OKI

User's Manual
for
MSM7731-02 Evaluation Board

Oki Electric Industry Co., Ltd.
Ver. 2.0
February 2000

NOTICE

1. The information contained herein can change without notice owing to product and/or technical improvements. Before using the product, please make sure that the information being referred to is up-to-date.

2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit, assembly, and program designs.

3. When designing your product, please use our product below the specified maximum ratings and within the specified operating ranges including, but not limited to, operating voltage, power dissipation, and operating temperature.

4. Oki assumes no responsibility or liability whatsoever for any failure or unusual or unexpected operation resulting from misuse, neglect, improper installation, repair, alteration or accident, improper handling, or unusual physical or electrical stress including, but not limited to, exposure to parameters beyond the specified maximum ratings or operation outside the specified operating range.

5. Neither indemnity against nor license of a third party's industrial and intellectual property right, etc. is granted by us in connection with the use of the product and/or the information and drawings contained herein. No responsibility is assumed by us for any infringement of a third party's right which may result from the use thereof.

6. The products listed in this document are intended for use in general electronics equipment for commercial applications (e.g., office automation, communication equipment, measurement equipment, consumer electronics, etc.). These products are not authorized for use in any system or application that requires special or enhanced quality and reliability characteristics nor in any system or application where the failure of such system or application may result in the loss or damage of property, or death or injury to humans.
   Such applications include, but are not limited to, traffic and automotive equipment, safety devices, aerospace equipment, nuclear power control, medical equipment, and life-support systems.

7. Certain products in this document may need government approval before they can be exported to particular countries. The purchaser assumes the responsibility of determining the legality of export of these products and will take appropriate and necessary steps at their own expense for these.

8. No part of the contents contained herein may be reprinted or reproduced without our prior permission.

CONTENTS

MSM7731-02 EVALUATION KIT

This kit contains one Evaluation Board (10.5 × 7 inches), one MSM7731-02GA LSI, and this User's Manual.

1. GENERAL DESCRIPTIONS

This is a user's manual for OKI Noise/Echo Canceler LSI, MSM7731-02. The evaluation board is designed for your 'turn-key' evaluation of the MSM7731-02 with the following features.

1.1 LSI Socket and MSM7731-02GA LSI

1.2 Speaker Amplifier LSI (LM4861 manufactured by National Semiconductor)

This enables a direct connection to a speaker with ease.

1.3 Microphone Input Circuit

This enables a direct connection to a microphone with ease.

1.4 Single 12 V Power Supply Pin and Ground Pin (TP1 and TP2)

The 12 V power supply is suitable for the evaluation in car environment, as it is available for a cigarette lighter adapter and battery of an automobile. In the board, the single +3 V power supply is applied to the MSM7731-02 and +5 V is to the LM4861.

1.5 Various Test Pins

Test pins are mounted on the PCB for the connection to an external telephone handset, microcontroller, and digital interface for easy evaluation in the final application environment.

1.6 Various DIP Switches

DIP switches are mounted on the PCB for the evaluation of the Pin Control Mode of the MSM7731-02.

1.7 Various Toggle Switches

Toggle switches are mounted on the PCB for the evaluation of the MCU Interface Mode of the MSM7731-02.

1.8 Various Mini-Jacks

Mini-jacks are mounted on the PCB for connecting a speaker and microphone on the near-end and an external handset toward the far-end.

1.9 Variable Resistors

There are 4 variable resistors located on the right lower side of the evaluation board. The function of each resistor is as follows:

RV1: MIC (Microphone) level adjustment
RV2: MIN (Line input) level adjustment
RV4: SP (Speaker output) level adjustment
RV5: MOUT (Line out) level adjustment

1.10 On-board Microcontroller Interface Operation

Besides the Pin Control Mode operation, this board can evaluate the MSM7731-02 by using on-board registers as well as an external microcontroller. The on-board register can easily be set by using toggle switches on the PCB (MCU Interface Mode).

1.11 Spare Area for Additional Amplifier

The amplifier such as for the line out to an external telephone handset can be used as an option by using the area of U15.

1.12 LED Indicator

On-board LEDs are used for the confirmation of the register contents.

1.13 On-board Crystal

The 19.2 MHz crystal is equipped on the board. An oscillator can be used as an option by using the socket of XL2 (the oscillator is not included in this kit).

1.14 Measurement Location for External Oscilloscope

During the tuning process, some of the output pins of the MSM7731-02 have to be measured by using an external oscilloscope. There are 6 points where the pins of the oscilloscope have to be set.

(1) AVFRO: Right lead of R13 resistor
(See the Board Schematic of this user manual)
(2) AGSX: Left lead of R9 resistor
(See the Board Schematic of this user manual)
(3) Pin 8 of LM4861: (See the Board Schematic of this user manual)
(4) LVFRO: Left lead of R20 resistor
(See the Board Schematic of this user manual)
(5) LGSX: Right lead of R12 resistor
(See the Board Schematic of this user manual)
(6) LOUT: Left lead of R21 resistor
(See the Board Schematic of this user manual)

2. BOARD SCHEMATICS

Refer to Figure 1 for the MSM7731-02 Evaluation Board Schematic, Figure 2 for Chip Connection Circuits and Figure 3 for Peripheral Circuits.

3. FUNCTIONAL DESCRIPTIONS

Refer to Table 1 for analog/digital interface mode setting with an external handset, Table 2 for general functions of switches and pins.

3.1 Test Pin (TP)

3.1.1 TP1

TP1 located at the right upper corner of the evaluation board is a single DC +12 V power supply pin. The necessary voltages for the components on the board are automatically regenerated.

3.1.2 TP2

TP2 located at the right upper corner of the evaluation board is a ground pin for the above-mentioned DC +12 V power supply. Connect it to the ground level.

3.1.3 TP3

TP3 located at the left upper corner of the evaluation board consists of digital interface pins. These pins are used when a handset has a digital interface to the evaluation board (PCMO, PCMI), or when you want to transmit digital voice data of telephone conversation down to external memory or to other directions for the purpose of recording and playback (PCME0, PCMEI).

3.1.4 TP4

TP4 located at the left upper corner of the evaluation board consists of external microcontroller interface pins. When you want to evaluate your microcontroller, connect the appropriate pins of the microcontroller to these pins. When the microcontroller interface is used, set DSW6 (DEN, DIN and EXCK) to "OFF".

3.1.5 TP5

TP5 located at the right lower corner of the evaluation board consists of analog interface pins for Line in and out. These pins are connected to the mini-jacks of J2 (MIN) and J4 (MOUT) on the evaluation board and the jacks could be used as alternative interface of the same function..

3.2 DIP Switch (DSW)

DSW is used for the pin setting in the Pin Control Mode.

3.2.1 DSW1

DSW1 located at the upper middle of the evaluation board consists of switches for manufacturer's LSI test pins (TEST1, 2, 3 & 4) and noise canceler level control (NCSEL2). Always set the switches (TEST1, 2, 3 & 4) to "0". For switch No. 5 (NCSEL2), refer to "Table 2-1: DIP Switch Settings" or the "Pin Functional Description" of the MSM7731-02 Data Sheet. When evaluating the microcontroller or on-board register, set switch No. 5 to "0".

3.2.2 DSW2

DSW2 located at the upper middle of the evaluation board consists of switches for mode selection. Refer to "Table 2-1: DIP Switch Settings or the "Pin Functional Description" of the MSM7731-02 Data Sheet for details. When evaluating the microcontroller or on-board register, set the switches other than switches No. 1 (CLKSEL) and No. 5 (SYNCSEL) to "0".

3.2.3 DSW3

DSW3 located at the lower middle of the evaluation board consists of switches for acoustic echo canceler mode control (AGC, AATT, AHD, and ATHR), noise canceler input/output gain adjustment (NCPAD2), noise cancellation level control (NCSEL1), and slope filter mode control (SLPTHR). Refer to "Table 2-1: DIP Switch Settings" or the "Pin Functional Description" of the MSM7731-02 Data Sheet for details. When evaluating the microcontroller or on-board register, set all the switches to "0".

3.2.4 DSW4

DSW4 located at the lower middle of the evaluation board consists of switches for line echo canceler mode control (LGC, LATT, LHD, and LTHR), and noise canceler input/output gain adjustment (NCPAD1). Refer to "Table 2-1: DIP Switch Settings" or the "Pin Functional Description" of the MSM7731-02 Data Sheet for details. When evaluating the microcontroller or on-board register, set all the switches to "0".

3.2.5 DSW5

DSW5 located at the lower middle of the evaluation board consists of switches for gain adjustment control and mute of voice data (TPADn for the transmit side, and RPADn for the receive side). Refer to "Table 2-1: DIP Switch Settings" or the "Pin Functional Description" of the MSM7731-02 Data Sheet for details. When evaluating the microcontroller or on-board register, set all the switches to "0".

3.2.6 DSW6

DSW6 located at the upper middle of the evaluation board consists of switches to select the mode of the evaluation board. The external microcontroller mode is selected when all the switches are set to "OFF", and the on-board register mode or pin control mode is selected when all the switches are set to "ON".

3.3 Toggle Switch (SW)

Toggle switches are used for the register setting in the on-board register mode and external MCU mode. SW1 and SW10 are also used in the pin control mode for the reset functions.

3.3.1 SW1 (PDNRST)

SW1 is a switch for power down reset. The evaluation board goes into a power down reset mode when the switch is pulled up once. For detailed explanation, refer to the "Pin Functional Description" of the MSM7731-02 Data Sheet.

3.3.2 SW10 (RST)

SW10 is a switch for the reset of all internal coefficients of the echo and noise canceler.
For detailed explanation, refer to the "Pin Functional Description" of the MSM7731-02 Data Sheet.

3.3.3 SW2 to SW9 (D7 to D0) and SW14 to SW17 (A3 to A0)

SW2 to SW9 (D7 to D0) and SW14 to SW17 (A3 to A0) are switches for setting the contents and addresses of the control register. SW14 to SW17 (A3 to A0) are used to set the control register address and SW2 to SW9 (D7 to D0) are used to set the addresses of the designated internal data memory and the contents of each mode. Those contents and addresses will not be valid till SW19 (SET) is pressed. For detailed explanation, refer to the Functional Description - Control Registers of the MSM7731-02 Data Sheet.

3.3.4 SW18 (R/W)

This is a switch to select the read and write mode of control registers. Set SW18 to "W" to write the address and register contents into the MSM7731-02 which is set by the toggle switches of SW2 to SW9 (D7 to D0) and SW14 to SW17 (A3 to A0). Set SW18 to "R" to read the written data of the address and register contents out of the MSM7731-02. The contents of the MSM7731-02 register addressed by the toggle switches of SW2 to SW9 (D7 to D0) are read out and displayed on the LEDs (LED2 to LED9) at the right bottom of the evaluation board. For detailed operations, refer to Sections 4-4 and 4-5 of this manual.

3.3.5 SW19 (SET)

This switch has an "enter" function. After setting the toggle switches, press this switch to execute the read or write operation.

3.4 Mini-Jack

3.4.1 J1 (MIC)

MIC is a jack for acoustic side microphone input. This jack is connected to AIN of the MSM7731-02. For the detailed schematic between MIC and AIN, refer to Figure 3-2 of this user's manual.

3.4.2 J2 (MIN)

MIN is a jack for line side analog voice input. The jack is connected to LIN of the MSM7731-02 and MIN pin of TP5 on this evaluation board. For the detailed schematic between MIN and LIN, refer to Figure 3-1 of this user's manual.

3.4.3 J3 (SP)

SP is a jack for acoustic side speaker output. This jack is connected to the on-board speaker amplifier LM4861 manufactured by National Semiconductor at U13 (left side of the demonstration board). The input pin of the LM4861 is connected to AOUT of the MSM7731-02. For the detailed schematic between SP and AOUT, refer to Figure 3-3 of this user's manual.

3.4.4 J4 (MOUT)

MOUT is a jack for line side analog voice output. The jack is connected to LOUT of the MSM7731-02 and MOUT pin of TP5 on this evaluation board. For the detailed schematic between MOUT and LOUT, refer to Figure 3-1 of this user's manual.

3.5 Variable Resistor (RV)

3.5.1 RV1

RV1 is a variable resistor to control the input gain from a microphone through the J1 (MIC) mini-jack. The MIC jack is connected to the AIN pin of the MSM7731-02. For the detailed schematic between AIN and MIC, refer to Figure 3-2 of this user's manual.

3.5.2 RV2

RV2 is a variable resistor to control the input gain from analog line input from the handset side through the J2 (MIN) mini-jack or MIN pin of TP5. The MIN jack and MIN pin are connected to the LIN pin of the MSM7731-02. For the detailed schematic between MIN and LIN, refer to Figure 3-1 of this user's manual.

3.5.3 RV4

RV4 is a variable resistor to control the output gain for speaker output through the J3 (SP) mini-jack. The SP jack is connected to the AOUT pin of the MSM7731-02 through the LM4861 speaker amplifier. For the detailed schematic between SP and AOUT, refer to Figure 3-3 of this user's manual.

3.5.4 RV5

RV5 is a variable resistor to control the output gain of analog line output into the handset side through the MOUT mini-jack or MOUT pin of TP5. The MOUT jack is connected to the LOUT pin of the MSM7731-02. For the detailed schematic between MOUT and LOUT, refer to Figure 3-1 of this user's manual.

3.6 Jumper (JP)

JP1 and JP2 located at the upper left corner are switches for a digital interface. In both digital (TP3) and analog (MIN, MOUT) interface modes, set both JP1 and JP2 to "1 (pull-up state)" as far as PCMSEL

(DSW2) is set to "1", and set both JP1 and JP2 to "0 (pull-down state)" as far as PCMSEL (DSW2) is set to "0".

Table 1 Jumper Settings

Mode		JP1	JP2
Analog and Digital Interface Mode	PCMSEL = 0	Set to "0"	Set to "0"
	PCMSEL = 1	Set to "1"	Set to "1"

3.7 External Oscillator (XL2)

When an external oscillator is used, insert the oscillator into the socket of XL2. The crystal XL1, capacitors C7 and C8, and resistor R5 have to be removed.

3.8 Extra Amplifier Setting

This evaluation board can be provided with an additional amplifier by using U15 which is used for connecting the amplifier such as to an external telephone handset. The pin 4 of U15 is connected to GND and the pin 8 is to a single +5 V power supply. Other pins of U15 are open and can be connected by using a jumper line at your disposal.

Table 2-1 DIP Switch Settings

Refer to the "Pin Functional Description" of the MSM7731-02 data sheet for detailed explanation.

SW Name		Parameter Name	Set to "1"	Set to "0"
DSW1	1-4	TEST 1, 2, 3 & 4	—	Always set to 0
	5	NCSEL2	Noise cancellation level select. Refer to Table 2-2 for details.	
DSW2	1	CLKSEL	External clock mode	Internal clock mode
	2	ECSEL	Single EC mode	Dual EC mode
	3	MCUSEL	MCU interface disabled	MCU interface enabled
	4	PCMSEL	μ-law PCM mode	16-bit linear mode
	5	SYSNCSEL	Short frame sync mode	Normal sync mode
	7	GLPADTHR	GLPAD active	GLPAD inactive (through mode)
	8	LINEEN	Line side codec power down	Line side codec normal operation
DSW3	1	SLPTHR	Slope filter inactive	Slope filter active
	2	NCSEL1	Noise cancellation level select. Refer to Table 2-2 for details.	
	4	ATHR	Acoustic echo canceler inactive	Acoustic echo canceler active
	5	AHD	Acoustic howling detector inactive	Acoustic howling detector active
	6	NCPAD2	Noise canceler input/output gain adjustment. Refer to Table 2-3.	
	7	AATT	Setting acoustic attenuation 6 dB	Setting acoustic attenuation 12 dB
	8	AGC	Acoustic gain control inactive	Acoustic gain control active
DSW4	1	LTHR	Line echo canceler inactive	Line echo canceler active
	2	LHD	Line howling detector inactive	Line howling detector active
	3	NCPAD1	Noise canceler input/output gain adjustment. Refer to Table 2-3.	
	4	LATT	Line attenuation function inactive	Line attenuation function active
	5	LGC	Line gain control inactive	Line gain control active
DSW5	1-8	RPAD4-1, TPAD4-1	Transmitting and receiving gain adjustment. Refer to Table 2-4.	

Table 2-2 Noise Cancellation Level Select

NCSEL2	NCSEL1	Noise Cancellation Level
0	0	17 dB
1	1	13.5 dB
1	0	8 dB
0	1	0 dB

Table 2-3 Noise Cancellation Input/Output Gain Adjustment

NCPAD2	NCPAD1	GPADNC Gain	LPADNC Gain
0	0	0 dB	0 dB
0	1	6 dB	–6 dB
1	0	12 dB	–12 dB
1	1	18 dB	–18 dB

Table 2-4 Transmitting and Receiving Gain Adjustment

RPAD4	RPAD3	RPAD2	RPAD1	TPAD4	TPAD3	TPAD2	TPAD1	Level
0	1	1	1	0	1	1	1	21 dB
0	1	1	0	0	1	1	0	18 dB
0	1	0	1	0	1	0	1	15 dB
0	1	0	0	0	1	0	0	12 dB
0	0	1	1	0	0	1	1	9 dB
0	0	1	0	0	0	1	0	6 dB
0	0	0	1	0	0	0	1	3 dB
0	0	0	0	0	0	0	0	0 dB
1	1	1	1	1	1	1	1	–3 dB
1	1	1	0	1	1	1	0	–6 dB
1	1	0	1	1	1	0	1	–9 dB
1	1	0	0	1	1	0	0	–12 dB
1	0	1	1	1	0	1	1	–15 dB
1	0	1	0	1	0	1	0	–18 dB
1	0	0	1	1	0	0	1	–21 dB
1	0	0	0	1	0	0	0	MUTE

4. HOW TO SET THE OPERATION MODE

There are two modes for controlling the MSM7731-02; the pin control mode that controls the device through pin settings, the MCU interface mode that controls the device through control register settings. Not only you can simulate both modes by various switches on this evaluation board but also you can connect an external microcontroller, which could serve as easy-to-use microcontroller software development environment.

4.1 Pin Control Mode

(1) Set all the switches of DSW1 to "0" other than DSW1-5 (NCSEL2).
(2) Set DSW2-1 (CLKSEL) to "0" when the analog line interface is selected, or when the digital line interface is selected while SYNC and BCLK are used by internal clocks.
Set DSW2-1 (CLKSEL) to "1" when the digital line interface is selected while SYNC and BCLK are used by external clocks.
(3) Set DSW2-3 (MCUSEL) to "1" to select the pin control mode.
(4) Set DSW2-4 (PCMSEL) to "0" when the analog line interface is selected, or when digital line interface is selected while the 16-bit linear code format is used.
Set DSW2-4 (PCMSEL) to "1" when the digital line interface is selected while the μ-law PCM code format is used.
(5) Set DSW2-8 (LINEEN) to "0" when the analog line interface is selected.
When the digital line interface is selected, set DSW2-8 (LINEEN) to "1" to power down the line CODEC.
(6) See Table 2-1 "DIP Switch Settings" of this document or the "Pin Functional Description" of the MSM7731-02 Data Sheet for settings of DSW1-5, DSW-2-2, DSW2-5, DSW-2-7, DSW3, and DSW5.
(7) Set all the switches of DSW6 to "ON".
(8) Connect TP3 to the cellular phone when the digital line interface is selected.
Connect TP5 or J2 and J4 to the cellular phone when the analog line interface is selected.
(9) TP4 is unused.
(10) Set JP1 and JP2 to "0" when DSW2 (PCMSEL) is set to "0".
Set JP1 and JP2 to "1" when DSW2 (PCMSEL) is set to "1".
(11) All toggle switches other than SW1 (PDNRST) and SW10 (RST) are unused.
(12) Apply the DC 12 V power supply to TP1 and connect TP2 to GND.
(13) The MSM7731-02 enters the normal operation mode when SW1 (PDNRST) is executed.

4.2 MCU Interface Mode Using On-board Registers

(1) Set DSW2-1 (CLKSEL) to "0" when the analog line interface is selected, or when the digital line interface is selected while SYNC and BCLK are used by internal clocks.
Set DSW2-1 (CLKSEL) to "1" when the digital line interface is selected while SYNC and BCLK are used by external clocks.
(2) See Table 2-1 "DIP Switch Settings" of this document or the "Pin Functional Description" of the MSM7731-02 Data Sheet for setting of DSW2-5 (SYNCSEL).
(3) Set all the switches of DSW6 to "ON".
(4) Set DSW1, DSW2 (other than DSW2-1, DSW2-5), DSW3, DSW4, and DSW5 to "0".
(5) Connect TP3 to the cellular phone when the digital line interface is selected.
Connect TP5 or J2 and J4 to the cellular phone when the analog line interface is selected.
(6) TP4 is unused.
(7) Set JP1 and JP2 to "0" when CR11-B1 (PCMSEL) is set to "0".
Set JP1 and JP2 to "1" when CR11-B1 (PCMSEL) is set to "1".
(8) Apply the DC 12V power supply to TP1 and connect TP2 to GND.
(9) Execute SW1 (PDNRST).
(10) Set the CR (Control Register) using SW2 to SW9 and SW14 to SW19 of the MCU control circuit. See Sections 4-4 and 4-5 for details.

The MSM7731-02 can change the initial values of cancellable echo delay time, noise attenuation, and attenuation of ATT function using the CR. See Sections 4-6 and 4-7 or "Method of Internal Memory Access" of the MSM7731-02 Data Sheet for reference. The MSM7731-02 enters the normal operation mode after CR0 has been set.

4.3 MCU Interface Mode Using External Microcontroller

(1) Set DSW2-1 (CLKSEL) to "0" when the analog line interface is selected, or when the digital line interface is selected while SYNC and BCLK are used by internal clocks.
Set DSW2-1 (CLKSEL) to "1" when the digital line interface is selected while SYNC and BCLK are used by external clocks.
(2) See Table 2-1 "DIP Switch Settings" of this document or the "Pin Functional Description" of the MSM7731-02 Data Sheet for setting of DSW2-5 (SYNCSEL).
(3) Set all the switches of DSW6 to "OFF".
(4) Set DSW1, DSW2 (other than DSW2-1, DSW2-5), DSW3, DSW4, and DSW5 to "0".
(5) Connect TP3 to the cellular phone when the digital line interface is selected.
Connect TP5 or J2 and J4 to the cellular phone when the analog line interface is selected.
(6) Connect TP4 to the external microcontroller.
(7) Set JP1 and JP2 to "0" when CR11-B1 (PCMSEL) is set to "0".
Set JP1 and JP2 to "1" when CR11-B1 (PCMSEL) is set to "1".
(8) Apply the DC 12V power supply to TP1 and connect TP2 to GND.
(9) Execute SW1 (PDNRST).
(10) SW2 to SW9 and SW14 to SW19 are unused.
(11) Set the CR (Control Register) using an external microcontroller.
The MSM7731-02 can change the initial values of cancellable echo delay time, noise attenuation, and attenuation of ATT function using the CR. See Sections 4-6 and 4-7 or "Method of Internal Memory Access" of the MSM7731-02 Data Sheet for reference. The MSM7731-02 enters the normal operation mode after CR0 has been set.

Table 3 Mode Settings

Component Name	Pin Control Mode	MCU Mode	
		On-board Register	External MCU
TP1	Connect the DC 12 V power supply		
TP2	Connect to GND		
TP3	Used in digital interface mode only		
TP4	Not used	Not used	Connect to MCU
TP5 / J2, J4	Used in analog interface mode only		
DSW1-1, 2, 3, 4	Set to "0"		
DSW1-5 (NCSEL2)	Setting at your choice	Set to "0"	Set to "0"
DSW2-1 (CLKSEL) (a) Analog I/F Mode	Set to "0"		
(b) Digital I/F Mode	Setting at your choice		
DSW2-2 (ECSEL)	Setting at your choice	Set to "0"	Set to "0"
DSW2-3 (MCUSEL)	Set to "1"	Set to "0"	Set to "0"
DSW2-4 (PCMSEL) (a) Analog I/F Mode	Set to "0"	Set to "0"	Set to "0"
(b) Digital I/F Mode	Setting at your choice		
DSW2-5 (SYNCSEL)	Setting at your choice	Setting at your choice	Setting at your choice
DSW2-7 (GLPADTHR)	Setting at your choice	Set to "0"	Set to "0"
DSW2-8 (LINEEN) (a) Analog I/F Mode	Set to "0"	Set to "0"	Set to "0"
(b) Digital I/F Mode	Set to "1"		
DSW3	Setting at your choice	Set to "0"	Set to "0"
DSW4	Setting at your choice	Set to "0"	Set to "0"
DSW5	Setting at your choice	Set to "0"	Set to "0"
DSW6	Set all switches to "ON"	Set all switches to "ON"	Set all switches to "OFF"
SW2-SW9, SW14-SW19	Not used	Setting at your choice	Not used
SW1, SW10	Used	Used as an option	
JP1, JP2	Set the same value as DSW2-4 (PCMSEL).	Set the same value as that set in the control register of CR11-B1 (PCMSEL).	

4.4 How to Write the Control Register by Using Toggle Switches

(1) Select the address of designated Control Register (CR) by setting SW14 to SW17 (A3 to A0) to either "0" or "1". For detailed explanation, refer to the Control Register MAP under the Functional Description of the MSM7731-02 Data Sheet.
(2) Set the designated bits (B7 to B0) to "0" or "1" through the corresponding SW2 to SW9 (D7 to D0). For detailed explanation, refer to the Control Register MAP under the Functional Description of the MSM7731-02 Data Sheet.
(3) Set SW18 (R/W) to "W".
(4) Press SW19 (SET) to execute the write operation.
(5) For further settings of internal data memory other than control registers (cancellable echo delay time setting, noise cancellation level setting and attenuation level setting for ATT function) by toggle switches, refer to the "Method of Internal Data Memory Access" of the MSM7731-02 Data Sheet. The written data in the CR (control register) will remain unchanged till the SW1 (PDNRST) is pressed or new data is overwritten.

4.5 How to Read the Control Register by Using Toggle Switches

(1) Select the address of designated Control Register (CR) by setting SW14 to SW17 (A3 to A0) to either "0" or "1". For detailed explanation, refer to the Control Register MAP under the Functional Description of the MSM7731-02 Data Sheet.
(2) Set SW18 (R/W) to "R".
(3) Press SW19 (SET) to execute the read operation.
(4) The contents of the register is displayed on LED2 to LED9 for confirmation. LED2 to LED9 correspond to B0 to B7 of Control Registers (CR) respectively.

4.6 How to Set Cancellation Echo Delay Time

4.6.1 Single EC Mode (Acoustic Echo Cancellation Mode)

The echo cancellation mode can be selected by ECSEL (CR0-B0). When ECSEL is set to "1", only the acoustic mode is selected. The cancellable echo delay time of the acoustic echo canceler is set to 59 ms as a default value and the line echo canceler is disabled. In order to change the default value of 59 ms, use the MCU mode using the external microcontroller or MCU mode using the on-board register in the initial mode. For detailed explanation, refer to the "Method of Internal Data Memory Access" of the MSM7731-02 Data Sheet.
The cancellable echo delay time can be modified by writing data into control registers as follows:

CR6	(Write) High address data
CR7	(Write) Low address data
CR8	(Write) High data for cancellable echo delay time
CR9	(Write) Low data for cancellable echo delay time

Address of internal data memory for cancellable echo delay time setting: 009Bh
Formula for the data: Cancellable echo delay time (s) × 8,000 = data (hex)

The following explains the procedure to modify the cancellable echo delay time to 30 ms in the MCU mode using the on-board register.

(1) Execute the power down reset by using SW1 (PDNRST) to reset the register data and go into the initial mode.
(2) Calculate the data to be written.
0.03 sec × 8,000 = 240 (in decimal) = 00F0h
(3) Address is "009Bh".
(4) Set SW18 (R/W) to "W".
(5) Set SW14 to SW17 (A3 to A0) to "6h (0110b)" to select CR6.
(6) Set SW2 to SW9 (D7 to D0) to "00h (0000 0000b)" which is high address of "009Bh".

(7) Switch SW19 (SET)to ON (up) to set high addresses.
(8) Set SW14 to SW17 (A3 to A0) to "7h (0111b) to select CR7".
(9) Set SW2 to SW9 (D7 to D0) to "9Bh (1001 1011b)" which is low address of "009Bh".
(10) Switch SW19 (SET) to ON (up) to set low addresses.
(11) Set SW14 to SW17 (A3 to A0) to "8h (1000b)" to select CR8.
(12) Set SW2 to SW9 (D7 to D0) to "00h (0000 0000b)" which is high data of "00F0h".
(13) Switch SW19 (SET) to ON (up) to set high data.
(14) Set SW14 to SW17 (A3 to A0) to "9h (1001b)" to select CR9.
(15) Set SW2 to SW9 (D7 to D0) to "F0h (1111 0000b) " which is low data of "00F0h".
(16) Switch SW19 (SET) to ON (up) to set low data.
(17) Set SW14 to SW17 (A3 to A0) to "1h (0001b)" to select CR1.
(18) Set SW2 to SW9 (D7 to D0) to "8Xh (1000 0xxxb)" to set DMWR (CR1-B7) to "1".
(19) Press SW19 (SET) to change the default value. After this write operation is completed, DMWR (CR1-B7) becomes "0" automatically.
(20) Perform other CR settings. In order to change the set data, execute the power down reset by using SW1 (PDNRST) and repeat the above procedure.

4.6.2 Dual EC Mode (Acoustic and Line Echo Cancellation Mode)

When ECSEL (CR0-B0) is set to "0", the acoustic and line echo canceler mode is activated. The default values of cancellable echo delay time are 44 ms and 15 ms respectively. In order to change the default values, use the MCU mode using the external microcontroller or MCU mode using the on-board register in the initial mode. For detailed explanation, refer to the "Method of Internal Data Memory Access" of the MSM7731-02 Data Sheet.

Address of acoustic default value: 0099h
Address of line default value: 009Ah
The echo cancellation formula and internal memory write operation are the same as those described in Chapter 4-6-1 above.

Table 4 Echo Canceler Address

	Acoustic Echo Address	Line Echo Address	Data to be written
Single EC Mode	009Bh	—	Calculated by Formula
Dual EC Mode	0099h	009Ah	Calculated by Formula

4.7 How to Set Noise Cancellation Levels

The 4 levels of noise cancellation, 17, 13.5, 8 or 0 (Off) dB, are selectable in the pin control mode. Table 5 below shows how to set the noise cancellation level by using NCSEL1 and NCSEL2 pins.

Table 5 Noise Cancellation Level

NCSEL2	NCSEL1	Noise Cancellation Level
0	0	17 dB
1	1	13.5 dB
1	0	8 dB
0	1	0 dB

In order to change the default value other than the above, use the MCU interface mode using the external microcontroller or the MCU mode using the on-board register in the initial mode. When changing the default value, set the NCSEL1 and NCSEL2 pins to "0". For detailed explanation, refer to the "Method of Internal Data Memory Access" of the MSM7731-02 Data Sheet.

There are 2 parameters (Address 1 & 2) which adjust the voice quality and noise canceler level. The examples of the appropriate combination corresponding to each noise cancellation level are shown in Table 6-1. As the noise cancellation level and voice quality are in a trade-off relationship, try the examples to find out your best combination. Even with the same noise cancellation level, the voice quality differs depending on the 2 parameter values. Try and find your best combination. The combinations marked with a double line are Oki's recommendations.
Address of default value (Address 1): 01C8h
Address of default value (Address 2): 01C2h
Refer to Table 6-2 for the setting data of the noise cancellation level.
The internal memory write operation is the same as those described in Chapter 4-6-1 of this manual.

Table 6-1 Noise Canceler Address

	Noise Canceler Address 1	Noise Canceler Address 2	Data to be written
Noise Canceler Mode	01C8h	01C2h	As per Table 6-2

Table 6-2 Noise Cancellation Level Setting Data

Noise Cancellation Level	17 dB	14 dB	13.5 dB	12 dB	11 dB	10 dB	9 dB	8 dB
Noise Canceler Address 1 (01C8h)	2000h	3333h	3333h	4666h	4666h	5999h	6666h	5999h
Noise Canceler Address 2 (01C2h)	0005h	0005h	0004h	0005h	0003h	0005h	0005h	0002h

Noise Cancellation Level	8 dB	8 dB	7 dB	7 dB	6 dB
Noise Canceler Address 1 (01C8h)	2000h	3333h	4666h	5999h	6666h
Noise Canceler Address 2 (01C2h)	0001h	0001h	0001h	0001h	0001h

4.8 How to Set Noise Canceler Pads (NCPAD1, NCPAD2)

There are 2 pads to control the input and output level to and from the noise canceler block. These pads are used to adjust the voice quality. This level can be modified by setting NCPAD1 and NCPAD2 to either "1" or "0". Refer to the table below.

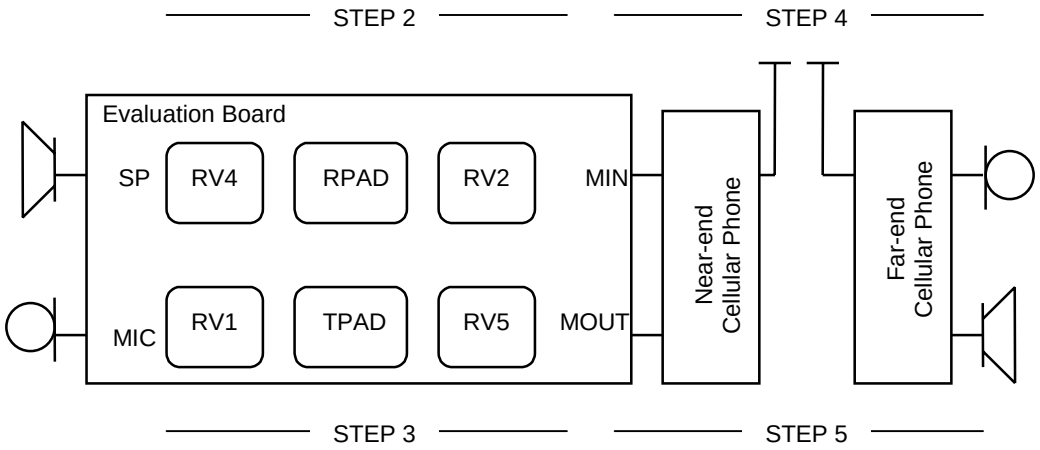
Table 7 Noise Cancellation Input/Output Gain Adjustment

NCPAD2	NCPAD1	GPADNC	LPADNC
0	0	0 dB	0 dB
0	1	6 dB	–6 dB
1	0	12 dB	–12 dB
1	1	18 dB	–18 dB

5. HOW TO CONTROL THE EVALUATION BOARD FOR BEST QUALITY VOICE

5.1 Overview

The voice quality is a key factor for a hands-free kit. The high-performance echo canceler, noise canceler and codec of the MSM7731-02 can realize the best quality voice.
In order to get the best quality voice, it is required to control the peripheral circuits for the MSM7731-02. This chapter describes how to get the best quality voice using the MSM7731-02 evaluation board. The following control method for the MSM7731-02 is described when the EC mode is the single EC mode and the line interface is the analog interface.



STEP 1: Initial settings of switches on the evaluation board
STEP 2: Level control of the path from MIN to SP (speaker)
STEP 3: Level control of the path from SP (speaker) to MIN
STEP 4: Level tuning of the path from MIN to SP with a cellular phone connected.
STEP 5: Level tuning of the path from MIC (microphone) to MOUT with a cellular phone connected, and control of voice quality

5.2 Instruments

- Audio analyzer (ex. HP-made 8903B)
- Sound level meter (ex. RION-made NL-05)
- Oscilloscope
- Two sets of cellular phones

5.2 Control Procedure

5.3.1 STEP 1

The STEP 1 performs initial settings of DIP switches (DSW1 to DSW6) and variable resistors (RV1, RV2, RV4, RV5) on the evaluation board.

(a) Set all the switches of DSW1 to "0".

(b) Set each switch of DSW2 as follows:

1 - CLKSEL:	Set this switch to "0" to select the internal clock mode.
2 - ECSEL:	Set this switch to "1" to select the single echo canceler mode.
3 - MCUSEL:	Set this switch to "1" to select the pin control mode.
4 - PCMSEL:	Set this switch to "0" to select the 16-bit linear.
7 - GLPADTHR:	Set this switch to "0" to disable GLPAD.
8 - LINEEN:	Set this switch to "0" to enable the line CODEC.

(c) Set each switch of DSW3 as follows:

1 - SLPHR:	Set this switch to "1" to disable the slope filter.
2 - NCSEL1:	Set this switch to "1" to disable the noise canceler.
4 - ATHR:	Set this switch to disable the acoustic echo canceler.
5 - AHD:	Set this switch to enable the acoustic howling detector.
6 - NCPAD2:	Set this switch to "0" to disable NCPAD.
7 - AATT:	Set this switch to "0" to enable the acoustic attenuator.
8 - AGC:	Set this switch to "0" to enable the acoustic gain controller.

(d) Set each switch of DSW4 as follows:

1 - LTHR:	Set this switch to "0" to enable the line echo canceler.
2 - LHD:	Set this switch to "0" to enable the line howling detector.
3 - NCPAD1:	Set this switch to "0" to disable NCPAD.
4 - LATT:	Set this switch to "0" to enable the line attenuator.
5 - LGC:	Set this switch to "0" to enable the gain controller.

(e) Set all the switches of DSW5 to "0" to set the transmit/receive control PAD to 0 dB.

(f) Set all the switches of DSW6 to "ON".

(g) Set the variable resistor RV1 to 1 kΩ, RV2 to 20 kΩ, RV4 to 700 Ω (from GND), and RV5 to 22 kΩ.

5.3.2 STEP 2

The STEP 2 controls the level of the path from MIN (line analog input) to the speaker output by using a single tone.

(a) Maintain the previous PADs for controlling the echo canceler, noise canceler, and transmit/receive gain as set in STEP 1.

(b) Connect the audio analyzer (HP-made 8903B) to the MIN pin (TP5) or the MIN jack (J2).

(c) Place the sound level meter (RION NL-05) in front of the speaker connected to the SP jack (J3). The distance between the speaker and the sound level meter is approximately 1 meter.

(d) The 1 kHz - 20 dBm single tone signal is output from the audio analyzer.

(e) Control the variable resistor RV2 so that the waveform at the LGSX pin is equal to 1.3 Vp-p. See the location of LGSX in Figure 1 Board Schematic.

(f) Control the variable resistor RV4 so as to avoid the clipping of the speaker amplifier output waveform (pin 8 of LM4861). See the location of pin 8 of the LM4861 in Figure 1 Board Schematic.

(g) Set the variable resistor RV2 to 20 kΩ again and control the DSW5 (RPAD1-4) so that the speaker output level (measured by the sound level meter) is 80 dBA.

5.3.3 STEP 3

The STEP 3 controls the level of the path from the speaker to MIC (acoustic analog input).

(a) Maintain the previous RV2, RV4 and DSW5 (RPAD1-4) levels set in STEP 2.

(b) Place the microphone approximately 50 cm away from the speaker.

(c) Check that the echo path (from the AVFRO pin to the AGSX pin) is attenuating. If the echo path is amplifying, the echo attenuation will be greatly degraded.

Perform the level control so as to satisfy the following conditional expression.
<Conditional expression>
AVFRO output level + 4 dB ≥ AGSX input level of echo canceler
(See the AVFRO and AGSX locations of Figure 1 Board Schematic)

(d) If the above conditional expression is not satisfied, increase the variable resistance RV1 for gain control (decrease the gain), increase the distance between the microphone and the speaker, or set the GLPADTHR (DSW2-7) to "1".

(e) Disable the single tone output of the audio analyzer and enter the voice through the microphone. Control the variable resistor RV1 so that the maximum input amplitude is 1.3 Vp-p or less even if a large quantity of voices are input to the AGSX pin.

5.3.4 STEP 4

The STEP 4 tunes the level of the path from MIN (line analog input) to the speaker output using a cellular phone.

(a) Connect the cellular phone to MIN and MOUT (TP5 or mini-jack) of the evaluation board.

(b) Set each switch of DSW3 as follows:
- 1 - SLPTHR: Set this switch to "1" to disable the slope filter.
- 2 - NCSEL1: Set this switch to "0" to enable the noise canceler.
- 4 - ATHR: Set this switch to "0" to enable the acoustic echo canceler.
- 5 - AHD: Set this switch to "0" to enable the acoustic howling detector.
- 6 - NCPAD2: Set this switch to "0" to disable NCPAD.
- 7 - AATT: Set this switch to "0" to enable the acoustic attenuator.
- 8 - AGC : Set this switch to "0" to enable the acoustic gain controller

(c) Enable the communication between the far-end cellular phone and the near-end cellular phone (connected to the eva board) and enter the voice into the far-end cellular phone.

(d) Control the variable resistor RV2 so that the average input level at the LGSX pin is approximately -20 dBm and the maximum input amplitude is 1.3 Vp-p or less. See the LGSX location of Figure 1 Board Schematic.

(e) Control DSW5 (RPAD1 to 4) so that an appropriate level of sound are output from the speaker. If the sound level meter located approximately 1 meter away from the speaker shows 75 dBA, the sound level will be sufficient.

5.3.5 STEP 5

The STEP 5 tunes the level of the path between the microphone to MOUT (line analog output) and also controls the quality of voices.

(a) Maintain the cellular phone connection made in STEP 4.

(b) Enable the communication with cellular phones and enter voices into the microphone.

(c) Control DSW5 (TPAD1-4) or the variable resistor RV5 so that a good sound level of voices are output from the speaker of a far-end cellular phone.

(d) Set DSW3-6 (NCPAD2) and DSW4-3 (NCPAD1) so that the best sound level of voices are output from the speaker of a far-end cellular phone.

(e) Compare the noise canceler attenuation with the sound level of voices that are output from the far-end cellular phone. Change the settings of DSW1-5 (NCSEL2) and DSW3-2 (NCSEL1) to determine

the best of noise cancelling level. The noise canceler of the MSM7731-02 has a trade-off relationship between the voice quality and the noise canceler attenuation. When DSW1-5 (NCSEL2) and DSW3-2 (NCSEL1) have been changed, it is required to execute SW1 (PDNRST).

The basic sound level control procedure is complete.

6. PRECAUTIONS

(1) The clock outputs (SYNC, BCLK) are disabled during the power down/reset mode.
Since the on-board MCU control circuit is activated by the clock signal of the MSM7731-02, it is required to release the power down/reset mode using SW1 (PDNRST) if the power down/reset mode has been set using CR (CR0-B7).

(2) When the power has been turned ON, be sure to execute SW1 (PDNRST).

(3) Be aware that the switch name indexes on the evaluation board are printed with an over-bar meaning negative logic (ex. $\overline{\text{PDN/RST}}$) omitted.

7. CIRCUIT DIAGRAMS

Figure 1 Board Schematic

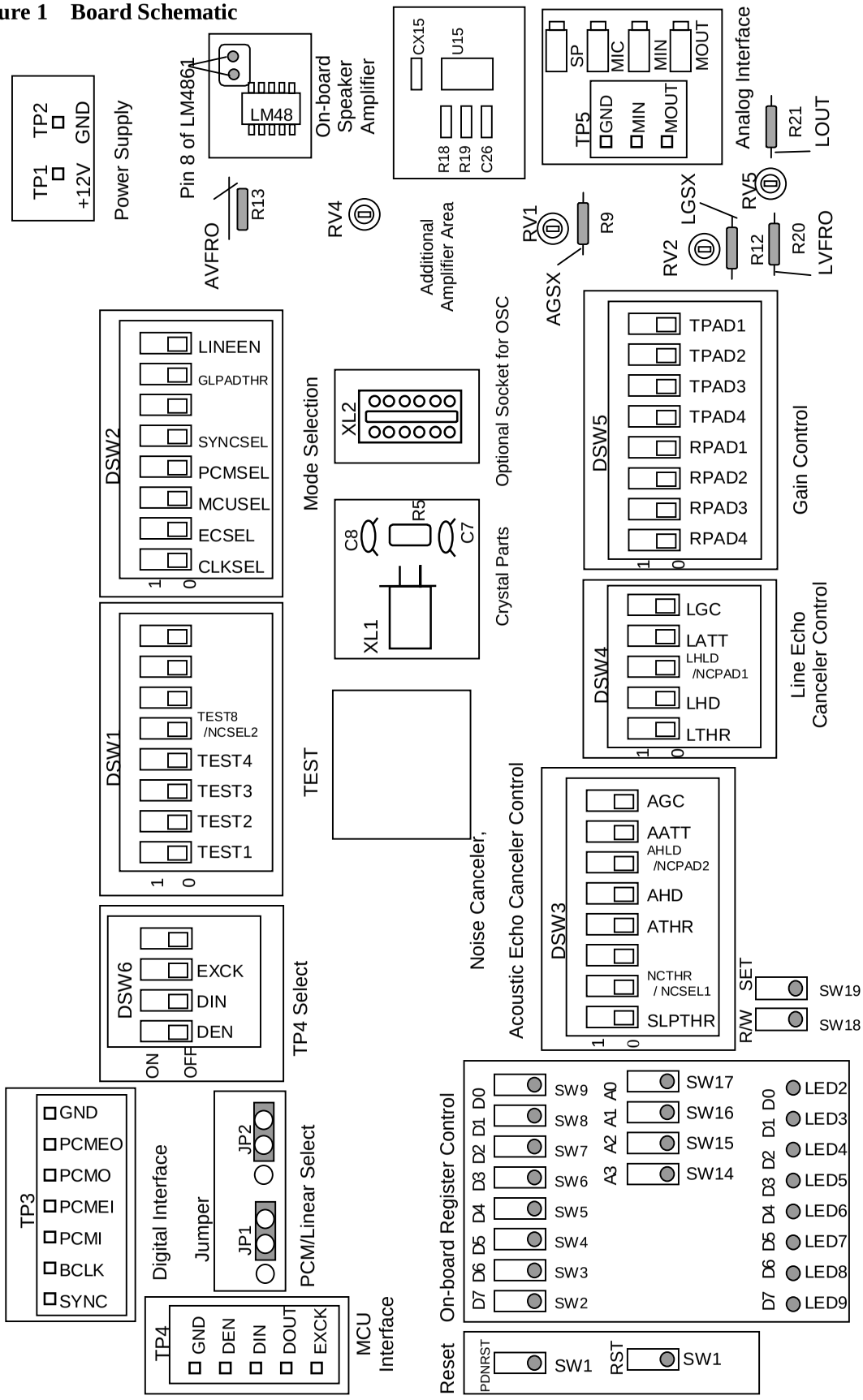


Figure 2 Chip Connection Circuits

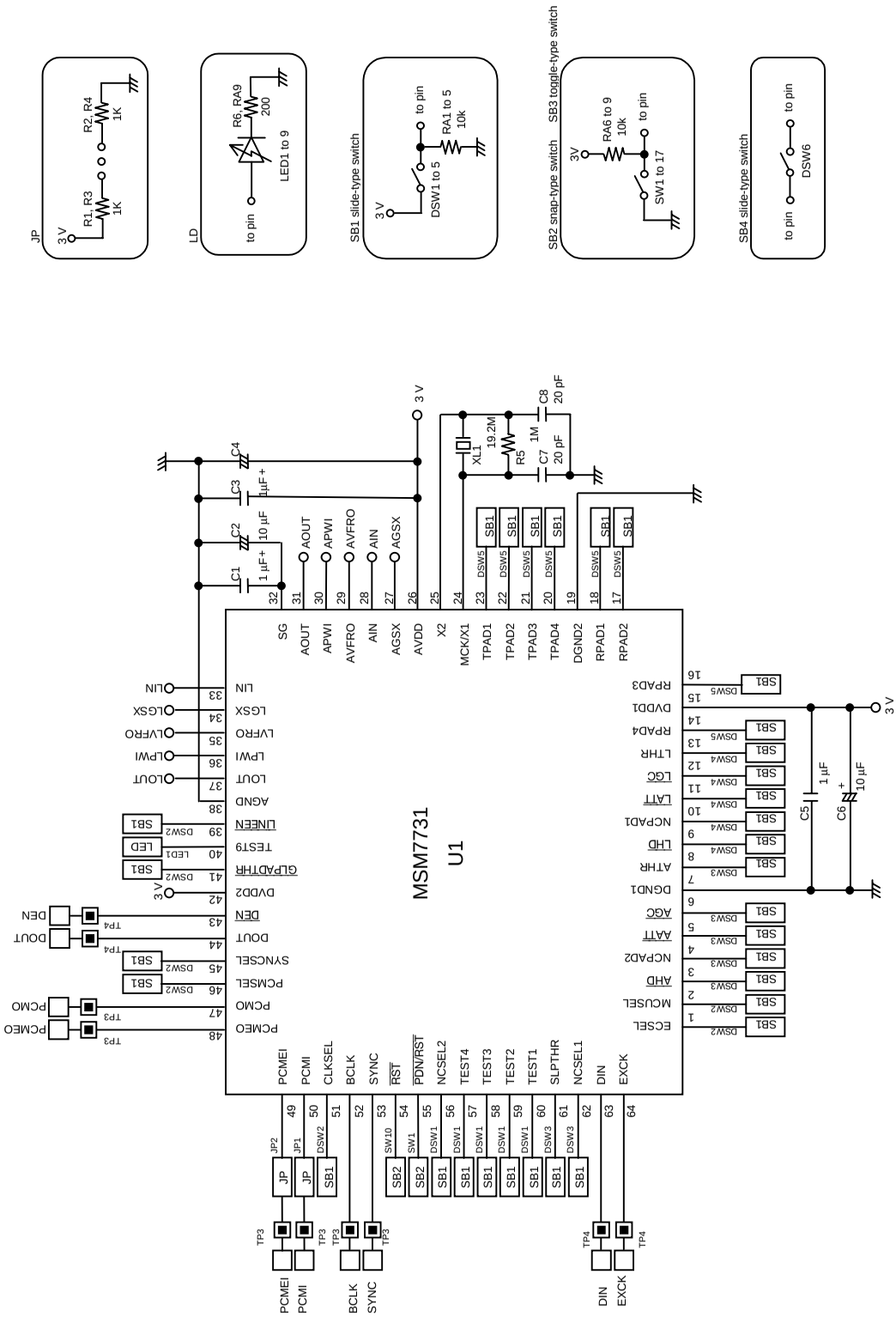


Figure 3 Peripheral Circuits

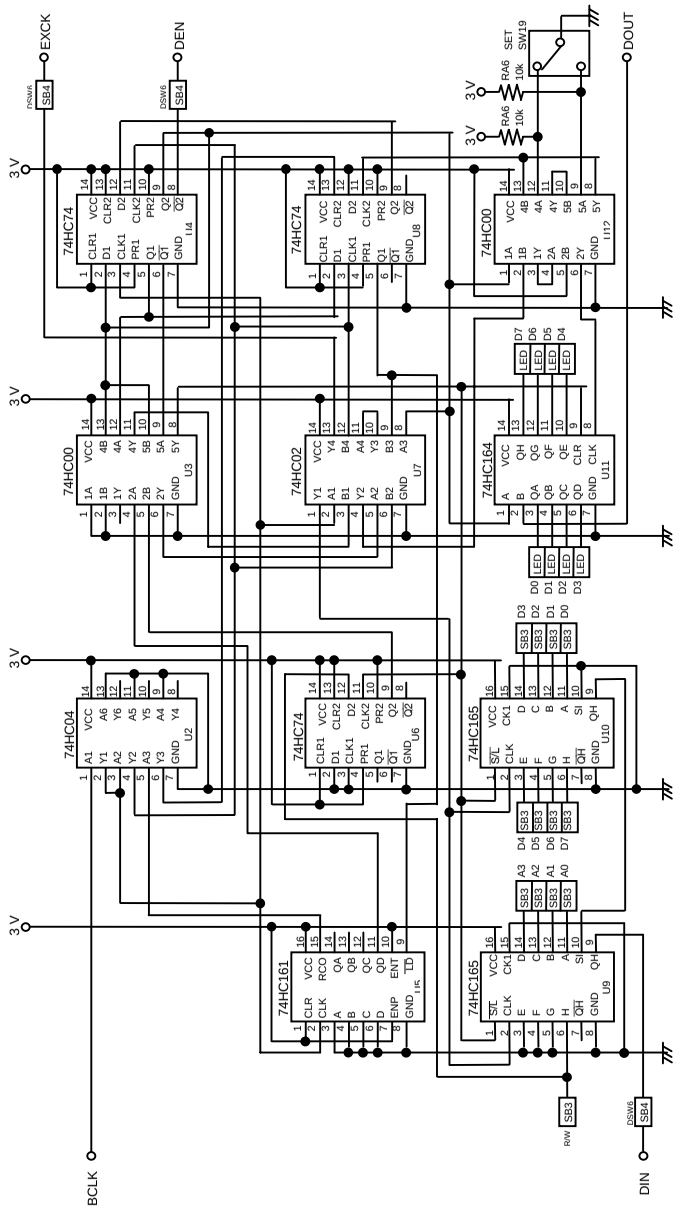


Figure 3-4 MCU-Interface

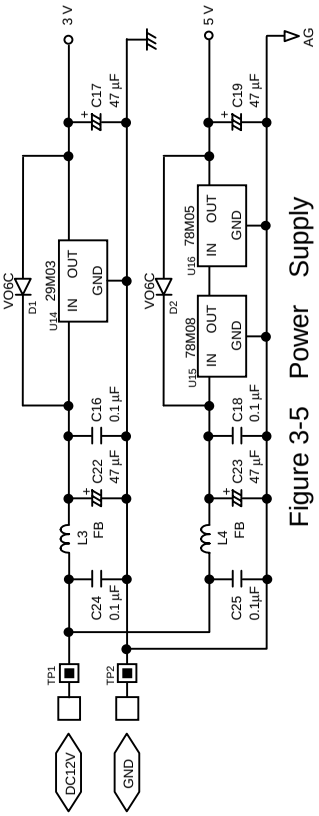


Figure 3-5 Power Supply

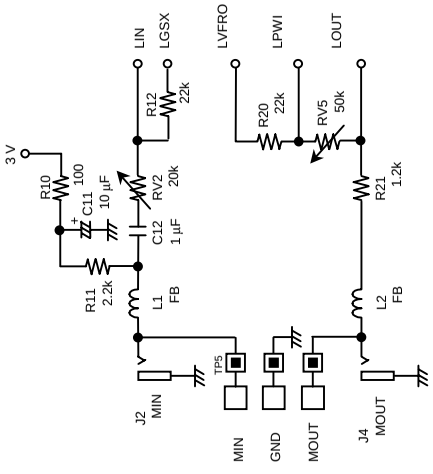


Figure 3-1 MIN-LIN and MOUT-LOUT

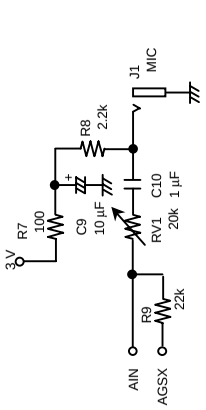


Figure 3-2 MIC-AIN

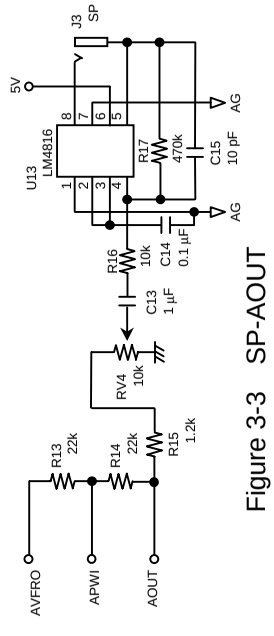


Figure 3-3 SP-AOUT