Be Boulder.

University of Colorado Boulder

Request for Services (RFS)

Project:	Signal Analyzer Design Evaluation
Creation Date:	2016-02-29
Last Revision Date:	2017-10-18
Version:	1.2
Status:	Proprietary and Confidential

Table of Contents

1 Introduction and Background

1.1 Purpose

Keithley, a Tektronix company, provides a greater measure of confidence to customers around the world by designing solutions for their test and measurement needs. By building from its strength in electrical measurement solutions for research, Keithley has become a production test technology leader through working partnerships with leaders in fields where the pace of innovation and change is very fast, such as global communications, semiconductors, and components manufacturing. More information is available at http://www.keithley.com/.
Keithley products are sold in more than 80 countries including Belgium, Brazil, China, France, Germany, Great Britain, India, Italy, Japan, Korea, Malaysia, the Netherlands, Russia, Singapore, Switzerland, Taiwan, and the United States.

Keithley requires hardware development services in support of a new product development. Specifically, the company requires embedded system design evaluation for the proposed 2017 Signal Analyzer. Implementation of pre-production prototypes is a desirable follow-on contract. The scope of the work required includes evaluation, and testing of the proposed embedded system platforms.

In particular, Keithley wants a result better than the competitive product pictured here, making reuse of the product shown in the next picture:

1.2 Administrative

1.2.1 TECHNICAL CONTACT

Any questions concerning technical specifications or Statement of Work (SOW) requirements must be directed to:

Name	Arundhathi Swami
Address	1111 Engineering Drive, Boulder CO, 80309
Phone	NA
FAX	NA (are you kidding?)
Email	Arundhathi.swami@colorado.edu

Name	Shalin Shah
Address	1111 Engineering Drive, Boulder CO, 80309
Phone	TBD
FAX	NA
Email	Shalin.shah@colorado.edu

1.2.2 CONTRACTUAL CONTACT

Any questions regarding contractual terms and working conditions or report format must be directed to:

Name	Tim Scherr
Address	1B67, 1111 Engineering Drive, Boulder CO, 80309
Phone	3037357633
FAX	NA
Email	Timothy.scherr@Colorado.edu

1.3 DUE DATES

All Reports are due by 11:59 am MST on 2014/11/08. Any Report received at the designated location after the required time and date specified for receipt shall be considered late and receive a 10% per day penalty. Any late reports will not be evaluated for the Top Prize.

1.4 SUGGESTED SCHEDULE OF EVENTS

Event	Date
1. RFS Distribution to Vendors	2017/10/18
2. Platform Evaluation begins	2017/10/18
3. Questions from Vendors about scope or approach due	2017/10/23
4. Approximate Completion of Module 1	2016/10/25
5. Approximate Completion of Module 2	2016/10/27
6. Approximate Completion of Module 3	2016/10/30
7. Approximate Completion of Module 4	2016/11/06
8. Report and Deliverables Due Date	2016/11/08
9. Awarding of Prizes	2016/11/17

1.5 Reference Documents

1. Project 2 Guide, which describes the 4 Test Modules to be completed.
2. ST STM32F401RE Datasheet.
3. ST STM32F401RE Reference Manual.
4. ST Nucleo 401 Product Brief
5. ST Nucleo 401 User's Guide.
6. Keithley 2015-2016 Datasheet
7. Others, yet to be determined.

1.6 Scope

The scope of this document concerns the requirements for the Keithley 2017 Signal Analyzer product and work to evaluate a potential MCU to meet those requirements. It describes the product function, criteria for evaluating the performance of the product, and performance requirements to guide the evaluation work. It does not describe how the design is to be done, only what the outcome should be. The work required is limited to evaluation of potential solutions to the embedded system implementation for the product.

2 Guidelines for Report Preparation

2.1 REPORT SUBMISSION

Award of the Top Prize resulting from this RFS will be based upon the most responsive Vendor whose evaluation results will be the most advantageous to Keithley in terms of cost, functionality, and other factors as specified elsewhere in this RFS.

Vendor's Report shall be submitted in several parts as set forth below. The Vendor will confine its submission to those matters sufficient to define its Report and to provide an adequate basis for GE's evaluation of the Vendor's Report. In no case should the report exceed **5** pages long.

Vendor's Report(s) in response to this RFS must include a system block diagram and links to code, images and diagrams. We recommend storage of these items in a GIT repository. The submitted Reports are suggested to include each of the following sections:

1. Executive Summary
2. Problem Statement and Objectives
3. Approach and Methodology for Evaluation
4. Module Test Results
5. List of Project Deliverables
6. Recommendations
7. Appendix: References
8. Appendix: Project Team Staffing

The detailed requirements for each of the above-mentioned sections are outlined below.

3 DETAILED KEITHLEY PRODUCT REQUIREMENTS

3.1 SCHEDULE

This product must be developed within the next 9 months, ready for market. It is an evolution of existing products.

3.2 BUDGET

Budget for the embedded system is not to exceed $20 in production. This includes the PCB and connectors. Cost for the MCU should not be greater than $3.

3.3 PERFORMANCE (FEATURES)

3.3.1.1 Functionality:

- Analog and Digital Audio Analysis
- Characterize signal-to-noise ratio, SINAD, IMD, DFD, THD+N ratio, THD+N level, crosstalk, and more
- View numerical and graphical displays of measurement results
- 2 in 1 screen (generator and analyzer in the same display screen)
- 20Hz-20kHz sine wave generator
- Fast frequency sweeps
- Identifies peak spectral components
- 9.5Vrms single-ended or 19Vrms differential output
- Individual harmonic magnitude measurements
- 5 standard audio shaping filters

3.3.1.2 Performance:

- 5ppm frequency accuracy for generator and analyzer
- ±1% amplitude accuracy for generator and analyzer
- -101dB analyzer residual distortion + noise at 20Hz to 20kHz
- ±0.01dB signal flatness

3.3.1.3 Automation & communication interface:

- LXI compliant
- USB 2.0, LAN and RS232 connectivity

3.3.1.4 Digital audio features (option 113/4/5 only):

- S/PDIF/AES3 and/or Digital Serial Interface (DSI)
- Multiple DSI formats: I2S, Left Justified, Right Justified, DSP
- Wide logic level input range from 1.2V to 3.3V
- Audio bit: 8bit to 24bit

Environmental:
1. Commercial Temp, 95% RH
2. Conforms to FCC EMC requirements
3. UL Certification
4. Compliant with ROHS requirements

Inputs:
1. 14 buttons
2. 8 position switch
3. 8 rocker buttons
4. Single ended analog Audio
5. Differential analog Audio
6. Hi Impedance Audio
7. SPDIF Digital Audio
8. I2S Digital Audio
9. 2 Temperature Sensors

20 bit ADC required at 192 kSps
16 bit DAC required at 192 kSps

Outputs
1. 8 LEDs
2. QVGA display
3. 2 relays
4. Stereo Audio Speakers

Processing Requirement
Estimated 100 DMIPs, 100 MMACs

Power: Universal AC input, with +/-12, +/-5, and +/-3.3 volt DC rails.

4 EVALUATION FACTORS

4.1 CRITERIA

Any award to be made pursuant to this RFS will be based upon the proposal with appropriate consideration given to technical, spelling, grammar, and management requirements. Evaluation of projects will be based upon the Vendor's responsiveness to the RFS. The following elements will be the primary considerations in evaluating all submitted Reports and in the selection of a Vendor or Vendors for Top Prizes:

30% Technical Report
10% Executive Summary
10% Recommendations
10% TA Review
10% Deliverables for each Project Module (4 total possible)

5 SCOPE OF WORK

5.1 EVALUTION

At a minimum, the work to be performed includes:

- Evaluate the hardware and software capabilities of the ST STM32F401RE MCU by using the ST Nucleo 401 platform to perform a series of tests and also by design calculations.
- Draw a block diagram showing the inputs, processor, and outputs for this device.
- Create a simulation in Simulink of your harmonic analysis algorithm
- Evaluate software performance by completion of the 4 assigned modules. See the Project 3 Guide for details. If a better processor choice is available, please recommend it.
- Evaluate hardware suitability by suggesting possible I/O interfaces including Analog Signal conditioning, ADCs, DACs, speaker driver, Display, buttons, LED drivers and calculating required I/O current drive and voltage levels for the processor I/O.
- Produce a Technical Report showing results of the evaluation.
- Provide a recommendations for circuit design and MCU selection.

5.2 DELIVERABLES

At the conclusion of the project, KEITHLEY requires written documentation of the approach, findings, and recommendations associated with this project to be delivered to the contracting agent through D2L. An informal presentation of the findings and recommendations to senior management may also be required as part of a peer evaluation. The documentation should consist of the following:

1 DETAILED TECHNICAL REPORT

A document developed for the use of KEITHLEY's technical staff which discusses: the evaluation methodology employed, detailed technical findings, and recommendations as indicated in section 2 of this document.

2 EXECUTIVE SUMMARY REPORT

A document developed to summarize the scope, approach, findings and recommendations, in a manner suitable for senior management (3 paragraphs or less).

3 SOFTWARE DESIGN FILES AND DOCUMENTATION

Deliverables should include

- All drawings, images, and design documents in Word or PDF electronic
- Source code in zip format
- Test Data and Screenshots

6 Acronyms and Definitions

Item	Description
ATP	Acceptance Test Plan
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
LED	Light Emitting Diode
PWM	Pulse Width Modulation
RFS	Request For Services