
Contents

Foreword 1	ix
Frédéric SUTTER	
Foreword 2	xiii
Maryline CHETTO	
Preface	xvii
Chapter 1. Wireless Sensor Networks	1
1.1. Brief historical perspective.	1
1.2. Some principles and definitions.	2
1.2.1. The structure of a wireless sensor network.	2
1.2.2. Structure of a node	4
1.3. The energy question.	5
1.4. Aeronautics.	8
Chapter 2. Energy Autonomy	13
2.1. Introduction.	13
2.2. Electrochemical source and electrostatic energy storage	13
2.3. General points relating to the retrieval of ambient energy	18
2.3.1. The structure of a system based on the harvesting of ambient energy.	18
2.3.2. Justification and sizing of storage	21
2.3.3. A few points relating to supercapacitors (also ultra-capacitors)	23

2.4. Ambient energies and associated transducers	26
2.4.1. Harvesting light energy	27
2.4.2. Using thermal gradients	31
2.4.3. Using vibrations.	46
2.5. Conclusion	53
Chapter 3. Architectures and Electric Circuits	55
3.1. Introduction.	55
3.2. Different storage modes	57
3.2.1. System without storage	57
3.2.2. System with electrochemical storage	57
3.2.3. Storage made using supercapacitors	58
3.3. Set up and operation of the energy harvesting system	67
3.3.1. Initial startup.	67
3.3.2. Startup of the energy harvesting system under low voltage	68
3.3.3. Operating the energy harvesting system under low voltage	69
3.4. Delayed load activation (undervoltage lockout – UVLO)	72
3.4.1. Illustration of problems	72
3.4.2. Carrying out the UVLO	75
3.4.3. Control logic.	80
3.5. DC/DC converters	83
3.5.1. Functions.	83
3.5.2. Topology and scaling rules	84
3.5.3. Step-down converter	85
3.5.4. Step-up converter	90
3.5.5. Supplying power to converter electronics	93
3.6. Safeguards	94
3.6.1. Input safeguards.	95
3.6.2. Output safeguards.	97
3.7. Conclusion	100
Chapter 4. Build Achievements	103
4.1. Introduction.	103
4.2. Autonomous power supply for external sensors in a flight testing campaign.	104
4.2.1. Flight testing background	104
4.2.2. Situations with external sensors	104

4.2.3. Principal elements of the design brief	105
4.2.4. Choosing technologies	107
4.2.5. Builds and tests	116
4.3. Autonomous power supply for age tracking sensors	118
4.3.1. Introduction to structural health monitoring	118
4.3.2. Context of our study	119
4.3.3. Design brief	122
4.3.4. Thermogeneration module	123
4.3.5. Electronic energy management system	127
4.3.6. Energy management system testing	131
4.3.7. Airplane assembly and flight testing	138
4.4. Aeroacoustic energy recovery	139
4.4.1. Introduction	139
4.4.2. Concept	140
4.4.3. Experimental results	140
4.4.4. Conclusion: aeroacoustic noise harvesting	144
4.5. General conclusion: build achievements provided	144
Conclusion	147
Appendix. Summary of Certifications and Standards	149
Bibliography	153
Index	157