### Contents

**SPARK**

- **06** Top Projects
  - Creativity is all around us!
- **16** Objet 3d’art
  - Form meets function in 3D-printed steel!
- **18** Meet the Maker: Andrew Ziminski
  - What it’s like to use tools from 2000 years ago
- **22** Columns
  - Why CircuitPython is the future of digital making
- **24** Letters
  - Continuing our endless love for free-form circuits
- **26** Kickstarting
  - Clothing to signal your group identity
- **28** Hackspace Maker Works
  - They make things in Michigan – lots of things!

**ELECTRONICS**

- **34** Electronics
  - The components and modules to make your circuits soar
- **52** How I Made The Mask
  - Paranoid about state surveillance? Make one of these!
- **58** In the Workshop Ultrasonic pong
  - Play this classic game without getting your hands dirty
- **62** Interview York Robotics Lab
  - “Mummy, Daddy, where do robots come from?”
- **70** Improviser’s Toolbox Toothpicks
  - Sharp mini tree-trunks for quick and easy builds
- **74** Breaking 3D prints
  - Test the strength of outlines and infill densities

**33 LENS**

- **112** Identify the odds and ends in your component drawer

**FORGE**

- **06** Top Projects
  - Creativity is all around us!
- **16** Objet 3d’art
  - Form meets function in 3D-printed steel!
- **18** Meet the Maker: Andrew Ziminski
  - What it’s like to use tools from 2000 years ago
- **22** Columns
  - Why CircuitPython is the future of digital making
- **24** Letters
  - Continuing our endless love for free-form circuits
- **26** Kickstarting
  - Clothing to signal your group identity
- **28** Hackspace Maker Works
  - They make things in Michigan – lots of things!

**SoM**

- **77** CircuitPython
  - Manipulate the brightness of LEDs with dithering
- **80** Precision boring
  - Make holes bigger with confidence and control!
- **84** Tutorial Welders
  - Hot the right stick welder for your workshop
- **86** Tutorial Raspberry Pi audio
  - From beeps and fizzes to high fidelity sound
- **90** Tutorial Shop organisation
  - Aid tool-based omniscience
- **92** Tutorial Belt drives
  - Get power from where it is to where you need it
- **96** Tutorial 3D-printed vase
  - Explore effects in Cura
- **104** Tutorial BeagleBone gamepad
  - Low-latency IO using programmable real-time units

**FIELD TEST**

- **112** Direct from Shenzhen Component tester
  - Identify the odds and ends in your component drawer

**LENS**

- **114** Electronics
  - The components and modules to make your circuits soar
- **118** How I Made The Mask
  - Paranoid about state surveillance? Make one of these!
- **124** In the Workshop Ultrasonic pong
  - Play this classic game without getting your hands dirty
- **128** Interview York Robotics Lab
  - “Mummy, Daddy, where do robots come from?”
- **136** Improviser’s Toolbox Toothpicks
  - Sharp mini tree-trunks for quick and easy builds
- **140** Breaking 3D prints
  - Test the strength of outlines and infill densities

**Cover Feature**

- **34** Build better, stronger, faster, higher, circuits

**LENS**

- **34** Electronics
  - The components and modules to make your circuits soar
- **52** How I Made The Mask
  - Paranoid about state surveillance? Make one of these!
- **58** In the Workshop Ultrasonic pong
  - Play this classic game without getting your hands dirty
- **62** Interview York Robotics Lab
  - “Mummy, Daddy, where do robots come from?”
- **70** Improviser’s Toolbox Toothpicks
  - Sharp mini tree-trunks for quick and easy builds
- **74** Breaking 3D prints
  - Test the strength of outlines and infill densities

**FORGE**

- **112** Direct from Shenzhen Component tester
  - Identify the odds and ends in your component drawer

**LENS**

- **114** Electronics
  - The components and modules to make your circuits soar
- **52** How I Made The Mask
  - Paranoid about state surveillance? Make one of these!
- **58** In the Workshop Ultrasonic pong
  - Play this classic game without getting your hands dirty
- **62** Interview York Robotics Lab
  - “Mummy, Daddy, where do robots come from?”
- **70** Improviser’s Toolbox Toothpicks
  - Sharp mini tree-trunks for quick and easy builds
- **74** Breaking 3D prints
  - Test the strength of outlines and infill densities

**Cover Feature**

- **34** Build better, stronger, faster, higher, circuits