

Handmade Electronic Music

The Art of Hardware Hacking

THIRD EDITION

*Written and edited by
Nicolas Collins*

Illustrated by Simon Lonergan

Contents

<i>The Website: www.HandmadeElectronicMusic.com</i>	<i>xi</i>
<i>Foreword to the First Edition (2006)</i>	<i>xiii</i>
DAVID BEHRMAN	
<i>Introduction</i>	<i>xv</i>
Part 1 Starting	1
1 Getting Started: Tools and Materials Needed	3
2 The Seven Basic Rules of Hacking: General Advice	9
Part 2 Listening	11
3 The Victorian Synthesizer: Twitching Loudspeakers	13
4 In/Out: Speaker as Microphone, Microphone as Speaker, the Symmetry of It All	18
5 How to Solder: An Essential Skill	21
6 Circuit Sniffing: Eavesdropping on Hidden Magnetic Music <i>Art & Music 1 Mortal Coils</i>	25
7 How to Make a Contact Mike: Using Piezo Disks to Pick Up Tiny Sounds <i>Art & Music 2 John Cage—Father of Invention</i> <i>Art & Music 3 Piezo Music</i>	33
8 Turn Your Wall Into a Speaker: Resonating Objects With Transducers, Motors, and More <i>Art & Music 4 David Tudor and Rainforest</i> <i>Art & Music 5 Drivers</i>	47

9	Paper Speakers JESS ROWLAND	60
10	Tape Heads: Play Your Credit <i>Art & Music 6 Tape</i>	67
11	Electret Microphones: Binaural on a Budget	74
12	Laying of Hands: Transforming a Radio Into a Synthesizer by Making Your Skin Part of the Circuit <i>Art & Music 7 The Cracklebox</i>	82
	Part 3 Building	89
13	My First Oscillator™: Six Oscillators on a Chip, Guaranteed to Work	91
14	Solder Up! From Breadboard to Circuit Board	112
15	Getting Messy: Modulation, Feedback, Instability, and Crickets <i>Art & Music 8 Composing Inside Electronics</i>	118
16	Soft Circuitry: An Introduction to E-Textile Interfaces LARA AND SARAH GRANT <i>Art & Music 9 Soft Electrical Art</i>	136
17	On/Off (More Fun With Photo Resistors): Gating, Tremolo, Panning, and More	171
18	Mixers and Matrices: Very Simple, Very Cheap, Very Clean Ways of Configuring Lots of Circuits	185
19	Boost and Distort: A Simple Circuit That Goes From Clean Preamp to Total Distortion	198
20	Analog to Digital Conversion, Sort Of: Modulating Other Audio With Your Circuits, Pitch Tracking, and a Sequencer	210
21	Beyond Bending: Triggering, Sequencing, and Modulating Circuit-Bent Toys ALEX INGLIZIAN	224
22	Video Hacking LOVID (TALI HINKIS, KYLE LAPIDUS) AND JON SATROM	236
23	An Introduction to Op Amps	246
24	A Little Hacker's Amp	253
25	The Mumma-Tudor Ring Modulator MICHAEL JOHNSEN AND YOU NAKAI	259

26	Paper Circuits PETER BLASSER	266
27	Rule the Airwaves: Build a Radio Transmitter BRETT IAN BALOGH	274
28	A Grab Bag of Samples: A Voltage-Controlled Radio Receiver HOLGER HECKEROTH	288
29	A Lo-Fi Sampler and Looper HOLGER HECKEROTH	304
30	The Bissell Function Block: A Lag Processor PETER SPEER	312
31	Sounds From Neural Networks WOLFGANG SPAHN	319
Part 4	Computing	329
32	Sharing Traces: Designing and Fabricating Your Own Printed Circuit Boards With Fritzing EDUARDO F. ROSARIO	331
33	Microcontroller Sound JOSEPH KRAMER	351
34	Small Sound: Pure Data on Raspberry Pi ROBB DRINKWATER	364
35	Data Hacking: The Foundations of Glitch Art NICK BRIZ	377
Part 5	Connecting	391
36	Handmade Sound Communities LISA KORI AND DAVID NOVAK	393
37	Hello World!	406
	<i>Appendix A Resources</i>	415
	<i>Appendix B The Rules of Hacking</i>	419
	<i>Contributing Authors</i>	421
	<i>Illustration Credits</i>	425
	<i>Index</i>	427