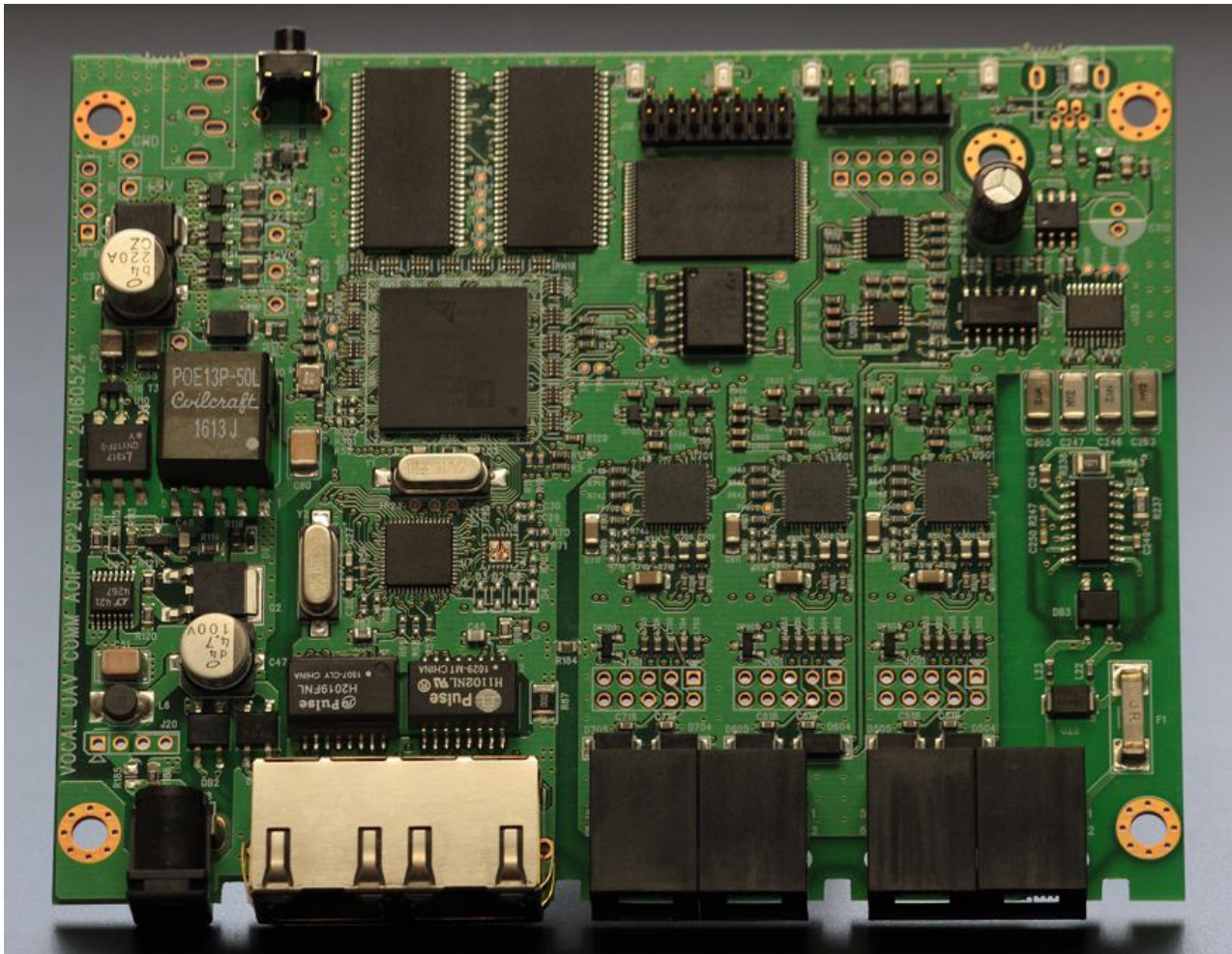


# VOCAL

## Analog Over IP for E&M/Radio Reference Design Kit

The AoIP Reference Design Kits enable licensees to develop a variety of standards-based next generation product configurations with extensive features and world-wide configurability. VoCAL's highly optimized On-One™ DSP technology is used to reduce system cost by controlling all AoIP operations for E&M audio ports and performing advanced signal processing on a single state-of-the-art DSP. Supports PTT and COS/COR signals for interfacing E&M ports to radio audio. These designs far surpass the competition in terms of cost advantage and time-to-market potential, and VoCAL's extensive customization support allows quick and easy implementation of value added features.

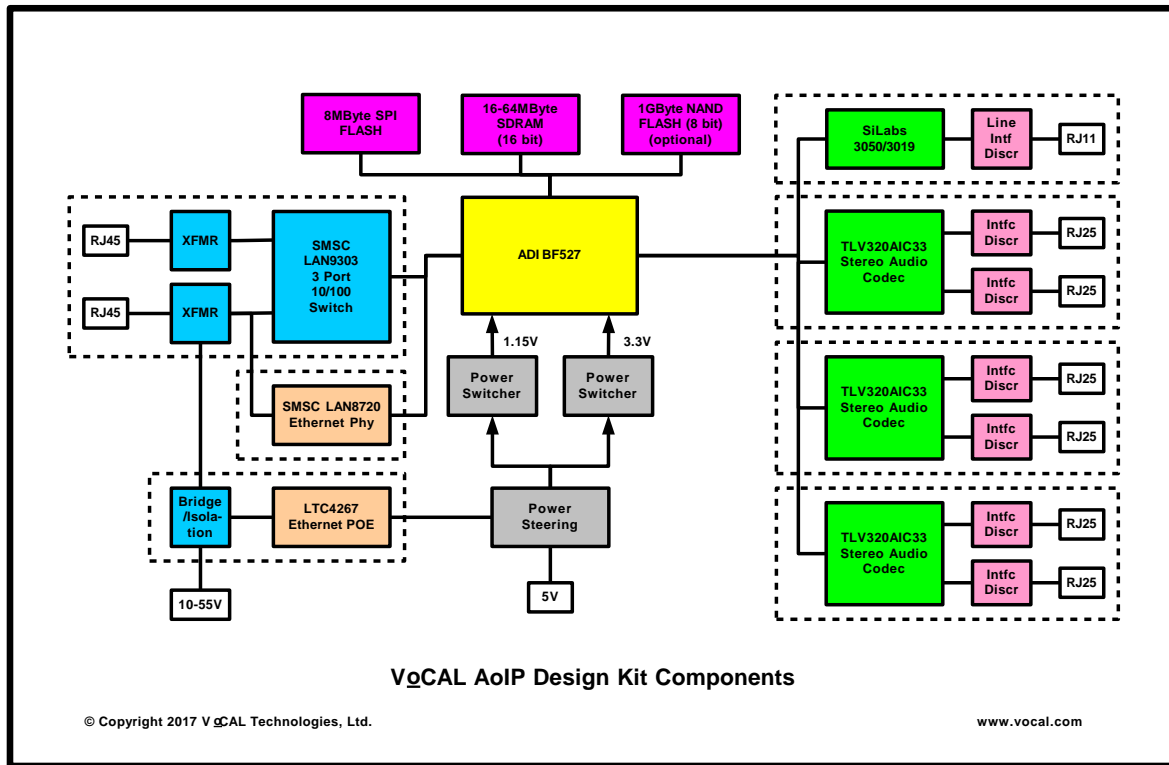


VOCAL Technologies, Ltd.  
520 Lee Entrance, Suite 202  
Buffalo, New York 14228

[www.vocal.com](http://www.vocal.com)  
Tel: (716) 688-4675  
Fax: (716) 639-0713

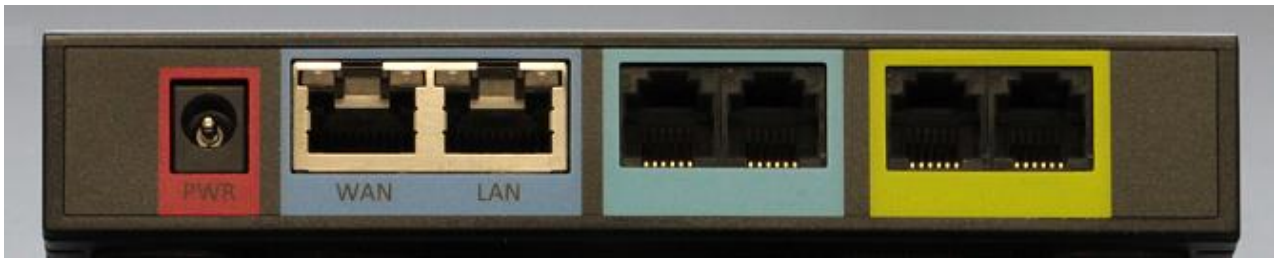
## Product configurations (please see diagram below)

- 3 Analog Ports with GPIO controls and one FXO Phone Port (standard configuration)
- 4 Analog Ports with GPIO controls
- 6 Analog Ports with one FXO Phone Port
- 8 Analog Ports
- 1 or 2 Ethernet with optional POE
- 5 volt wall adapter standard
- 10-55 volt isolated power option



The designs include options for GPIO control signals and RSSI signal monitoring. GPIO signals are protected and configurable for driving PTT (push to talk) and receiving COS/COR (carrier on squelch/receive) signals. Alternate control signals may be configured for I2C operation and/or an I2C Async serial UART using additional circuitry\*. Control signals may be optically or relay isolated\*. Analog signals are single-ended and may be converted to isolated 600 ohms\*. Digital MEMS microphones may be supported as an alternate use of GPIO signals with synchronous sampling of all channels.

\* - Requires external circuitry or a daughter board add-on to reference board.



**Connectors (left to right):**

5.5/2.1mm barrel connector for 5VDC or optional 10-50V isolated power+  
RJ45 Ethernet with optional POE  
RJ45 Ethernet (optional)  
RJ25 Analog Port 3 (channels 6 and 7 for L and R respectively)  
RJ25 Analog Port 2  
RJ25 Analog Port 1  
RJ11 Telephone FXO Port

+ - Optional isolated power supply also supports locking barrel connector. Requires resistor straps and eliminates Ethernet POE.

For all Analog Ports (RJ25 - 6 position, 6 contact):

Pin 1 – GPIO IN, I2C SDA, I2C SCL, +3.3V or +5V  
Pin 2 – Audio out L  
Pin 3 – Audio in L  
Pin 4 – Audio in R, GPIO IN, I2C SDA, RSSI  
Pin 5 – GPIO OUT, Audio out R, I2C SCL, Processor GPIO/IRQ  
Pin 6 – Ground

In case of multiple signals, the factory default signal is shown first. Alternative signals usually require reconfiguration of strapping resistors.

GPIO IN may be used as a secondary output. As an input, GPIO IN is buffered with Schmitt logic by default, and may drive the base of an NPN collector (for voltage isolation) or maybe a direct input. GPIO outputs are buffered by a high voltage (40V) open NPN collector by default or maybe a direct output.

Audio inputs may be biased for powering Electret or MEMS analog microphones using resistor straps and software configuration (none, 2, 2.5 or 3.1V bias). Audio inputs/outputs  $2V_{p-p}$  or  $0.707V_{rms}$  max (0dB). Audio input voltage divider are configurable with resistors.

I2C signals (SCL and SDA) may be used directly externally or connected to additional I2C compatible devices such as an I2C UART for external asynchronous connections.

Processor GPIO/IRQ is intended for use only by internal expansion daughter cards.

For Telephone FXO Port (RJ11 – 6 position, 2 contact):

Pin 1 –  
Pin 2 –  
Pin 3 – Tip  
Pin 4 – Ring  
Pin 5 –  
Pin 6 –

**Example Radio Configuration** – One UHF/VHF AM/FM radios using RSSI or COR for receiver activation:

Pin 1 – GPIO COR input  
Pin 2 – Audio out  
Pin 3 – Audio in  
Pin 4 – RSSI input  
Pin 5 – GPIO PTT output  
Pin 6 – Ground

**Example Dual Radio Monitor Configuration** – One port to two FM radios using VOX/VAD for receive activation:

Pin 1 – GPIO PTT R  
Pin 2 – Audio out L (connects to both audio transmit signals)  
Pin 3 – Audio in L  
Pin 4 – Audio in R  
Pin 5 – GPIO PTT L  
Pin 6 – Ground

**Example Beamformer Configuration** – dual microphones (analog or digital) on each port:

Pin 1 – Digital stereo microphone data (sampled on alternate clock edges)  
Pin 2 – Audio out (optional)  
Pin 3 – Analog microphone in L  
Pin 4 – Analog microphone in R  
Pin 5 – Digital microphone clock  
Pin 6 – Ground

**ED-137B E&M Daughter Board Expansion** - Attaches internally to the AoIP reference board and supports four ports of the following:

Pin 1 – SB (M Lead return) #  
Pin 2 – M Lead (COR) with configurable polarity and ground/return#  
Pin 3 – RX Audio+ (protected and 600ohm isolated)  
Pin 4 – TX Audio+ (protected and 600ohm isolated)  
Pin 5 – TX Audio-  
Pin 6 – RX Audio-  
Pin 7 – E Lead (PTT) with configurable polarity and ground/return#  
Pin 8 – SG (E Lead return) #

# - Supports E&M Types I to V by configuration jumper or soldered 0 ohm resistors

# Reference Design Kit

The AoIP Reference Design Kits from VoCAL offer the following capabilities:

## Technical Specifications

### Voice-over-IP (VoIP) protocols

SIPv2 - Session Initiation Protocol (RFC 3261, 3262, 3263, 3264)  
SDP - Session Description Protocol (RFC 4566)  
RTP - Real-Time Protocol (RFC 3550, 3551)  
RTCP - Real-Time Control Protocol (RFC 3550)  
RFC 4733 X-NSE Tone Events for SIP/RTP  
RFC 4733 AVT Tone Events for SIP/RTP  
STUN - Simple Traversal of UDP over NATs (RFC 3789)

### Network Protocols

IPv4 - Internet Protocol Version 4 (RFC 791)  
TCP - Transmission Control Protocol (RFC 793)  
UDP - User Datagram Protocol (RFC 768)  
ICMP - Internet Control Message Protocol (RFC 792)  
RARP - Reverse Address Resolution Protocol (RFC 903)  
ARP - Address Resolution Protocol (RFC 826)  
DNS - Domain Name Server  
DHCP Client - Dynamic Host Control Protocol (RFC 2131)  
NTP - Network Time Protocol (RFC 1305)  
SNTP - Simple Network Time Protocol (RFC 2030)  
HTTP - HyperText Transfer Protocol  
TFTP - Trivial File Transfer Protocol (RFC 1350)  
PPPoE - Point to Point Protocol over Ethernet (RFC 2516)

### Voice Codecs

G.711 - Pulse Code Modulation  
G.722 - Wideband ADPCM  
G.723.1 - 6.4 and 5.3 kbps ACELP/MP-MLQ  
G.726 - 16, 24, 32 and 40 kbps ADPCM  
G.728 - 16 kbps LD-CELP  
G.729A - 8 kbps CS-ACELP  
G.729B - Silence Detection/Comfort Noise Generation  
GSM, GSM HR, GSM FR and GSM AMR  
iLBC - Internet Low Bitrate Codec  
Speex/Opus - Nonproprietary VDR Codec  
MELPe - 2400/1200/600 bps Codec  
TSVCIS - Wideband VDR MELPe extension

### Telephony

Q.24 DTMF Generation with Zero Crossing Cutoff  
Q.24 DTMF Detection exceeding Bellcore Specifications  
Configurable Tone Generation for 4 Sets of Frequencies and  
4 Sets of On/Off Cadence  
Caller ID Type I Detection  
Caller ID Type II Detection

### Line-echo cancellation

G.168 Line Echo Cancellation  
16 to 64 ms Echo Length  
Nonlinear Echo Suppression (ERL greater than 28 dB for f =  
300 to 3400 Hz)  
Double-Talk Detection

### Quality of Service

Layer 2 Class-of-Service (CoS) Tagging (802.1P)  
Layer 2 (802.1Q VLAN)  
Layer 3 Type-of-Service (ToS) Tagging (RFC 791/1349)  
Layer 3 Diffserv (RFC 2475)

## Hardware Features

### Data Network

Ethernet - 10baseT/100baseT RJ-45  
Ethernet WAN Port RJ-45  
Ethernet LAN Port RJ-45  
Configurable MAC Address (IEEE 802.3)

### Analog Ports

Narrow (8KHz), wide (16KHz), or full (48KHz) band operation

### PSTN Port

FXO Analog RJ-11 Port  
Dial Plan Accessible

### Indicators

POWER LED (Power, Registration, Use)  
LAN LED (Activity and Link Fail)  
LINE LEDS (Line Status)

### Reset Button

System Reset  
Reset Configuration to Factory Defaults when Held

## Feature List

### Voice-over-IP (VoIP) protocols

Power-on Auto Registration  
Re-registration with SIP Proxy Server  
SIP over UDP  
SIP Authentication (HHP Digest with MD5)

### Quality of Service

Port Priority for VoIP Packets from Application  
High and Low Priority Transmit Queues for Interface

### NAT/Firewall Support

Built-in Router  
Automated NAT Traversal Without Manual Manipulation of  
Firewall/NAT  
NAT Traversal for Private Networks with STUN (RFC3489)  
NAT Firewall  
Gateway and DMZ Port Forwarding  
LAN Pass Through  
Voice Priority  
PPPoE - Point-to-Point Protocol over Ethernet (RFC2516)

### Security

Provisioning/Configuration/Authentications  
Password Protected Web based Administration  
RC4 Encryption for TFTP Configuration Profiles  
Authentication (DIGEST using MD5)  
Secure SIP (SIPS)  
Secure RTP (SRTP)  
TLS 1.1 or later

### Remote Configuration/Maintenance

Web Configuration via Built-in Web Server  
Configuration Update via TFTP or HTTP  
Firmware Upgrade via TFTP or HTTP  
SYSLOG Update/Upgrade Processing Notifications