THE LPC84X MCU FAMILY – A MULTI-TESTER TOOL OFFERING FEATURES FOR YOUR NEXT IOT DESIGN

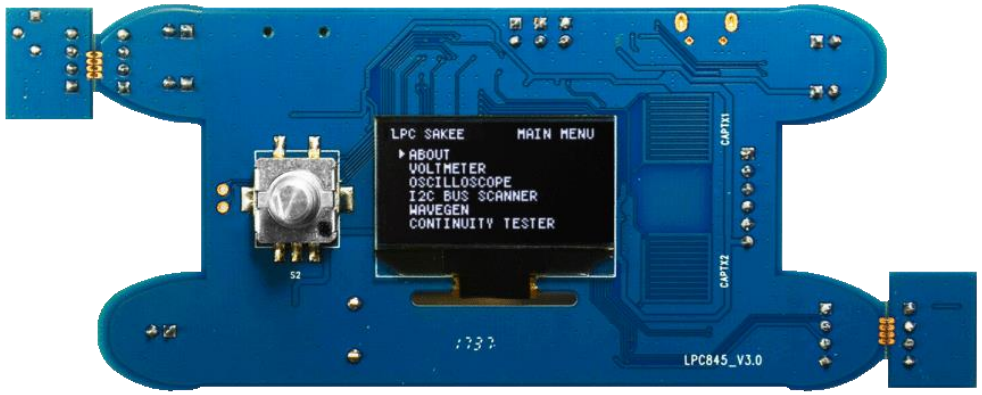
KEVIN TOWNSEND (MICROBUILDER)
BRENDON SLADE (NXP)

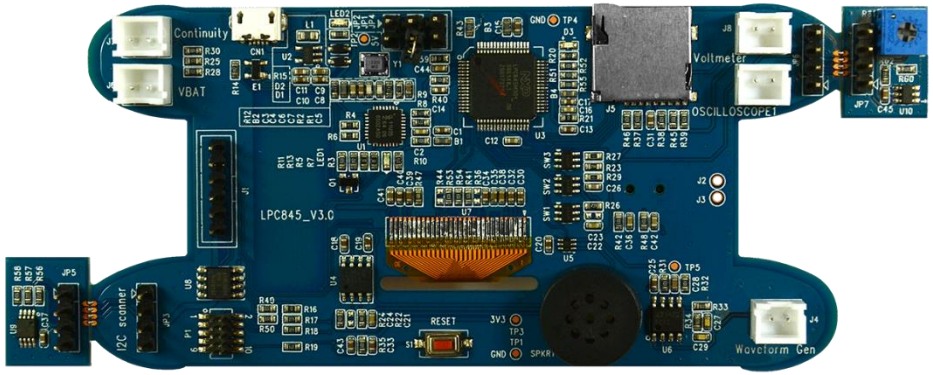
Agenda – Part I

- Overview of the LPC84x Multi-Tester "Swiss army knife" for EEs (SAKEE) project
- The LPC84x series from NXP
- Mixed signal features:
  - Voltmeter
  - Oscilloscope
  - Waveform generator
  - Continuity tester
- What's coming in the next webinars

Overview of Swiss Army Knife for EEs project

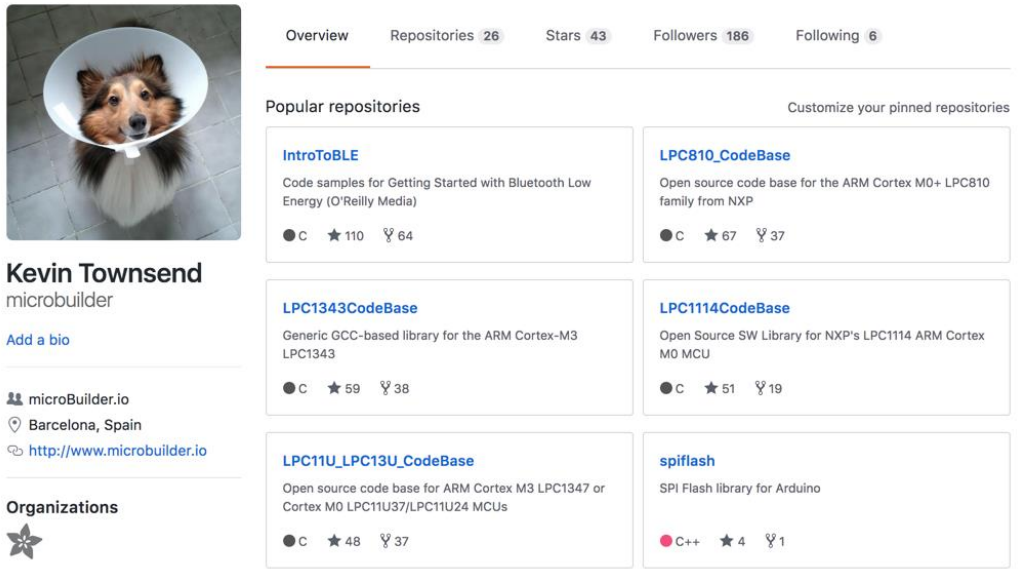
- Project aims
  - Develop a handy tool for basic testing tasks EEs frequently need to accomplish
  - Design a platform that can be easily customized and extended for specific testing tasks
  - Showcase how to use the main features of the highly flexible LPC845
  - Provide open source hardware and software to the LPC community of users for easy access to the design





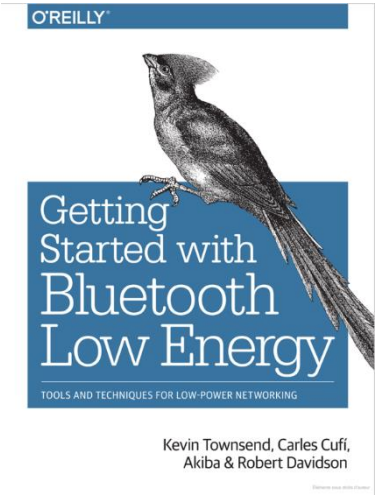
Kevin Townsend

- Lead Engineer at Adafruit Industries
- Cortex-M user since the first commercially available M0 device (the LPC1114 in 2009)
- Published some of the earliest open source Cortex-M codebases for the LPC800, LPC1100, and LPC1300 families
- Primary area of interest is extremely low cost 32-bit MCUs and RF solutions



GitHub

www.github.com/microbuilder



THE LPC84X MCU FAMILY

LPC Focus on Consumer & Industrial Markets

Architecting Scalable MCU Families with Flexible Integration
Enabling Fast Time & Platform Re-use

1. **Product Innovation.**
2. **Broad Ecosystem.**
3. **Quality & Longevity.**
4. **Local Support.**
5. **Extensive Software & Tools.**

- Accelerating Transition from 8-bit to **Entry-level Cortex-M0+ based MCUs**
- **Low Power, High Performance MCUs** for Energy Conscious Application

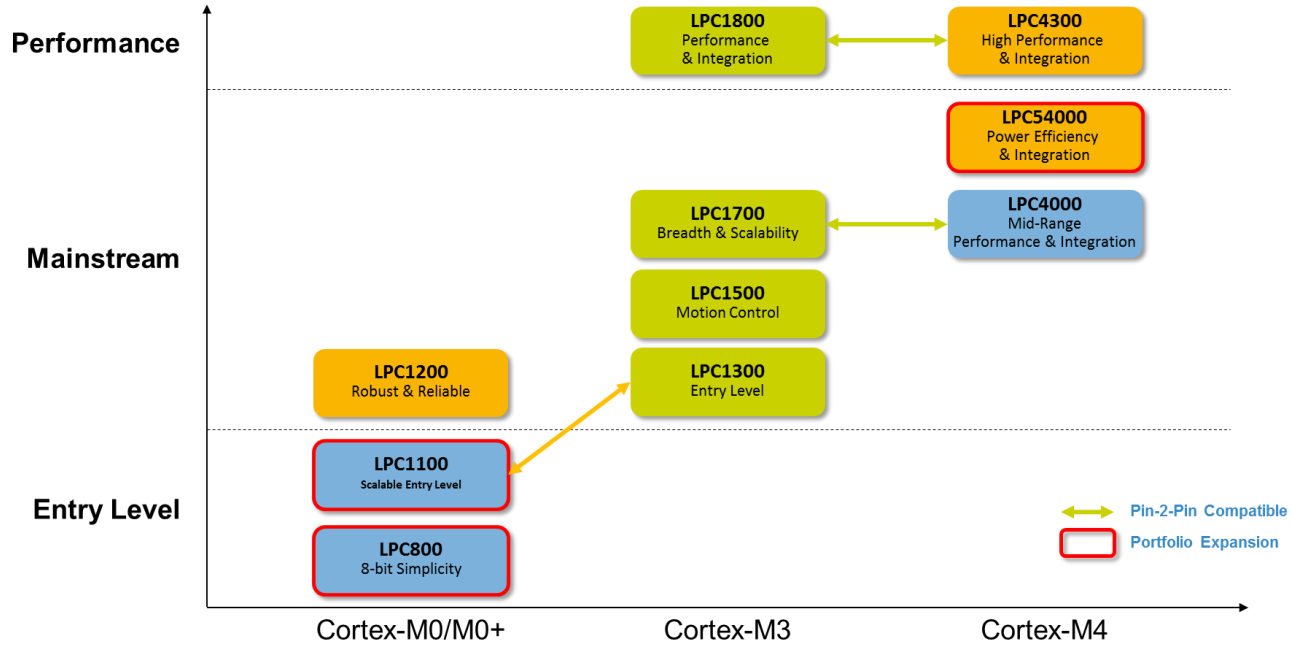
LPC 32-bit Microcontrollers for the Mass Market

Over 1B units shipped	>400 part numbers	Thriving ecosystem	Complementary professional development suite (HW/SW)

Open Development Environment

- **MCUXpresso IDE with Easy to Use Software Code Bundles**
- **Development, Debug & Expansion Boards**
- **Developer Community**

Complete Portfolio of Cortex-M MCUs



Easy Development

Scalable Expansion

LPC800 Growing Series of Microcontrollers

NXP's Investment in 8-bit Alternative MCUs

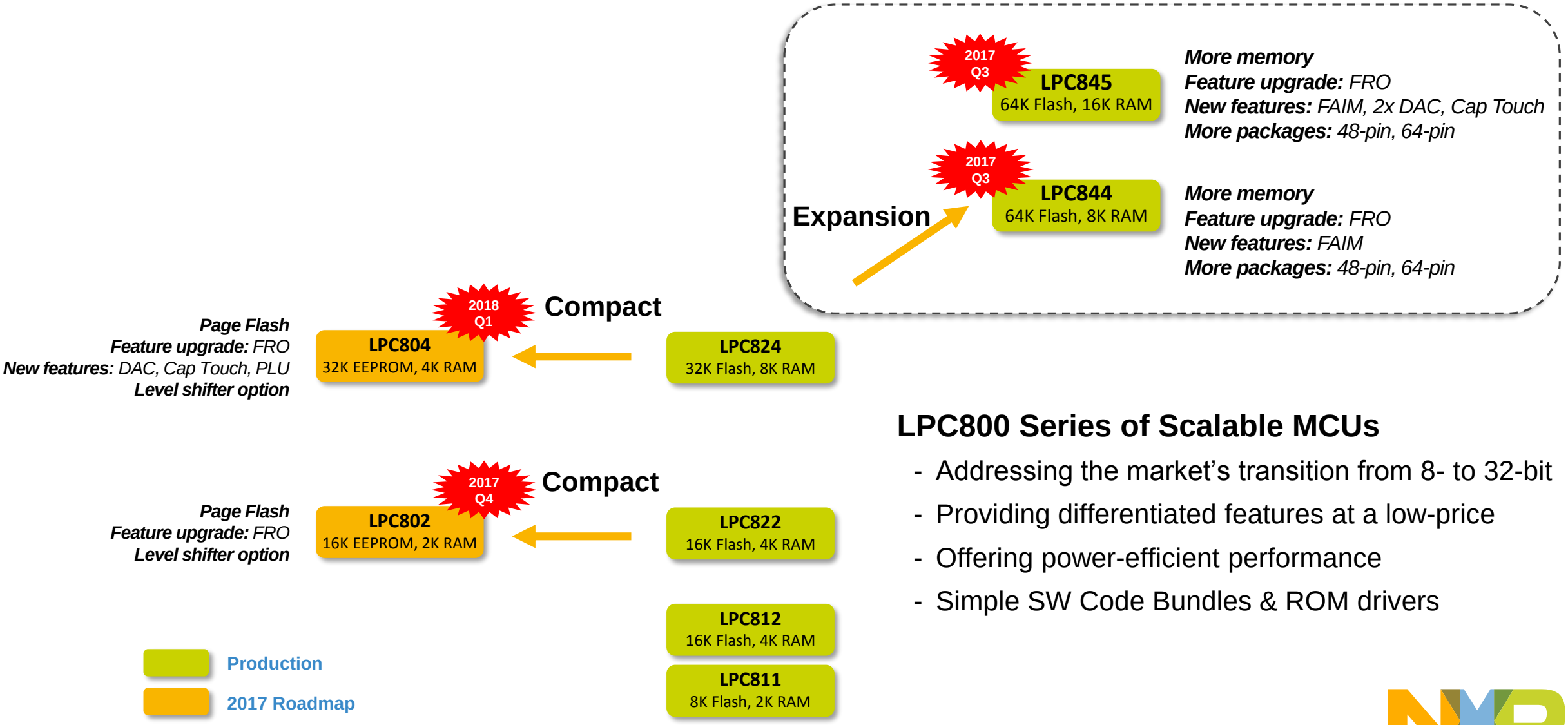
Strength in Longevity

Expecting to Surpass 50M Cumulative Shipments by end of 2017!

LPC800 building a broad, scalable portfolio of MCUs for a wide range of global applications

"At Nice, we strive to improve the quality of life for our customers by simplifying everyday experiences through automation," said Lauro Buoro, chairman of Nice SpA. "Turning this vision into a reality requires a supplier that can anticipate market changes to stay ahead of the technology curve. With NXP's LPC800 portfolio and roadmap, we are confident that they understand clearly the rapid move from proprietary 8-/16-bit architectures toward Cortex-M0+ based MCUs. We have no doubt that LPC will continue to stay ahead of the market and be well-positioned to support our long-term, entry-level MCU requirements."

LPC84x Part of NXP's Rapid Expansion of the LPC800 Series



LPC800 Series of Scalable MCUs

- Addressing the market's transition from 8- to 32-bit
- Providing differentiated features at a low-price
- Offering power-efficient performance
- Simple SW Code Bundles & ROM drivers

LPC84x MCU Family Overview

Power efficient
- 30 MHz ARM® Cortex®-M0+ with advanced power optimization
- Free Running Oscillator (FRO)
- Five power modes
- Power profile APIs for simple runtime power optimization

Expandable memory
- 64 kB Flash, small 64 B page size suitable for EEPROM emulation
- 16 kB RAM
- FAIM memory allowing the user to configure chip behavior on power-up

Expanded serial connectivity
- 4 I^2C for digital sensor interface and more
- 2 SPI, 5 UART
- 54 GPIO with switch matrix, support input pattern match engine
- I/O pin configuration (switch matrix)
- ISP supports via UART, SPI and I^2C

Precision, power-optimized analog
- Accurate 1.2-Msps ADC: 12 ch, 12-bit
- Digital-to-Analog Converter (DAC) : 2 ch, 10-bit
- Comparator with five input pins and external or internal reference voltage

LPC84x MCU Target Applications

- **Power- and size-sensitive control and connectivity tasks such as:**
  - Sensor gateways – connect to & concentrate data from analog and/or digital sensors
  - End-node connectivity, e.g. NFC, BLE, Zigbee ,etc.
  - Capacitive touch for HMI (Enablement coming in Q3)
  - Basic motor control (e.g. fan control, DC motor control, etc.)
  - Simple 8/16-bit replacements
- **In wide range of entry-level products in Consumer, Industrial, IoT, Wearable, and Gaming markets, such as:**
  - Thermostats and home environment monitoring devices
  - Toys, models, action figures
  - Home & building automation
  - Industrial controls
  - Lighting
  - Server/rack monitoring
  - Portable/Wearable fitness products
  - And many more…

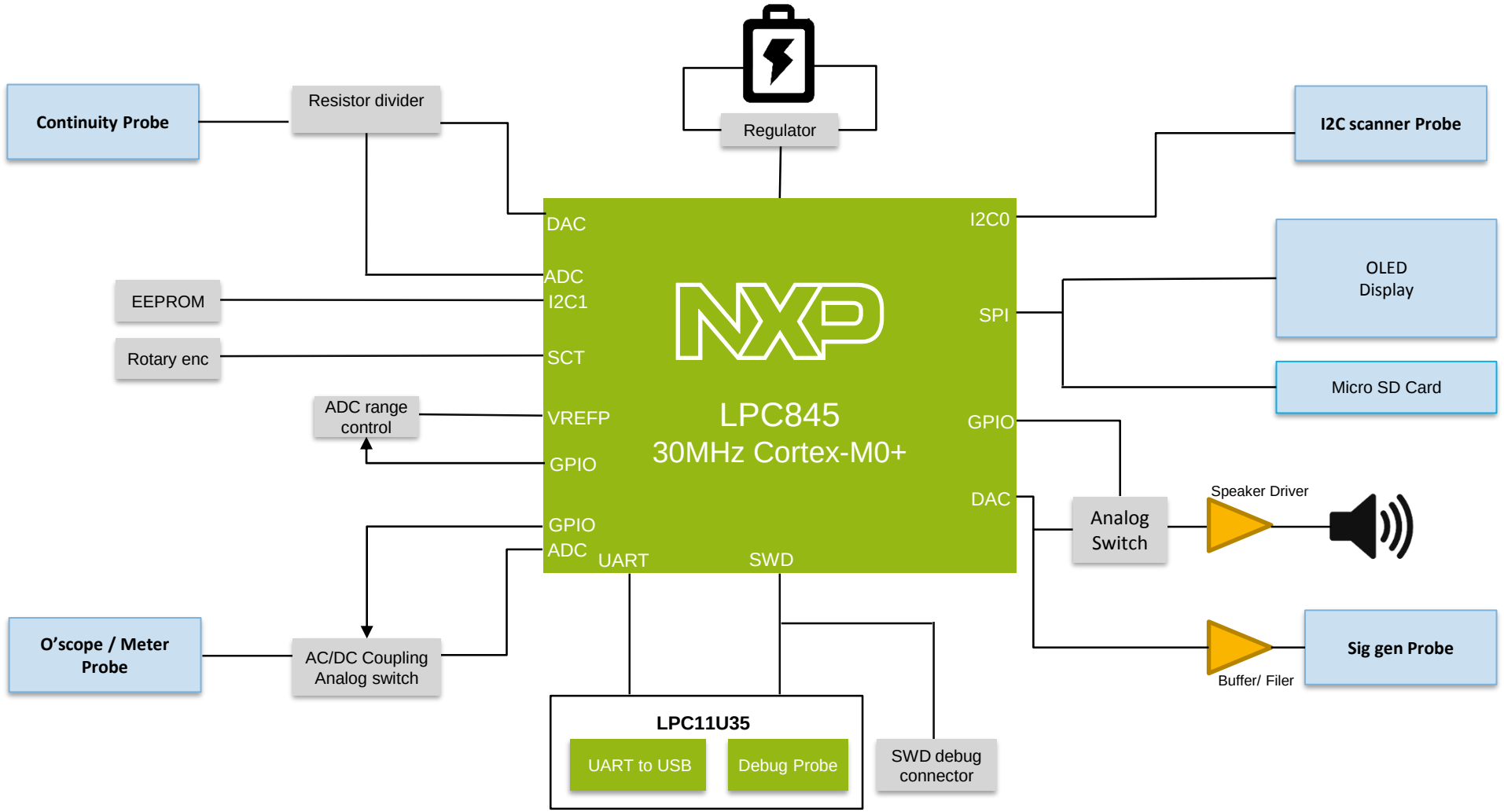




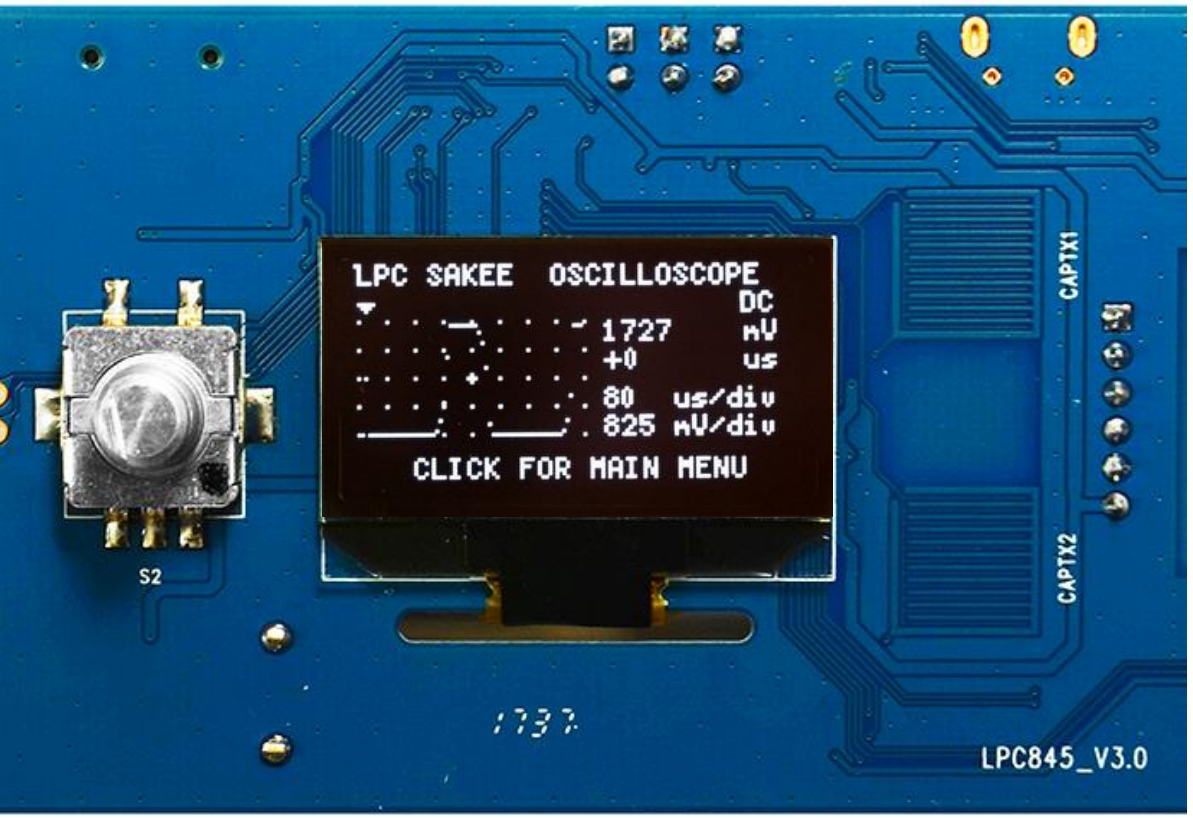


“SAKEE” MULTI-TOOL OVERVIEW

Block diagram



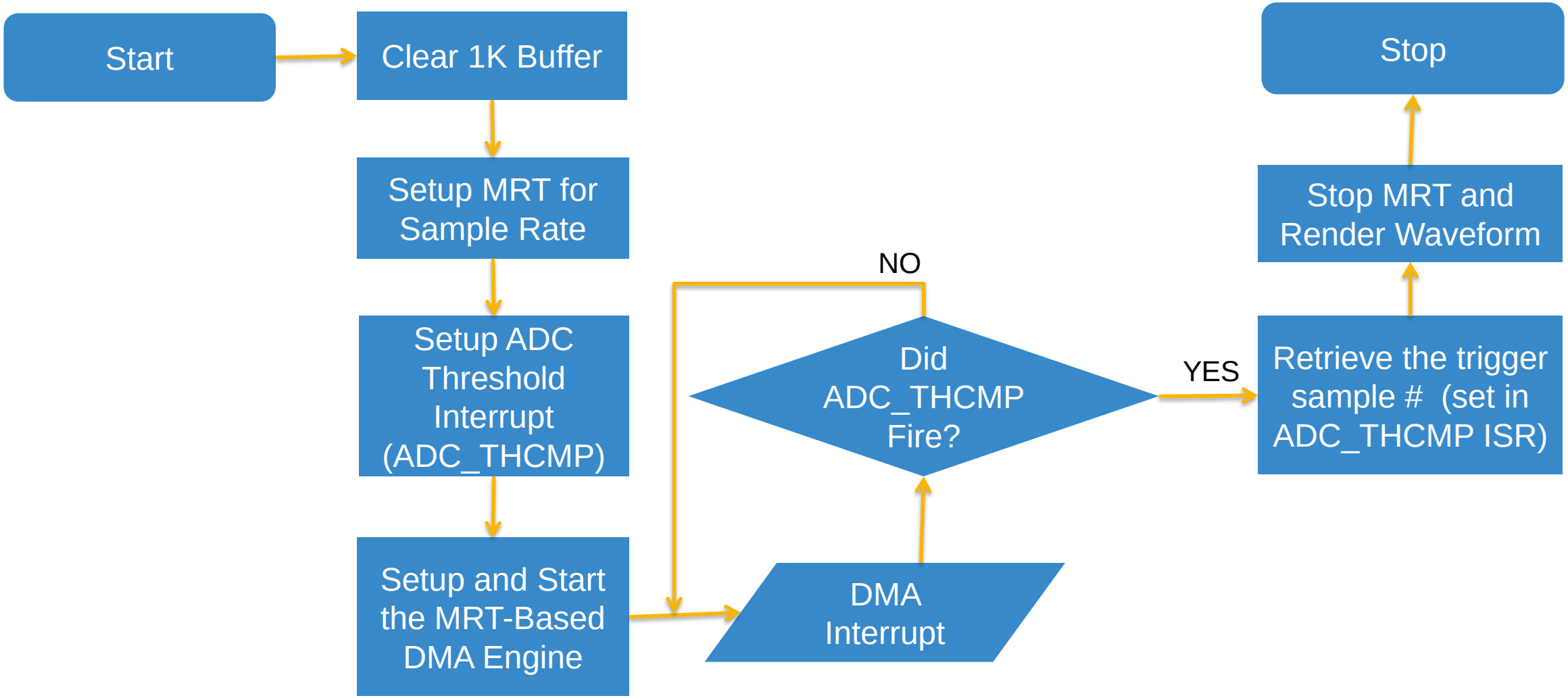
Feature: Oscilloscope



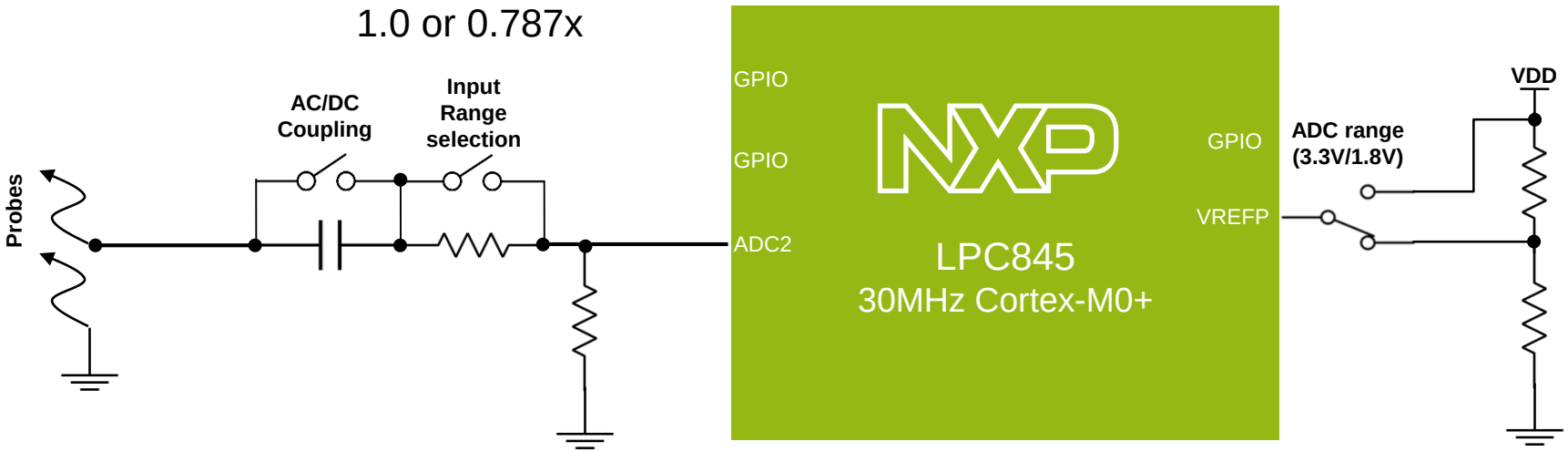
- Single shot capture of 1K samples
- High/low trigger level control
- Sampling frequency selection (10Hz to 500kHz)
- Hardware support for AC/DC coupling selection

- LPC845 features used:
  - ADC with reference voltage control
  - GPIOs
  - SPI (display)
  - SCT (rotary encoder)
  - MRT (ADC Sample Timer)
  - DMA

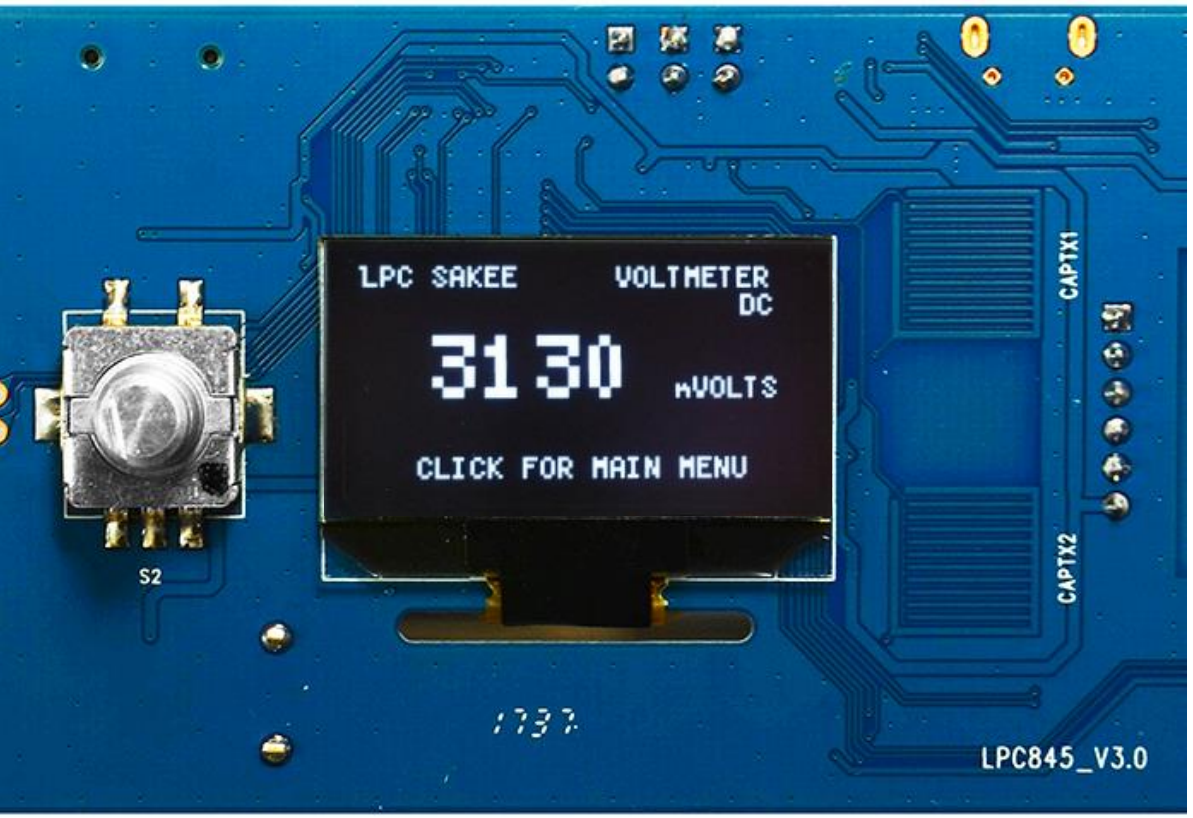
Oscilloscope Software Design



Oscilloscope / Voltmeter input circuit



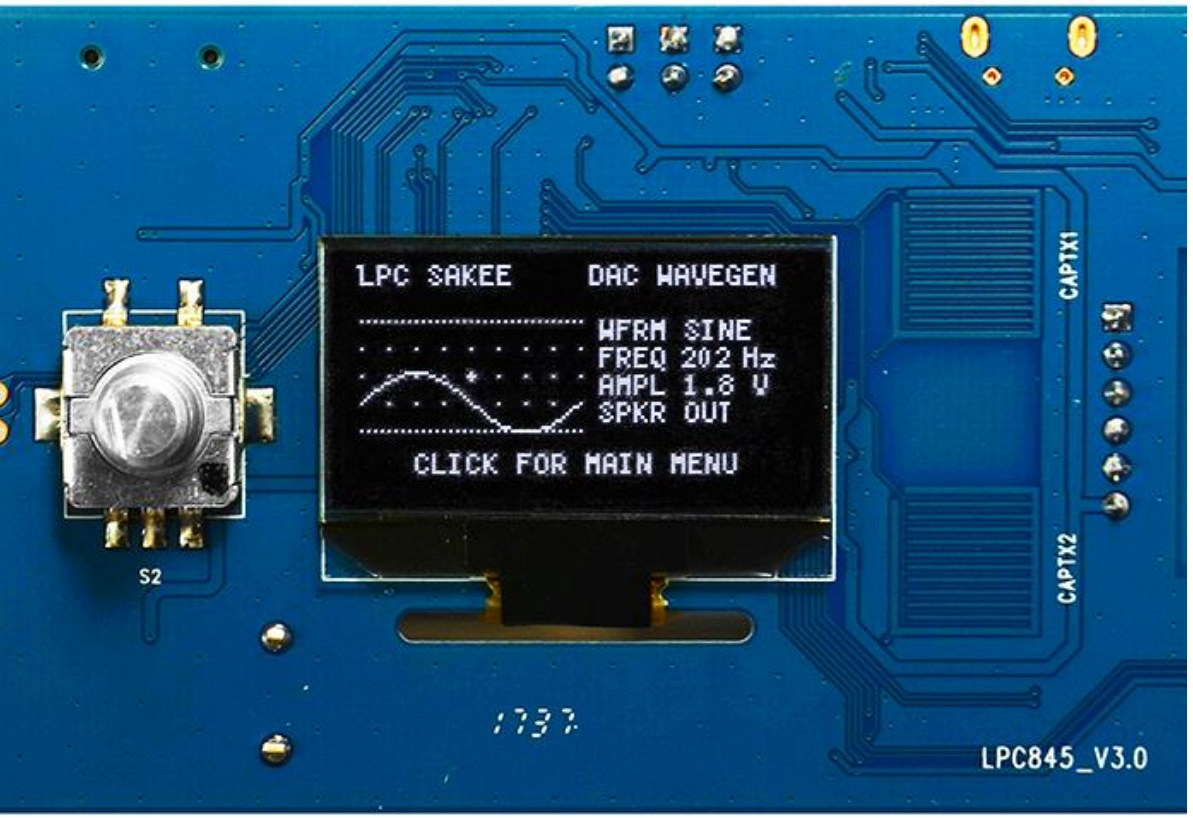
Feature: Voltmeter



- AC/DC coupling selection
- Hardware support for range selection
  - By resistor network
  - By voltage reference selection (3.3V or resistor-selected

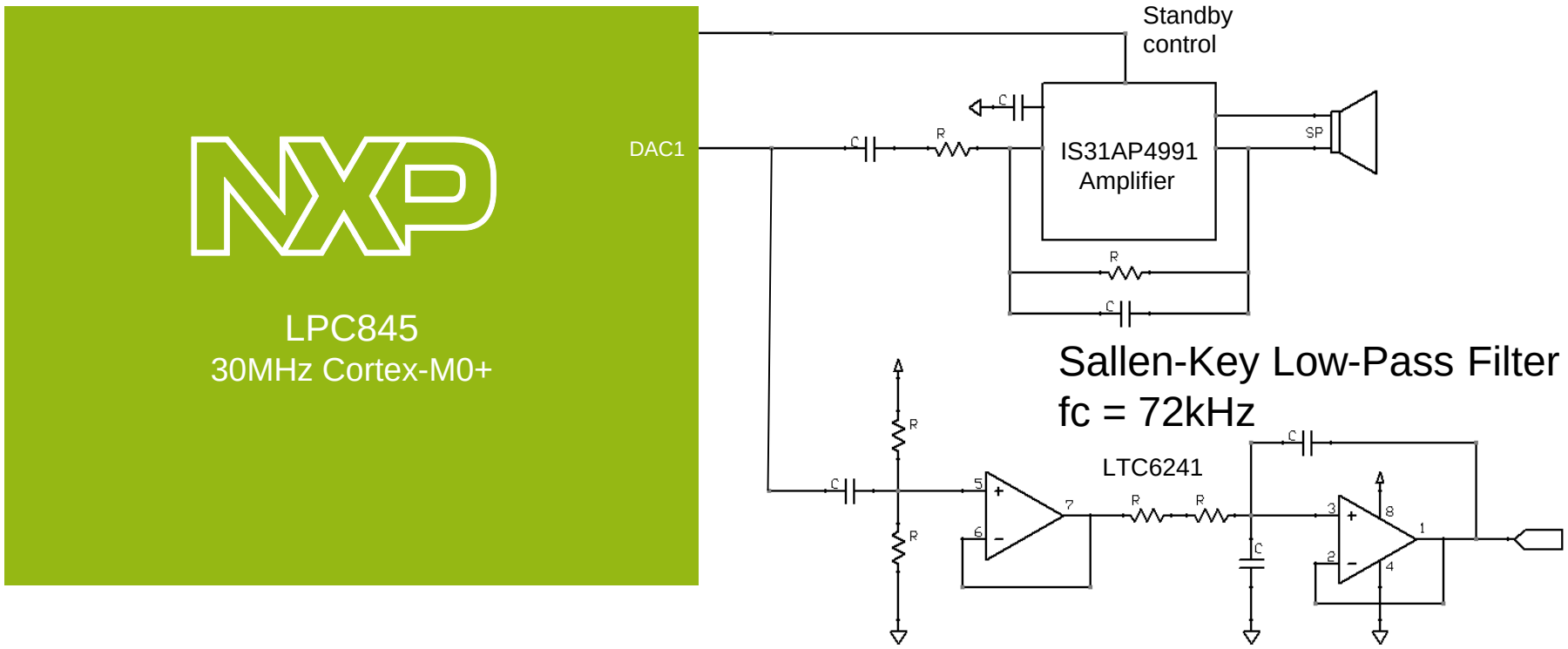
- LPC845 features used:
  - ADC with reference voltage control
  - GPIOs
  - SPI (display)
  - SCT (rotary encoder)

Feature: Waveform generator

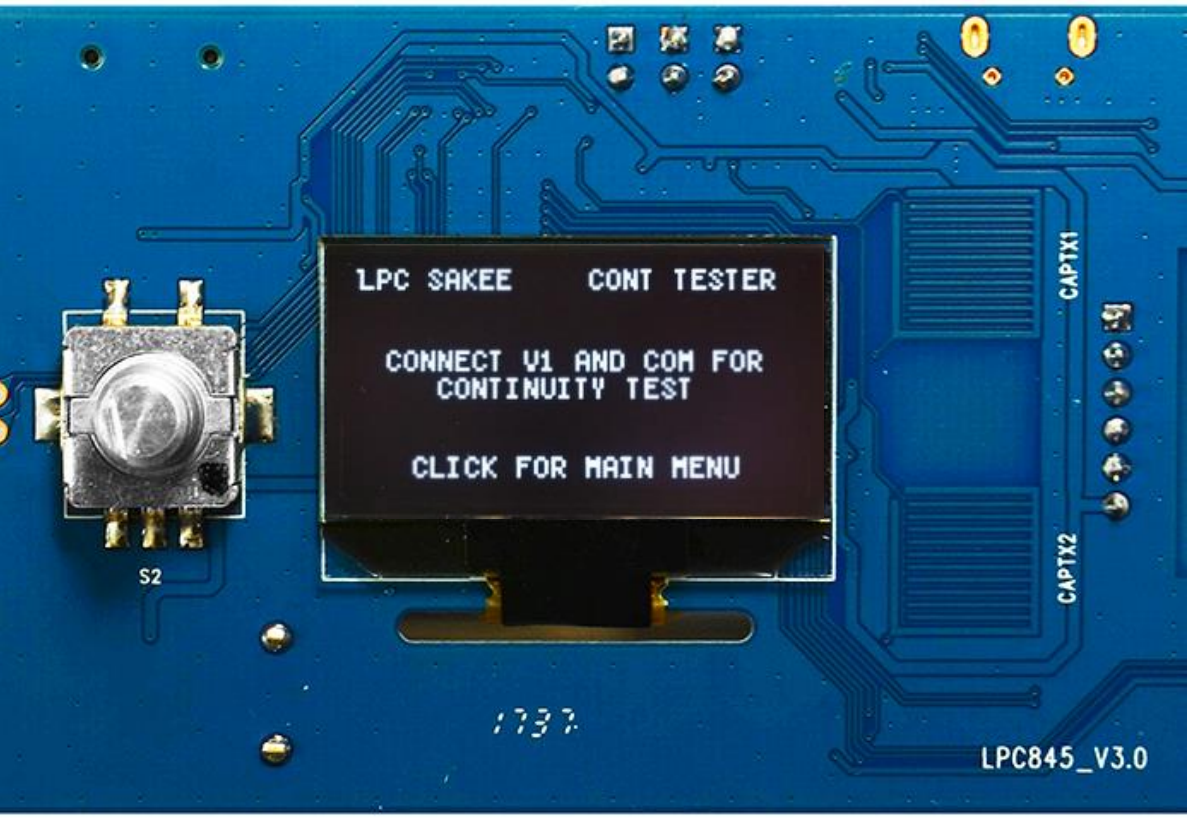


- LPC845 DAC used to generate pre-defined or user waveforms:
  - Sine
  - Triangle
  - Exponential
- User waveforms can be loaded over UART (via LPC11U35 USB bridge)
- 100-800 Hz output (Adjustable)
- LPC845 features used:
  - DAC
  - USART
  - GPIOs
  - SPI (display)
  - SCT (rotary encoder)

Waveform Generator / Continuity Buzzer tone circuit



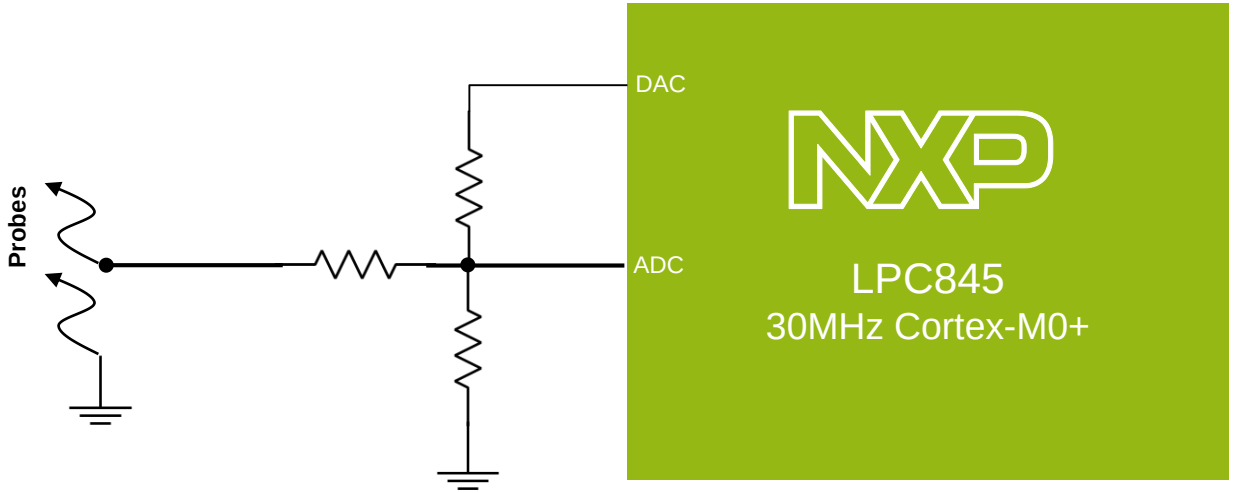
Feature: Continuity tester



- Easy check for shorts/opens on unpowered circuits
- Visual (display inversion) and audio (buzzer output) confirmation of short circuits

- LPC845 features used:
  - ADC
  - DAC
  - SPI (display)
  - SCT (rotary encoder)

Continuity tester input circuit



IN THE NEXT WEBINARS…

Next in this webinar series

- Part II – Enhancing the end-user experience by leveraging the digital and HMI features on the LPC84x MCU family
  - **October 26th**
  - Display control
  - Rotary encoder
  - I2C bus scanner
  - Other digital features in the hardware platform
- Part III - Take advantage of the rich ecosystem of enablement for LPC84x MCUs
  - **November 9th**
  - How SAKEE was developed
  - MCUXpresso IDE and Code Bundles
  - Starting from the LPCXpresso boards to develop SAKEE

Where to find out more

- Visit Developer Resources > Reference Designs > LPC845 Based Swiss Army Knife Multi-tester
  - Direct URL: http://www.nxp.com/pages/:LPC845-Multi-Tester
- Kevin's Github (software) : www.github.com/microbuilder
- More information on LPC84x: https://www.nxp.com/lpc84x
- MCUXpresso IDE: https://www.nxp.com/mcuxpresso

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