

## Evaluation Board for the CS6422

### Features

- Includes analog, digital ( $\mu$ -law/a-law), and POTS (Plain Old Telephone Service) network interfaces
- Variable gain ( $\pm 20$  dB) and user-defined fixed-gain options for analog acoustic and network inputs and outputs
- Integrated DTMF generator and keypad provide dialing function
- Operates from +5 V or +12 V power supply, allowing for use in car
- Operates in stand-alone or PC-based configuration
- On-board EEPROM stores CS6422 configuration settings
- On-board speaker driver capable of driving 1 Watt into a 4  $\Omega$  load with less than 1% THD

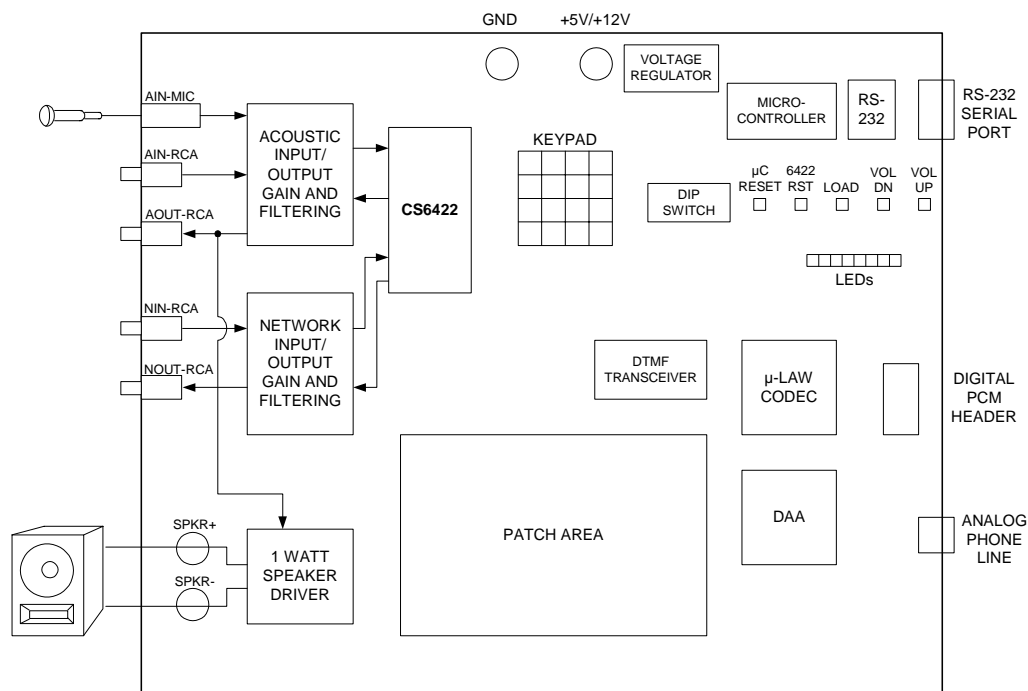
### Description

The CDB6422 provides an easy platform to evaluate the performance of the CS6422 echo cancelling IC in a target system. To facilitate evaluation, the board provides a wide selection of network interfacing options (analog telephone line,  $\mu$ -law/a-law PCM data, or analog RCA jack). The analog interfaces support both fixed and variable gain options to allow for level-matching with target hardware. The board includes a keypad and a DTMF generator to enable dialing on standard analog telephone systems.

The board can operate from a single +12V power supply and can be used in a stand-alone configuration allowing for easy testing in car cellular hands-free applications.

### ORDERING INFO

CDB6422 Evaluation Board



### Preliminary Product Information

This document contains information for a new product. Cirrus Logic reserves the right to modify this product without notice.

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## 1. GENERAL DESCRIPTION

The CDB6422 provides an easy interface to evaluate the performance of the CS6422 echo cancelling IC in a target system. To facilitate evaluation, the board provides a wide selection of network interfacing options (analog telephone line,  $\mu$ -law/a-law PCM data, or analog RCA jack). The analog interfaces support a variety of fixed and variable gain options to allow for easy level-matching with target hardware. The board includes a keypad and a DTMF generator that enable dialing on standard analog telephone systems.

Furthermore, the board can operate from a single +12V power supply and can be operated in a stand-alone configuration allowing for easy testing in cellular car hands-free applications.

For more information regarding the configuration of the CS6422 device, please refer to the CS6422 data sheet.

## 2. HARDWARE

### 2.1 Powering the Board

The CDB6422 board can operate from either a +12V supply or a +5V supply. When operating from a +5V supply, the  $\mu$ -law/a-law codec (MC145503) is unavailable. The board comes shipped from the factory configured for a +12V power supply. The power supply must be able to supply at least 500mA of current.

For operation from a +12V supply, the on-board voltage regulators must be selected by installing jumpers in the appropriate places marked '+12V'. These jumpers are labeled PWR\_SEL1 through PWR\_SEL4 and are located near the bulky 3-terminal voltage regulators.

If operating from a +5V supply, the jumpers should be installed in the '+5V' setting.

When the board is properly powered, at least 4 green LEDs should be lit. These LEDs are labeled +5VA, +5VD, +5VSPKR, and +10VD. If the

board is powered from a +5V supply, the +10VD LED will not be lit (or will be quite dim).

### 2.2 Analog Configuration

At first glance the analog section of the board (the left-most quarter) might appear dauntingly complex. The jumpers select, for the most part, a series of fixed or adjustable gains in the APO, AO, NI, and NO signal paths. Actual system implementation is not this complex. The following text describes the jumper settings in signal path order.

#### 2.2.1 Acoustic Input

##### 2.2.1.1 AIN1:

The acoustic input of the CDB6422 can be derived from an 1/8" mic jack (AIN\_MIC) or a standard RCA jack (AIN\_RCA). The header AIN1 selects the input source.

##### 2.2.1.2 MIC\_BIAS:

If the acoustic input source is a standard electret microphone, the board can supply a bias current to power it. The mic bias is enabled by installing the jumper on the "ENABLED" setting of the header called MIC\_BIAS. There is a fixed 2.2k series resistance (R1) between the op-amp supplying the bias voltage and the mic input. The value of the mic bias voltage can be adjusted by tuning the pot labeled "BIAS" (R6).

##### 2.2.1.3 AIN2:

AIN2 selects between the ACTIVE acoustic input circuitry (op-amps) and a PASSIVE RC-network.

##### 2.2.1.4 AIN3, AIN4:

AIN3 and AIN4 select the type and amount of gain for the acoustic input circuitry. For fixed gains (AIN4 = "0dB", "+20dB", or "USER"), AIN3 should be set to "FIXED". For variable gain (-20dB to +20dB) AIN3 should be set to "VARIABLE" and AIN4 should be set to "-20dB to

+20dB". The pot labeled "AIN\_GAIN" (R2) controls the variable gain.

#### 2.2.1.5 AIN5:

AIN5 selects the acoustic input source from the following options: "ACTIVE" (the previous gain sources), "PASSIVE" (the RC-network), and "DTMF" (the DTMF transceiver, used for testing purposes).

#### 2.2.1.6 AIN6, AIN7:

AIN6 and AIN7 are configured based on the state of the internal MIC preamp on the CS6422. If the internal mic preamp is enabled (Mic = '1'), then AIN6 and AIN7 should be configured to the "ON" position. If the internal mic preamp is disabled (Mic = '0'), then AIN6 and AIN7 should be configured to the "OFF" position.

### 2.2.2 Acoustic Output

#### 2.2.2.1 AOUT1:

AOUT1 selects between the "ACTIVE" drive output circuitry (op-amps) and the "PASSIVE" circuitry (simple RC-network). To take advantage of the supplied filters and gain stages, set AOUT1 to the "ACTIVE" state.

#### 2.2.2.2 AOUT2:

AOUT2 selects the order of the Butterworth filter following AO at either "1-POLE" or "3-POLES".

#### 2.2.2.3 AOUT3, AOUT4:

AOUT3 and AOUT4 select the type and amount of gain for the acoustic output circuitry. For fixed gains (AOUT4 = "0dB" or "USER"), AOUT3 should be set to "FIXED". For variable gain (-20dB to +20dB) AOUT3 should be set to "VARIABLE" and AOUT4 should be set to "-20dB to +20dB". The pot labeled "AOUT\_GAIN" (R3) controls the variable gain.

#### 2.2.2.4 AOUT5:

AOUT5 selects the source of the acoustic output RCA jack ("0dB" before gain stage, "GAINED" after gain stage, or "PASSIVE" RC-network).

#### 2.2.2.5 AOUT6:

AOUT6 selects the type of output ("AC"-coupled or "DC"-coupled) at the AOUT\_RCA jack.

#### 2.2.2.6 SPEAKER\_GAIN:

SPEAKER\_GAIN selects the gain of the on-board differential BTL speaker driver to "0dB", "+6dB", "+9dB", or "USER". The "+9dB" setting should not be used, as it will result in clipping at the speaker driver outputs.

### 2.2.3 Network Input

#### 2.2.3.1 NIN1:

NIN1 selects between the "ACTIVE" network input circuitry (op-amps) and a "PASSIVE" RC-network.

#### 2.2.3.2 NIN2, NIN3:

NIN2 and NIN3 select the type and amount of gain for the network input circuitry. For fixed gains (NIN3 = "0dB" or "USER"), NIN2 should be set to "FIXED". For variable gain (-20dB to +20dB) NIN2 should be set to "VARIABLE" and NIN3 should be set to "-20dB to +20dB". The pot labeled "NIN\_GAIN" (R5) controls the variable gain.

#### 2.2.3.3 NIN4:

NIN4 selects the network input source from the following options: "ACTIVE" (the previous gain sources), "PASSIVE" (the RC-network), "POTS(DAA)" (the analog telephone line), "CODEC" (the  $\mu$ -law codec), or "DTMF" (the DTMF transceiver, used for testing purposes).

## **2.2.4 Network Output**

### **2.2.4.1 NOUT1:**

NOUT1 selects between the “ACTIVE” drive output circuitry (op-amps) and the “PASSIVE” circuitry (simple RC-network). To take advantage of the supplied filters and gain stages, set NOUT1 to the “ACTIVE” state.

### **2.2.4.2 NOUT2:**

NOUT2 selects the order of the Butterworth filter following NO at either "1-POLE" or "3-POLES".

### **2.2.4.3 NOUT3, NOUT4:**

NOUT3 and NOUT4 select the type and amount of gain for the network output circuitry. For fixed gains (NOUT4 = “0dB” or “USER”), NOUT3 should be set to "FIXED". For variable gain (-20dB to +20dB) NOUT3 should be set to "VARIABLE" and NOUT4 should be set to "-20dB to +20dB". The pot labeled "NOUT\_GAIN" (R4) controls the variable gain.

### **2.2.4.4 NOUT5:**

NOUT5 selects the source of the network output RCA jack (“0dB” before gain stage, “GAINED” after gain stage, or “PASSIVE” RC-network).

### **2.2.4.5 NOUT6:**

NOUT6 selects the type of output (“AC”-coupled or “DC”-coupled) at the NOUT\_RCA jack.

## **2.3 CODEC Configuration**

The codec is accessible only if the board is operating from a +12V power supply.

The CDB6422 has a  $\mu$ -law/a-law PCM interface that is accessible through the PCM header (HDR49). HDR27 enables optional signal inversions for PCM\_IN (RDI), PCM\_OUT (TDI), CLK (CI), and SYNC (SI). To enable the inverter, install the header next to the appropriate label.

To select "a-law" data, install HDR53 (A-LAW).

To power down the codec, install HDR54 (PDI).

## **2.4 DAA Configuration**

To enable DTMF tones to be transmitted to the analog telephone network, HDR86 (DTMF\_TX) must be installed.

## **2.5 Microcontroller Configuration**

### **2.5.1 PROGRAM/RUN:**

The microcontroller is shipped preprogrammed from the factory. The configuration jumper should be loaded on HDR94 "RUN". To program the microcontroller with new software, the configuration jumper should be moved to HDR91 "PROGRAM" when the programming software prompts to do so.

### **2.5.2 EXT/UC:**

By default, the microcontroller writes configuration information to the CS6422 through the CS6422 uC interface. The microcontroller outputs can be disabled by moving the jumper from HDR90 (uC) to HDR89 (EXT) to allow an external source to configure the CS6422 through the "6422 EXT INTERFACE" header (HDR21).

### **2.5.3 UC\_RESET:**

The UC\_RESET pushbutton initiates a hardware microcontroller reset. The microcontroller programs Configuration 0 to the default CS6422 register state. It leaves the other Configuration sets alone. Furthermore, the UC\_RESET initiates a CS6422 reset which performs a hardware reset and downloads Configuration 0 to the CS6422.

## **2.6 Miscellaneous**

### **2.6.1 HOOK SWITCH:**

Sliding the HOOK SWITCH to “OFF\_HOOK” will cause the DAA to move to the OFF HOOK state (pick up the phone). Sliding the switch to “ON-HOOK” will cause the DAA to hang up (after about a 1 second delay). The uC software automatically answers the phone after 3 rings. To hang up

the phone after this occurs, slide the HOOK SWITCH first to the "OFF\_HOOK" position and then back to the "ON\_HOOK" position.

### **2.6.2    *KEYPAD:***

The default state of the keypad is to generate DTMF tones when the keys are pressed to enable dialing through the analog phone network. The keypad also allows for manual CS6422 register entry and CS6422 register configuration storage and recall in association with the LOAD pushbutton (SW5). See the description of the LOAD pushbutton for more information.

### **2.6.3    *DIP SWITCH:***

SW1 contains an 8-position DIP switch which enables access to some commonly-used CS6422 register parameters. The operation of the DIP switch is such that if the DIP switch is moved from the OPEN state to the CLOSED state, the specified register is written with the stated contents. For example, if switch 1 "MIC=0" is moved from the OPEN state to the CLOSED state, then the value of the MIC parameter is set to '0'. When the switch is moved from the CLOSED state to the OPEN state, the previous value of the parameter is restored. In the above example, if Mic were initially '1' when switch 1 was CLOSED, it would be restored to '1' when the switch was OPENed.

If the Mic parameter were initially '0' at the time switch 1 was CLOSED, it would remain '0' when switch 1 was switched from CLOSED back to OPEN.

### **2.6.4    *"6422\_RST" PUSHBUTTON:***

The "6422\_RST" pushbutton initiates a COLD hardware reset on the CS6422 device and downloads the register set stored in Configuration 0 to the CS6422.

### **2.6.5    *"LOAD" PUSHBUTTON:***

The "LOAD" button changes the state of the KEY-PAD to enable direct programming of the CS6422 registers and to allow access to the Configuration sets. Both of these features are particularly useful when using the CDB6422 in a "stand-alone" environment, that is, when the board is not connected to a PC.

Pressing the "LOAD" button once places the KEY-PAD in the "LOAD" state (LEDs in status bar turn off). The 4 following KEYPAD presses encode a hexadecimal (0000 to ffff) number which the microcontroller interprets as a CS6422 register write. Each KEYPAD press causes a pair of LEDs in the status bar to light. After the fourth keypress, the hex value is transmitted to the CS6422's uC interface. See the "Register Definition" section of the CS6422 data sheet.

If the register write is valid (last digit is '0', '2', '4', '6', '8', or 'a'), then the local copy of the CS6422 registers is updated in the microcontroller. If the register write is invalid, the register contents are transmitted to the CS6422, but the microcontroller's local copy remains unchanged.

After the last digit has been entered, the write takes effect and the KEYPAD returns to its normal DTMF state. Furthermore, the LEDs in the status bar return to display Receive Volume information.

Pressing the "LOAD" button twice in a row places the KEYPAD in "Configuration Recall" state (2 LEDs in status bar light). The next KEYPAD press selects a CS6422 register Configuration (0-9) to recall. Once selected, the configuration set (all 6 registers) is transmitted to the CS6422. The KEYPAD and status LEDs return to their normal states after the Configuration number has been selected.

Pressing the "LOAD" button three times in a row places the KEYPAD in "Configuration Save" state (4 LEDs in status bar light). The next KEYPAD press stores the current CS6422 register configuration in the selected Configuration location (0-9).

The KEYPAD and status LEDs return to their normal states after the Configuration number has been selected.

Because the Configuration sets are stored in EEPROM, they will survive a power-off event. However, Configuration 0 is special for two reasons: 1) it is reset to the CS6422 default register state on power-up or on microcontroller reset, and 2) it is automatically downloaded to the CS6422 when the "6422\_RST" pushbutton is pressed (or the 'r' command is sent from a terminal).

Thus, if you wish to test a RESET configuration state and you will be testing the board from power-off (for example, if you set up your configuration registers in the lab and want to perform testing in a car), you must store the configuration to be tested in Configuration space (1..9). Once the board has been powered for testing in the target environment (the car), you can RECALL the saved configuration and STORE it in Configuration 0. Pressing the "6422\_RST" button will reset the CS6422 and download the Configuration 0 information to the device for testing.

### 2.6.6 "VOL\_DOWN" PUSHBUTTON:

Pressing the "VOL\_DOWN" pushbutton decreases the receive (speaker) volume by 3dB per button press until RVol = 'mute'. The current receive volume is reflected in the status LED bar with the following mapping:

# LEDs on	RVol Value
0	mute
1	-12 to 0 dB
2	+3 to +6 dB
3	+9 to +12 dB
4	+15 to +18 dB (default)
5	+21 dB
6	+24 dB
7	+27 dB
8	+30 dB (maximum)

### 2.6.7 "VOL\_UP" PUSHBUTTON:

Pressing the "VOL\_UP" pushbutton increases the receive (speaker) volume by 3dB per button press until RVol = '+30dB'. The receive volume is reflected in the status LED bar with the mapping described in the "VOL\_DOWN" Pushbutton description.

## 3. COMMAND SERIAL PORT DESCRIPTION

The CDB6422 can operate connected to a PC or in a stand-alone configuration. If connected to a PC, the board can be controlled by supplied Windows-based software or through a simple terminal program. The board communicates at 19.2kbps, 8 data bits, 1 stop bit, and no parity or handshaking of any kind. All commands and responses are standard ASCII text with no special characters or binary data.

This section describes the commands and response primitives that the board accepts and provides through the serial connection. This can be thought of as a "command list" for "terminal" mode.

### 3.1 Command List:

The following is a listing of commands and messages that the CDB6422 (Rev. A) evaluation board accepts and transmits through the serial connection.

ver	reset
r	wr
wrb	rd
swd	swu
swp	off_hook
on_hook	d_reset
doff	dtmf
kd	ku
st	pd
pu	vol_up
vol_down	mute
unmute	save
recall	ring
mwr	uc
ext	d
?	



## **3.2 Command Descriptions:**

### **3.2.1 *ver* - Output Code Version**

- A. Writes current code and EEPROM versions to the UART
- B. No arguments accepted
- C. No MSG Stack pushes

### **3.2.2 *reset* - Reset 8515**

- A. Resets microcontroller just as with hardware reset
- B. Description:
  - 1. Initializes all hardware (ports, timers, UART, RAM spaces, external interrupts)
  - 2. Writes MSG jump table into EEPROM and the CS6422 default reset configuration into Configuration 0
  - 3. Initializes MSG Stack
  - 4. Pushes 'ver' command onto MSG Stack
  - 5. Pushes 'd\_reset' command onto MSG Stack
  - 6. Pushes 'r' command onto MSG Stack
  - 7. Pushes 'mwr 00c9 ff r' command onto MSG Stack - initializes polling input, DIP switches, pushbuttons, uC/EXT header)

### **3.2.3 *r* - Reset CS6422**

- A. Resets CS6422 with register set from Configuration 0
- B. No arguments accepted
- C. Description:
  - 1. Implements CS6422 reset sequence (see CS6422 datasheet)
  - 2. Pushes 'recall 0' onto MSG Stack - configures CS6422 with register set in Configuration 0

- 3. Polls dip switches for custom configuration

### **3.2.4 *wr [xxxb]* - Write CS6422 Register**

- A. Writes 16-bit value \$xxxb to CS6422 (b/2 designates register address)
- B. No MSG Stack pushes
- C. Description:
  - 1. Writes register value to Current register copy in EEPROM (if write is valid)
  - 2. Echoes register value to UART
  - 3. Implements CS6422 uC write timing

### **3.2.5 *wrb [ab cd]* - Write Bits in CS6422 Register**

- A. Writes 'c' number of bits with the value of 'd' to bits beginning at bit number 'b' in 6422 register 'a'
- B. Description:
  - 1. Decodes the arguments and uses Current register copy to obtain 2 byte value \$xxxb for writing to CS6422
  - 2. Pushes "wr xxxb" onto MSG Stack

### **3.2.6 *rd [x]* - Read CS6422 Register**

- A. Prints the value for the 6422 register 'x' stored in the Current register copy in the EEPROM of the microcontroller. If no parameter is specified, all 6 CS6422 registers are displayed.
- B. No MSG Stack pushes

### **3.2.7 *swd [1..9]* - Switch Down**

- A. Notifies microcontroller that DIP switch(es) 1..9 have been switched down (handles multiple switches)
- B. No MSG Stack pushes
- C. Description:

1. Saves the current state of the CS6422 register(s) bits to be changed in eeprom
2. Configures the CS6422 register(s) according to the switch function

### 3.2.8 *swu [1..9] - Switch Up*

- A. Notifies microcontroller that DIP switch(es) 1..9 have been switched up (handles multiple switches)
- B. No MSG Stack pushes
- C. Description:  
Returns the CS6422 register(s) to the state prior to the the respective 'swd' event

### 3.2.9 *swp - Poll Dip Switches*

- A. Polls the DIP switches (assumes all switches are down) and pushes "swu [1..8]" onto the MSGStack to reflect the current state of the DIP switches
- B. No arguments accepted

### 3.2.10 *off\_hook - DAA Off Hook*

- A. Places DAA OFF-HOOK (enables network connection)
- B. No arguments accepted
- C. No MSG Stack pushes

### 3.2.11 *on\_hook - DAA On Hook*

- A. Places DAA ON-HOOK (disconnects the call)
- B. No arguments accepted
- C. No MSG Stack pushes

### 3.2.12 *d\_reset - DTMF Transceiver Reset*

- A. Resets the DTMF transceiver
- B. No arguments accepted
- C. No MSG Stack pushes

### 3.2.13 *doff - DTMF Transmit Off*

- A. Stops transmission of any tone from the DTMF transceiver (dual and single tones).
- B. No arguments accepted
- C. No MSG Stack pushes

### 3.2.14 *dtmf [x] - DTMF Transmit On*

- A. Causes DTMF Transceiver to transmit tone associated with a telephone key 'x'
- B. No MSG Stack pushes

### 3.2.15 *kd [0..e] - Keypad Down Event*

- A. Message indicating that key(s) [0..e] are being pressed
- B. Pushes to MSG Stack depending on Keypad Mode (DTMF, LOAD, RECALL, STORE)

### 3.2.16 *ku [0..e] - Keypad Up Event*

- A. Message indicating that key(s) [0..e] have been released
- B. Pushes to MSG Stack depend on Keypad Mode (DTMF, LOAD, RECALL, STORE)

### 3.2.17 *st [x] - Single Tone Transmit On*

- A. Tells the DTMF transceiver to transmit a single tone of frequency associated with integer 'x' (see table below)
- B. No pushes to MSG Stack

### 3.2.18 *pd [1..4] - Push Button Down Event*

- A. Message indicating that push button(s) [1..4] have been pressed
- B. Pushes to MSG Stack are according to button number:  
Button 1 - 6422\_RST - initiates a CS6422 reset  
Button 2 - LOAD  
1st push: next 4 'kd [x]' events will

write the value formed by the buttons pushed to the CS6422 (i.e. push “wr [wxyz]” onto the MSG Stack)

2nd push: next 1 'kd [x]' event will push a 'recall [x]' onto the MSG Stack

3rd push: next 1 'kd [x]' event will push a 'save [x]' onto the MSG Stack

4th push: returns Keypad Mode to default DTMF state

Button 3 - VOL\_DOWN - decrements the CS6422 receive volume by 3dB

Button 4 - VOL\_UP - increments the CS6422 receive volume by 3dB

### **3.2.19 *pu [1..4] - Push Button Up Event***

A. Message indicating that push button(s) [1..4] have been released

B. No pushes to MSG Stack

### **3.2.20 *vol\_up - CS6422 RVol Up***

A. Increment the CS6422 RVol volume level by 3dB to a max value of '+30dB'

B. Pushes “wr [abc0]” to the MSG Stack

C. No arguments needed

### **3.2.21 *vol\_down - CS6422 RVol Down***

A. Decrement the CS6422 RVol volume level by 3dB to a min value of 'mute'

B. Pushes “wr [abc0]” to the MSG Stack

C. No arguments needed

### **3.2.22 *mute - Mute***

A. Sets the CS6422 TVol to 'mute', HDD=RSD=TSD='1', ACC=NCC='cleared'

B. Pushes “swd “ events on the MSG Stack

C. No arguments needed

### **3.2.23 *unmute - Unmute***

A. Restores CS6422 state from 'mute' command

B. No arguments needed

### **3.2.24 *save [x] - Save Current CS6422 Configuration***

A. Saves the current CS6422 register set into Configuration 'x' ('x' = 0-9) in EEPROM

B. No pushes to MSG Stack

### **3.2.25 *recall [x] - Recall CS6422 Configuration***

A. Reconfigures the CS6422 with Configuration set 'x'

B. Pushes 6 'wr' commands with arguments from the Configuration set in EEPROM

### **3.2.26 *ring - DAA Ring Event***

A. Message indicating the the DAA has detected a ring signal on the phone line

B. After 3 ring signals, an “off\_hook” command is pushed onto the MSG Stack

C. No arguments needed

### **3.2.27 *mwr [abcd ef g] - Memory Write (8515)***

A. Writes the byte \$ef to address \$abcd in either SRAM (g = 'r') or EEPROM (g = 'e')

B. No pushes to MSG Stack

### **3.2.28 *uc - UC Jumper Set***

A. Message indicating that the jumper UC is installed, enabling the microcontroller to drive the uC interface of the CS6422

B. No arguments needed

C. No pushes to MSG Stack

### **3.2.29 *ext - EXT Jumper Set***

- A. Message indicating that the jumper EXT is installed, allowing an external source to configure the CS6422
- B. No arguments needed
- C. No pushes to the MSG Stack

### **3.2.30 *d {number} - Dial Phone Number***

- A. Dials phone numbers up to 14 digits. A ',' will add a small delay between numbers.
- B. No pushes to the MSG Stack
- C. Description:

### **3.2.31 *? - List Commands***

- A. Prints the list of available commands to the UART
- B. No arguments needed
- C. No pushes to the MSG Stack

## **4. USAGE EXAMPLES**

This section provides some examples of configuration and use. All of the following examples assume +12V operation (PWR\_SEL1-4 = '+12V'), external microphone plugged into 1/8" jack, and CS6422 internal mic preamp enabled.

### **4.1 CS6422 Usage Notes:**

This section contains useful information regarding the operation of the CS6422 in a system.

- 1) The CS6422 begins operation in half-duplex mode. The device switches to full-duplex mode automatically when both of its echo cancellers have trained.
- 2) If an echo canceller is enabled but no echo path exists, then it will never train and the system will remain in half-duplex. If an echo path does not exist for the echo canceller, then the EC should be disabled. For example, if there is no coupling between NO and NI, the Network

Echo Canceller should be disabled by setting NECD to '1'.

- 3) If the echo path is distorted (THD > 2%) then the performance of the echo canceller will be degraded, which can cause the device to remain in half-duplex or to drop to half-duplex frequently (during loud speech, for example). Common sources of distortion are the speaker, the speaker driver, and clipping at the A/D converter at APO.
- 4) If the echo path is weak (gain between AO and APO less than -30dB) then the echo canceller will have difficulty adapting to the path and the system will remain in half-duplex. A good goal is to have a coupling gain between -20dB and -6dB
- 5) The coupling gain must always be less than 0dB, otherwise a full-scale signal at AO or NO will cause clipping at the associated A/D at APO or NI, resulting in large amounts of distortion which degrades echo canceller performance.
- 6) The Acoustic Echo Canceller trains when there is speech in the receive path (through RVol) but not in the transmit path.
- 7) The Network Echo Canceller trains when there is speech in the transmit path (through TVol) but not in the receive path.
- 8) During full-duplex operation, if there is speech in both transmit and receive paths (double-talk), then neither echo canceller will train.
- 9) The echo cancellers will not train in the presence of any periodic signals (sine waves or music, for example). Appropriate training signals are voice and white noise.

### **4.2 Setting the Acoustic Coupling:**

This section describes how to adjust the mic preamp gain or the speaker/mic position to set the

acoustic coupling between AO and APO to -9dB (a design target).

In a desktop speakerphone, the acoustic coupling is typically altered by adjusting the mic preamp gain. In a hands-free car kit, the acoustic coupling is typically altered by adjusting the speaker and mic position.

For this exercise, NIN4 should be set to 'ACTIVE', and there should be no signal connected to NIN\_RCA.

- 1) Configure the CS6422 from RESET with the following:

reg 0: 57a0 (d7a0 if the internal mic preamp is used) -- RVol = +9dB

reg 1: 26a2 -- TVol = +12dB

reg 5: 003a -- NSdt = -12dB

- 2) Adjust the speaker/mic position until the system is just on the verge of howling. At this point the loop gain is approximately equal to 0dB. The above register configuration sets a gain of +9dB between APO and AO. When the speaker and mic are placed such that the system is on the verge of howling, the coupling between AO and APO is approximately -9dB.
- 3) In the desktop telephone application (where the speaker and microphone are not mobile), adjust the mic preamp gain until the system is just on the verge of howling.

### 4.3 Jumper configuration:

Acoustic input using external microphone and internal mic preamp:

AIN1 = MIC

MIC\_BIAS = ENABLED

AIN2 = ACTIVE

AIN3 = FIXED

AIN4 = 0dB

AIN5 = ACTIVE

AIN6 = ON

AIN7 = ON

(Alternate) Acoustic input using AIN\_RCA with no mic bias and internal mic preamp disabled:

AIN1 = RCA

MIC\_BIAS = DISABLED

AIN2 = ACTIVE

AIN3 = FIXED

AIN4 = 0dB

AIN5 = ACTIVE

AIN6 = OFF

AIN7 = OFF

-- NOTE: 'Mic' bit in Register 0 should be '0' for this configuration!

Acoustic output using 3-pole Butterworth filter and speaker driver set to 0dB (1/4 Watt into 4 ohms).

AOUT1 = ACTIVE

AOUT2 = 3-POLES

AOUT3 = FIXED

AOUT4 = 0dB

AOUT5 = GAINED

AOUT6 = AC

SPEAKER\_GAIN = 0dB

Network input (input source varies based on scenario):

NIN1 = ACTIVE

NIN2 = FIXED

NIN3 = 0dB

NIN4 = ACTIVE, POTS(DAA), or CODEC depending on signal source

Network output using 3-pole Butterworth filter:

NOUT1 = ACTIVE

NOUT2 = 3-POLE

NOUT3 = FIXED

NOUT4 = 0dB

NOUT5 = GAINED

NOUT6 = AC

Other Jumper Settings:

HDR94 "RUN" installed

HDR90 "uC" installed

HDR86 "DTMF\_TX" installed

#### **4.4 Usage Scenario #1: Analog Phone Call with Separated Speaker and Microphone**

In this scenario, NIN4 is set to “POTS(DAA)” to select the analog phone line as the network input source. The analog phone line is plugged into the RJ-11 jack (J6) called "Phone Line".

The CS6422 is configured from default settings with the following:

reg 0: 9400 -- GB = '0.75dB/ms'

reg 3: 2006 -- PCSen = 'low'

reg 5: 004a -- ASdt = '-24dB'

To configure the CS6422 with the above:

- 1) press and release the "6422\_RST" pushbutton
- 2) press and release the "LOAD" pushbutton (once)
- 3) press '9' '4' '0' '0' on the keypad
- 4) press and release the "LOAD" pushbutton (once)
- 5) press '2' '0' '0' '6' on the keypad
- 6) press and release the "LOAD" pushbutton (once)
- 7) press '0' '0' '4' 'a' on the keypad

At this point, the CS6422 is loaded with the correct configuration. To save this configuration in Configuration set #1:

- 1) press and release the "LOAD" pushbutton (3) times
- 2) press '1' on the keypad

To save this configuration in the RESET configuration space (Configuration set #0):

- 1) press and release the "LOAD" pushbutton (3) times
- 2) press '0' on the keypad

To recall a configuration:

- 1) press and release the "LOAD" pushbutton (2) times
- 2) press the number on the keypad corresponding to the Configuration set to recall.

To make a call:

- 1) slide the HOOK SWITCH to the “OFF HOOK” position (you should hear a dial tone from the speaker)
- 2) dial the phone number to call using the keypad
- 3) when the far-end talker answers, begin speaking in turns
- 4) after the echo cancellers have trained properly, the system will move to full-duplex on its own
- 5) full-duplex operation can be verified by a double-talk test in which both parties speak at the same time
- 6) if the far-end talker does not hear the near-end talker during far-end speech, then the CS6422 is in half-duplex mode. Continue speaking in turns until the device switches to full-duplex mode.

#### **4.5 Usage Scenario #2: Cellular Call through Analog Network Interface**

In this scenario, NIN4 is set to “ACTIVE” to select the NIN\_RCA jack as the network input source. The cellular phone is connected to NIN\_RCA and NOUT\_RCA and the gain selection jumpers NOUT3, NOUT4, NIN2, and NIN3 have been set to match full-scale levels with the phone. The Network Echo Canceller (NEC) is disabled because there is no coupling between the NO pin on the CS6422 and the NI pin.

The CS6422 is configured from default settings with the following:

reg 0: 9400 -- GB = '0.75dB/ms'

reg 1: 0a02 -- Taps = '55.5ms'

reg 3: 2006 -- PCSen = 'low'

reg 5: 014a -- NECD = '1', ASdt = '-24dB'  
(disable NEC and enable acoustic  
sidetone)

Note: if the cellular phone provides a network sidetone (coupling between NO and NI), then Taps should be set to '39.5ms/24ms', and NECD should be set to '0'.

To configure the CS6422 with the above:

- 1) press and release the "6422\_RST" pushbutton
- 2) press and release the "LOAD" pushbutton (once)
- 3) press '9' '4' '0' '0' on the keypad
- 4) press and release the "Load" pushbutton (once)
- 5) press '0' 'a' '0' '2' on the keypad
- 6) press and release the "LOAD" pushbutton (once)
- 7) press '2' '0' '0' '6' on the keypad
- 8) press and release the "LOAD" pushbutton (once)
- 9) press '0' '1' '4' 'a' on the keypad

At this point, the CS6422 is loaded with the correct configuration. To save this configuration in Configuration set #2:

- 1) press and release the "LOAD" pushbutton (3) times
- 2) press '2' on the keypad

To recall a configuration:

- 1) press and release the "LOAD" pushbutton (2) times
- 2) press the number on the keypad corresponding to the Configuration set to recall.

To make a call:

- 1) initiate or answer a call from the cell phone
- 2) when the far-end talker answers, begin speaking in turns

- 3) after the echo canceller has trained properly, the system will move to full-duplex on its own
- 4) full-duplex operation can be verified by a double-talk test in which both parties speak at the same time
- 5) if the far-end talker does not hear the near-end talker during far-end speech, then the CS6422 is in half-duplex mode. Continue speaking in turns until the device switches to full-duplex mode.

#### **4.6 Usage Scenario #3: Cellular Call Through Digital Network Interface**

In this scenario, NIN4 is set to "CODEC" to select the CODEC as the network input source. The cellular phone is connected to the PCM header, and the optional inversion jumpers on HDR27 are configured for the proper polarity. The Network Echo Canceller (NEC) is disabled because there is no coupling between the NO pin on the CS6422 and the NI pin.

The CS6422 is configured from default settings with the following:

reg 0: 9400 -- GB = '0.75dB/ms'

reg 1: 0a02 -- Taps = '55.5ms'

reg 3: 2006 -- PCSen = 'low'

reg 5: 014a -- NECD = '1', ASdt = '-24dB'  
(disable NEC and enable acoustic  
sidetone)

To configure the CS6422 with the above:

- 1) press and release the "6422\_RST" pushbutton
- 2) press and release the "LOAD" pushbutton (once)
- 3) press '9' '4' '0' '0' on the keypad
- 4) press and release the "Load" pushbutton (once)
- 5) press '0' 'a' '0' '2' on the keypad
- 6) press and release the "LOAD" pushbutton (once)

- 7) press '2' '0' '0' '6' on the keypad
- 8) press and release the "LOAD" pushbutton (once)
- 9) press '0' '1' '4' 'a' on the keypad

At this point, the CS6422 is loaded with the correct configuration. To save this configuration in Configuration set #2:

- 1) press and release the "LOAD" pushbutton (3) times
- 2) press '2' on the keypad

To recall a configuration:

- 1) press and release the "LOAD" pushbutton (2) times
- 2) press the number on the keypad corresponding to the Configuration set to recall.

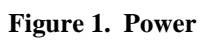
To make a call:

- 1) initiate or answer a call from the cell phone
- 2) when the far-end talker answers, begin speaking in turns
- 3) after the echo canceller has trained properly, the system will move to full-duplex on its own
- 4) full-duplex operation can be verified by a double-talk test in which both parties speak at the same time
- 5) if the far-end talker does not hear the near-end talker during far-end speech, then the CS6422 is in half-duplex mode. Continue speaking in turns until the device switches to full-duplex mode.



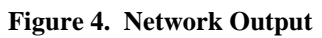


**DS295DB1**

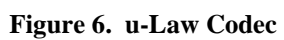














**Figure 7. DAA (POTS Interface)**

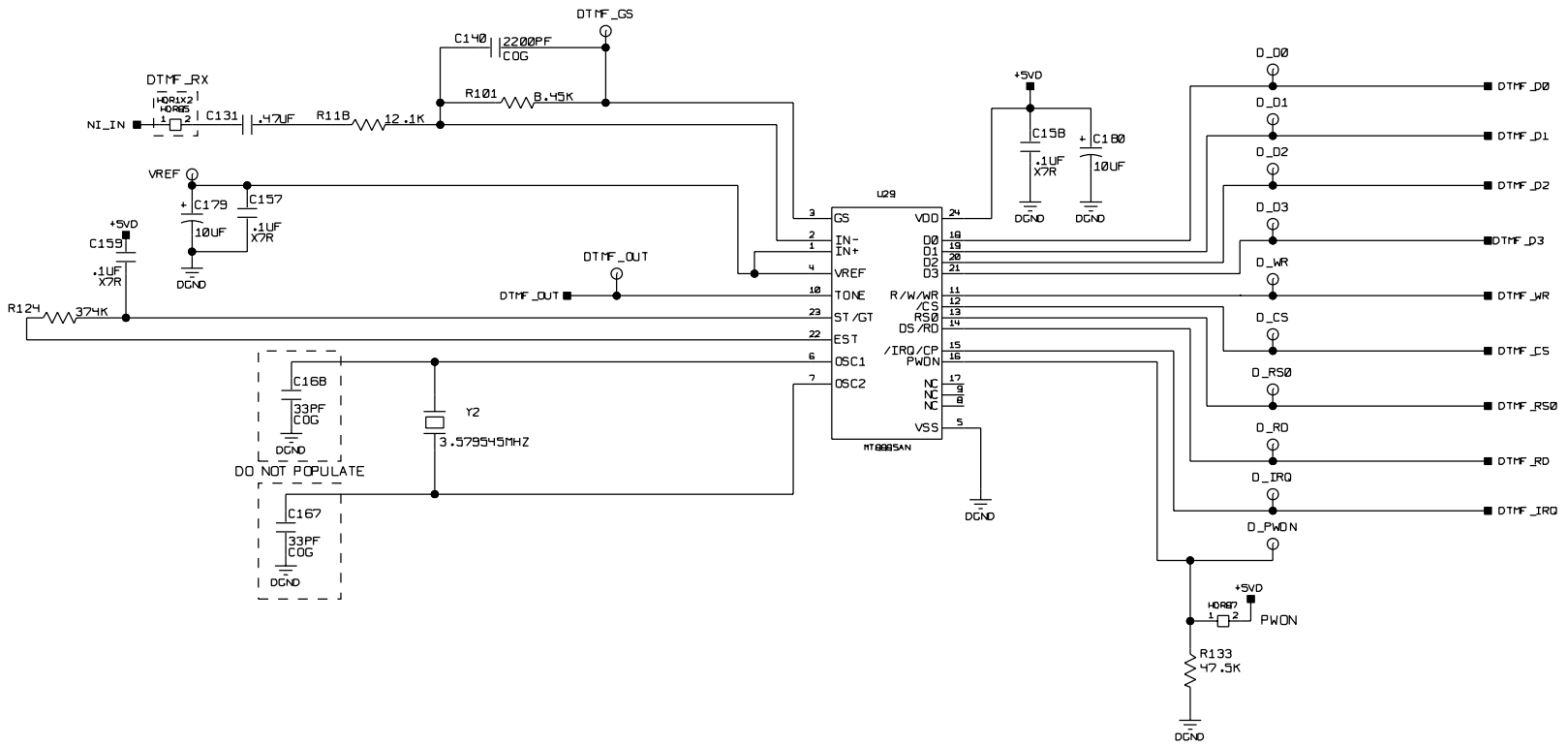


Figure 8. DTMF Transceiver



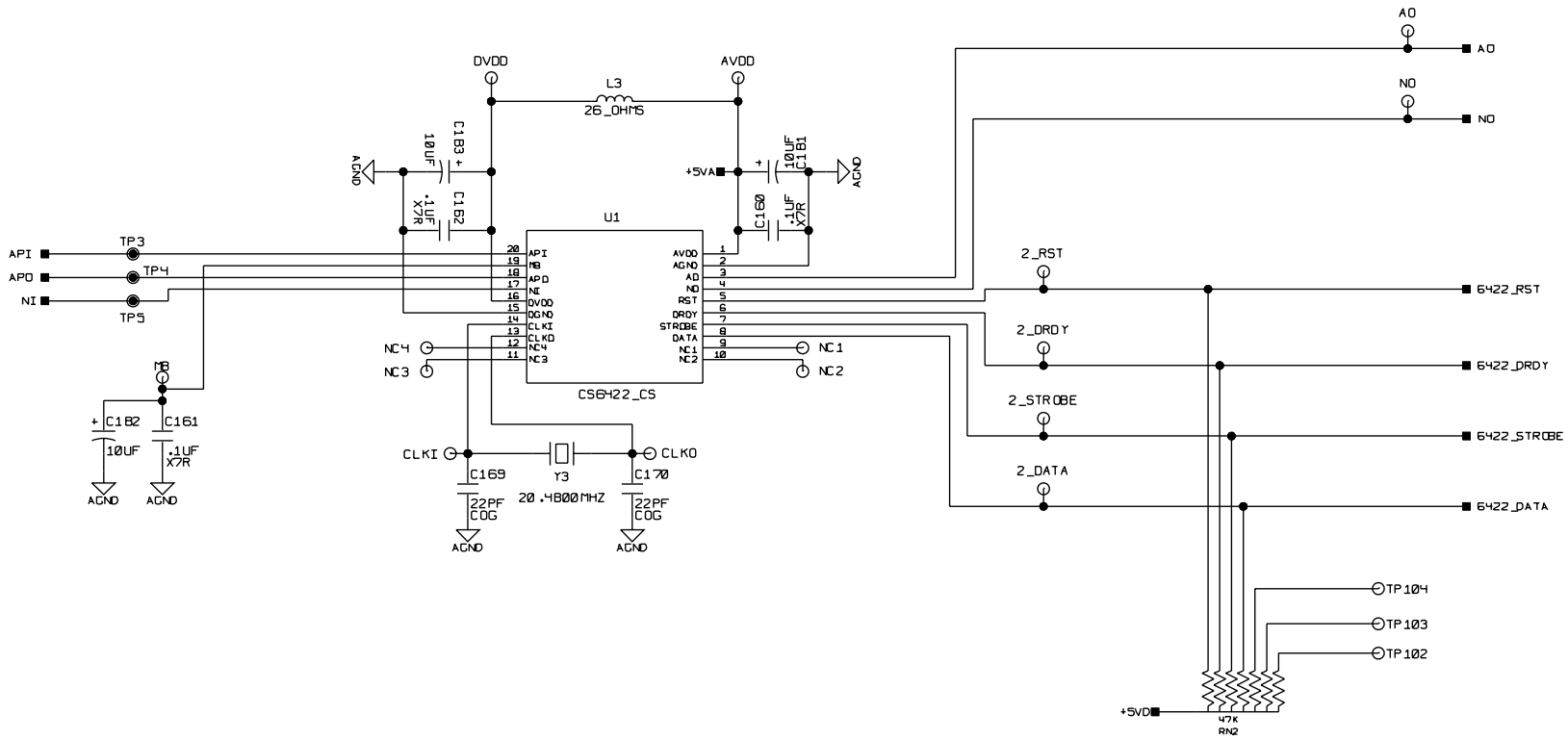


Figure 9. CS6422



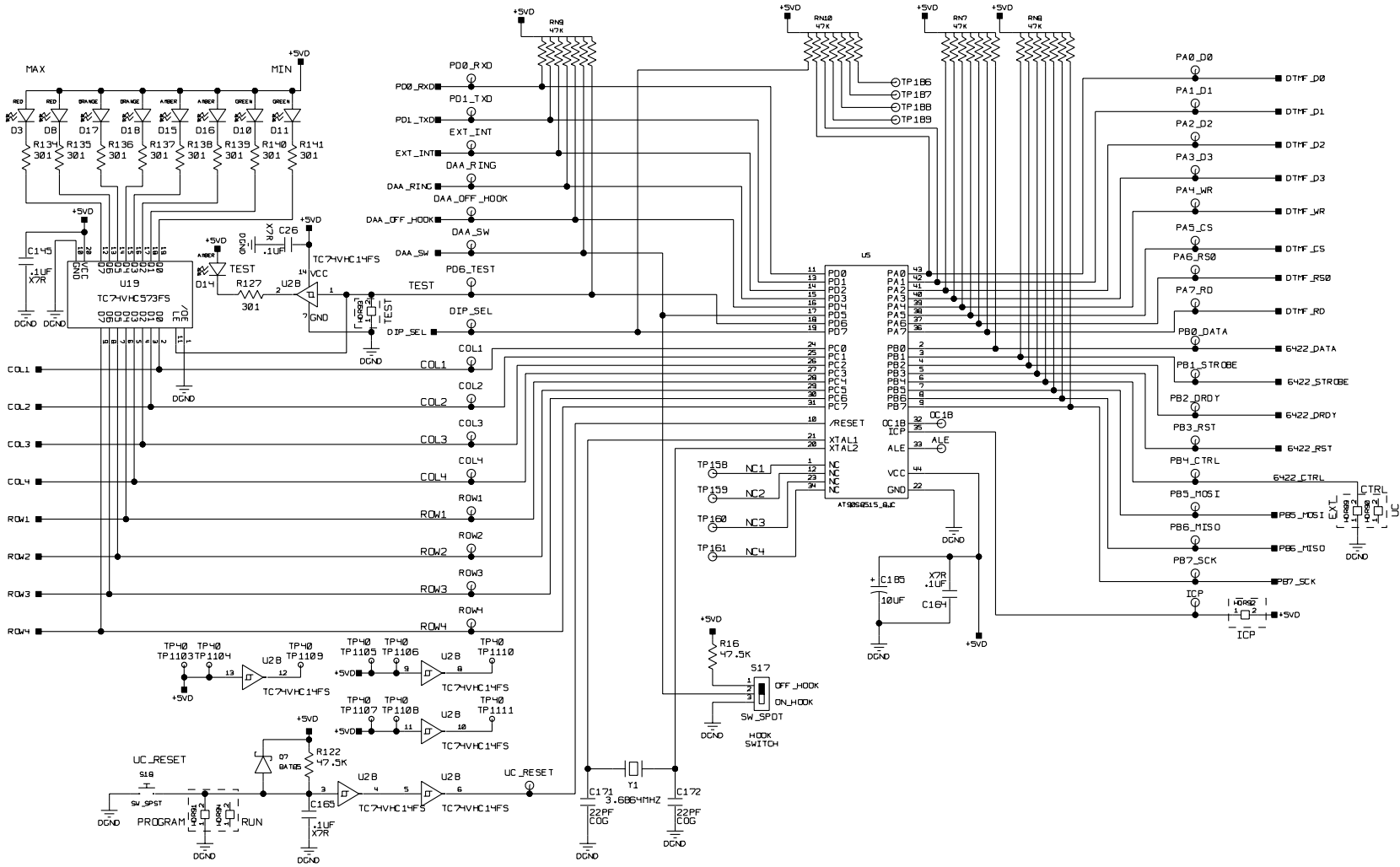


Figure 11. Microcontroller



• Notes •

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