10
1.1.4. Symmetry .....	11
1.2. Harmonics.....	11
1.2.1. How to measure harmonics .....	12
1.3. Detrimental effects of harmonics .....	13
1.4. Standards and regulations.....	14
1.4.1. EN-50160 .....	14
1.4.2. IEEE 519-2014 .....	15
1.4.3. Standard used.....	16
2. Description of the installation .....	17
3. Measurements.....	23
3.1. Simplifications and hypothesis .....	23
3.2. Procedure.....	23
3.3. Measuring equipment .....	25
3.4. Results .....	25
3.4.1. Consuming / On-grid.....	26
3.4.2. Consuming / Off-grid .....	38
3.4.3. Generating / On-grid.....	42
3.4.4. Inverter analysis.....	45
4. Matlab model.....	51
4.1. Description and hypothesis of the model .....	51
4.2. Simulation results .....	55
5. Possible improvement measures.....	62
Conclusions .....	63
List of references .....	64
Appendices .....	65
Appendix 1. Weather conditions considered for the simulation .....	65