GENERAL DESCRIPTION

The CT7601 is a single chip audio USB 2.0/1.1 payback and record bridge.

FEATURES

- 2 playback port, and 1 record port

  PLAY 0: 8-channel I2S, 6-channel DSD, 2-channel SPDIF

  PLAY 1: 2-channel I2S, 2-channel DSD, 2-channel SPDIF

  RECORD: 8-channel I2S, 6-channel DSD, 2-channel SPDIF

  The clock systems are independent
- I2S Interface

  PLAY port supports standard/left justified format, master mode.

  RECORD port supports standard/left justified, master/slave mode.
- Audio transmission

  PCM support up to 768K/32bit through USB, I2S, SPDIF ports.

  DSD (PDM) support 1x/2x/4x/8x bandwidth through DSD(PDM) port.

  DSD (Native) support 1x/2x/4x/8x bandwidth through USB, I2S, DSD(PDM) , SPDIF ports.

  DoP support 1x/2x/4x bandwidth through USB, I2S, SPDIF ports.
- Interface

  Up to 16 GPIOs configurable as input or output.

  Master / Slave I^2C interface.

  Interrupt function.

  PWM-LED.
- Format auto detecting

  Auto detecting PCM / DoP format.

  Auto detecting I2S / DSD interface.
- Misc

  Embeded 8051 controller

  UART interface

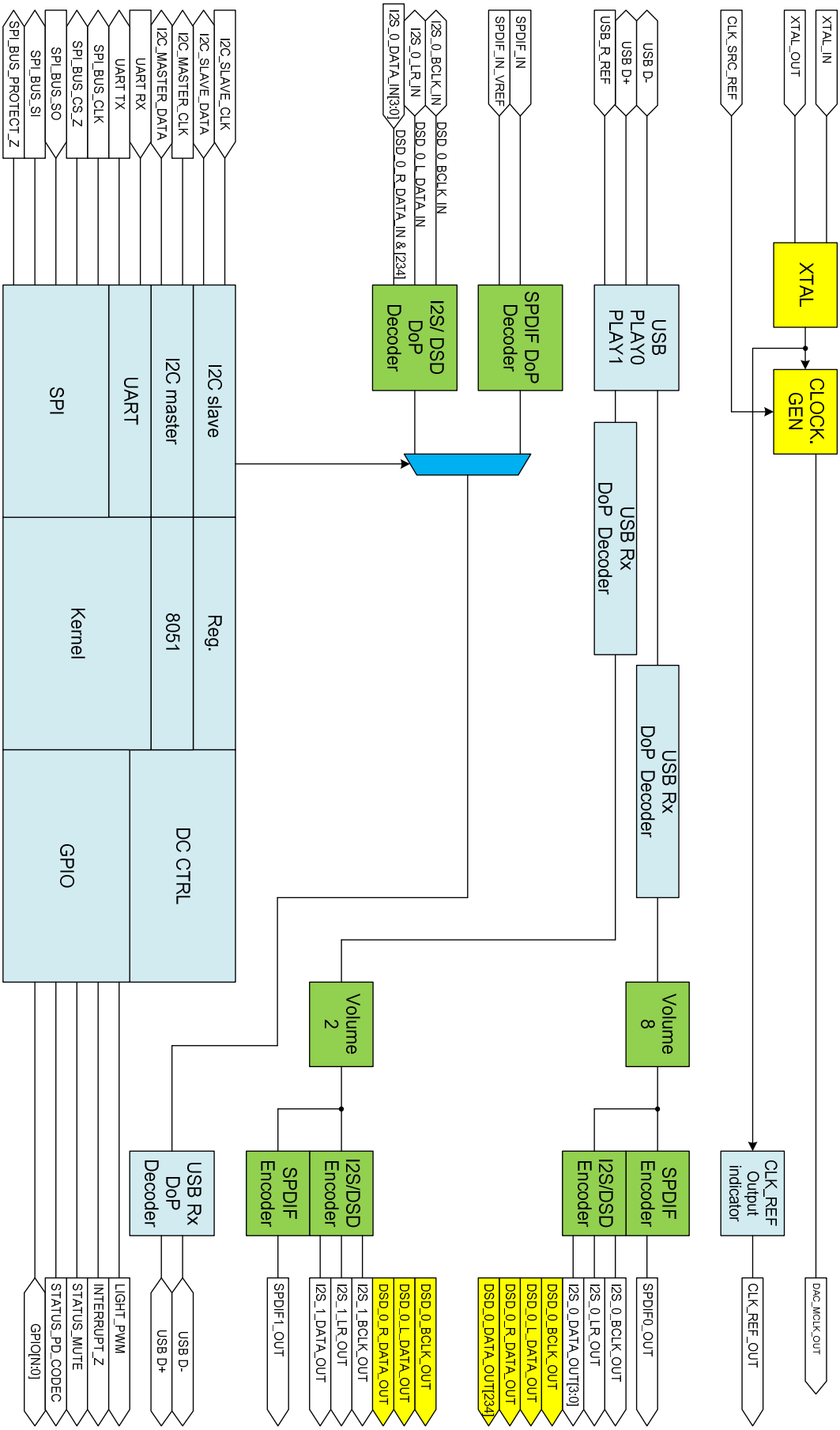
  Volume control with fading in/out function.

  Playback basic auto De-pop function.

  One 12MHz crystal requirement only.

Table of Contents

FUNCTION BLOCK

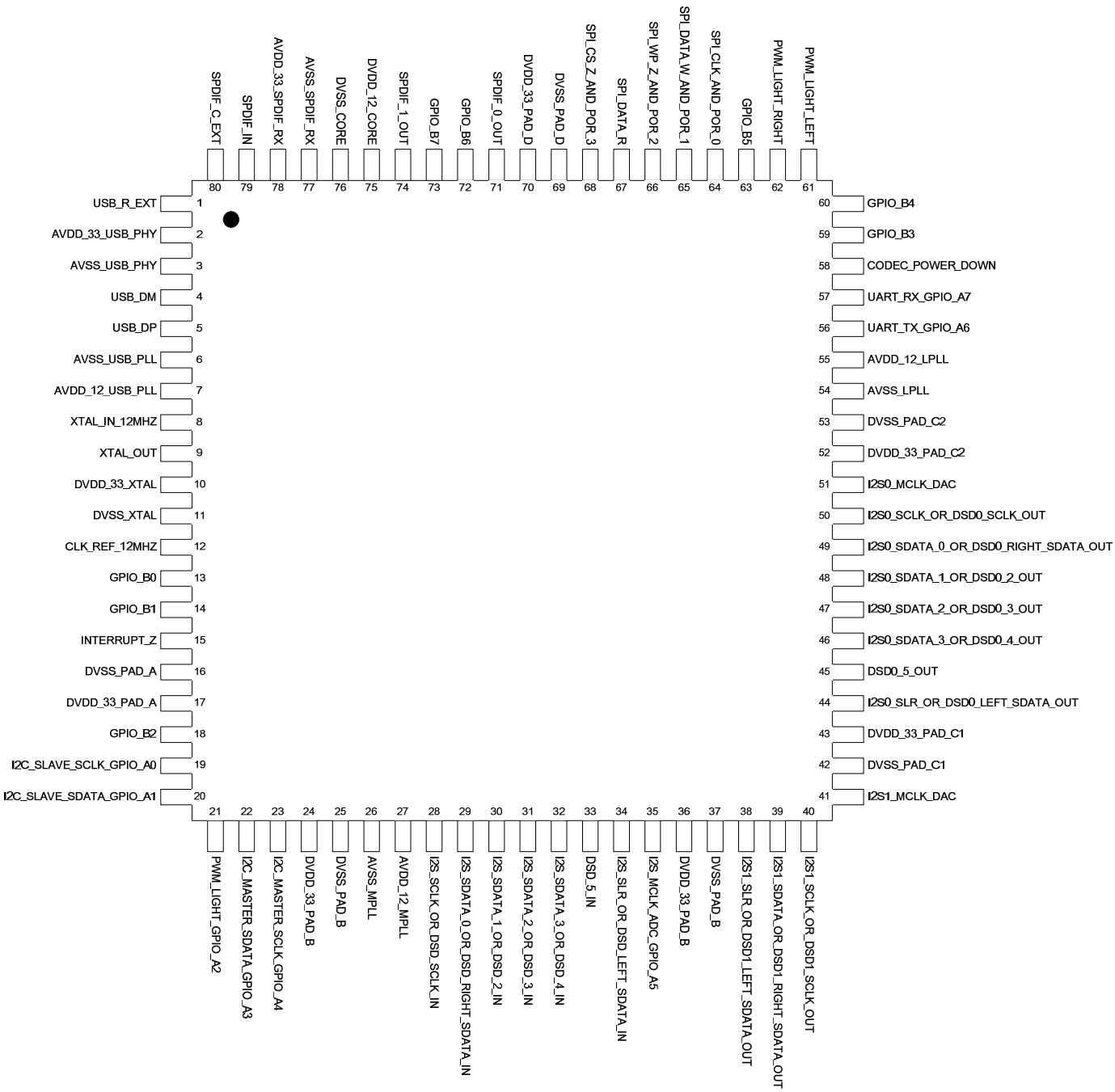


CT7601 FAMILY

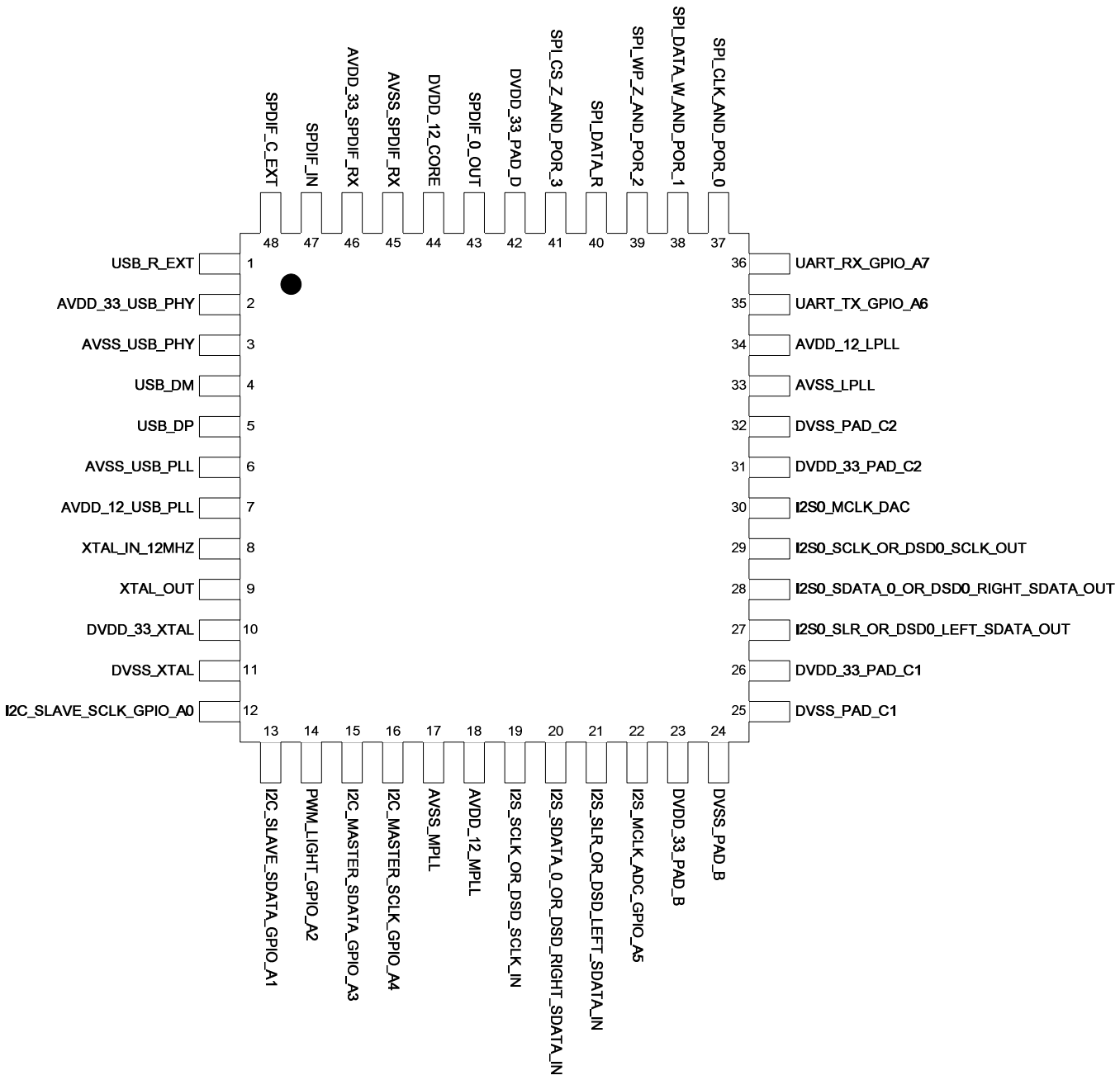
Description	CT7601PH	CT7601CH	CT7601PR	CT7601CR	CT7601SR
USB Port PLAY / RECORD					
USB PCM (Stereo)	768kHz / 32-bit	384kHz / 32-bit	768kHz / 32-bit	384kHz / 32-bit	192kHz / 32-bit
USB PCM (8 channel)	192K / 32-bit	96K / 32-bit	-	-	-
USB DoP	4x	2x	4x	2x	1x
USB DSD (Stereo)	8x	4x	8x	4x	2x
USB DSD (6 channel)	2x	1x	-	-	-
I2S Port					
I2S PCM (Stereo)	768kHz / 32-bit	384kHz / 32-bit	768kHz / 32-bit	384kHz / 32-bit	192kHz / 32-bit
I2S PCM (8 channel)	192K / 32-bit	96K / 32-bit	-	-	-
I2S DoP (Stereo)	4x	2x	4x	2x	1x
I2S Dop (8 channel)	1x	-	-	-	-
Native DSD (Stereo)	8x	4x	8x	4x	2x
Native DSD (6 channel)	2x	1x	-	-	-
SPDIF Port					
SPDIF PCM	768kHz / 32-bit	384kHz / 32-bit	768kHz / 32-bit	384kHz / 32-bit	192kHz / 32-bit
SPDIF DoP	4x	2x	4x	2x	1x
SPDIF native DSD	8x	4x	8x	4x	2x
Package					
Package	LQFP 80(H)	LQFP 80(H)	QFN 48(R)	QFN 48(R)	QFN 48(R)
GPIO	8+8	8+8	8	8	8
I2S Play 0 ch PCM	8	8	2	2	2
I2S Play 0 ch DSD	6	6	2	2	2
I2S Play 1 channel	2	2	2	2	2
I2S Record ch PCM	8	8	2	2	2
I2S Record ch DSD	6	6	2	2	2
SPDIF Play0 channel	2	2	2	2	2
SPDIF Play1 channel	2	2	2	2	2
SPDIF Record channel	2	2	2	2	2

** CT7601P is only for professional engineering design.

Package LQFP-80 (Top View) CT7601xL



Package QFN-48 (Top View) CT7601xR



LQFP 48/80 PIN DESCRIPTION

Pin Name	80Pin No.	48Pin No.	Type	Description
USB_R_EXT	1	1	I	***USB external resistor :*** 1.8k ohm (1%) pull low
AVDD_33_USB_PHY	2	2	P	***3.3V Pad Power Connection:*** Power supply for USB physical layer. Connect to 3.3V.
AVSS_USB_PHY	3	3	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
USB_DM	4	4	I/O	***USB D - :*** refer to USB Specification.
USB_DP	5	5	I/O	***USB D + :*** refer to USB Specification.
AVSS_USB_PLL	6	6	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVDD_12_USB_PLL	7	7	P	***1.2V Core Power Connection:*** Power supply for USB PLL function. Connect to 1.2V.
XTAL_IN_12MHZ	8	8	I	***External Crystal input:*** Connect to external crystal pin. Or external clock input. Selection : 12 MHz
XTAL_OUT	9	9	O	***External Crystal output:*** Connect to external crystal pin
DVDD_33_XTAL	10	10	P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
DVSS_XTAL	11	11	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
CLK_REF_12MHZ	12		O	***Reference clock output:*** Crystal clock output with buffer pad.
GPIO_B0	13		I/O	***General purpose input/output pin bank_B[0] :*** 3.3V TTL input/output pin, define by internal control register.
GPIO_B1	14		I/O	***General purpose input/output pin bank_B[1] :*** 3.3V TTL input/output pin, define by internal control register.
INTERRUPT_Z*	15		I/O	***Interrupt open drain input/output:*** Internal pull high 120k-ohm.
DVSS_PAD_A	16		G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
DVDD_33_PAD_A	17		P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
GPIO_B2	18		I/O	***General purpose input/output pin bank_B[2] :*** 3.3V TTL input/output pin, define by internal control register.
I2C_SLAVE_SCLK _GPIO_A0	19	12	I/O	***I2C slave serial clock :*** Clock pin for serial interface. Refer to I2C specification. ***General purpose input/output pin bank_A[0] :*** 3.3V TTL input/output pin, define by internal control register.
I2C_SLAVE_SDATA _GPIO_A1	20	12	I/O	***I2C slave serial data :*** Data pin for serial interface. Refer to I2C specification. ***General purpose input/output pin bank_A[1] :*** 3.3V TTL input/output pin, define by internal control register.
PWM_LIGHT _GPIO_A2	22	14	I/O	***USB Play channel 0 audio left/right channel PWM light control output :*** refer to programming guide ***General purpose input/output pin bank_A[2] :*** 3.3V TTL input/output pin, define by internal control register.
I2C_MASTER_SDATA _GPIO_A3	22	15	I/O	***I2C master serial data :*** Data pin for serial interface. Refer to I2C specification. ***General purpose input/output pin bank_A[3] :*** 3.3V TTL input/output pin, define by internal control register.
I2C_MASTER_SCLK _GPIO_A4	23	16	I/O	***I2C master serial clock :*** Clock pin for serial interface. Refer to I2C specification.

Pin Name	80Pin No.	48Pin No.	Type	Description
				General purpose input/output pin bank_A[4] : 3.3V TTL input/output pin, define by internal control register.
DVDD_33_PAD_B	24		P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
DVSS_PAD_B	25		G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVSS_MPLL	26	17	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVDD_12_MPLL	27	18	P	***1.2V MPLL Connection:*** Power supply for all digital and MPLL function. Connect to 1.2V.
I2S_SCLK_OR _DSD_SCLK_IN	28	19	I/O	***I2S serial clock input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial clock input :*** 3.3V TTL input, refer to DSD Specification.
I2S_SDATA_0_OR _DSD_RIGHT_SDATA_IN	29	20	I/O	***I2S serial data0 input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial right data (channel 1) input:*** 3.3V TTL input, refer to DSD Specification.
I2S_SDATA_1_OR _DSD_2_IN	30		I/O	***I2S serial data1 input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial data2 input:*** 3.3V TTL input, refer to DSD Specification.
I2S_SDATA_2_OR _DSD_3_IN	31		I/O	***I2S serial data2 input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial data3 input:*** 3.3V TTL input, refer to DSD Specification.
I2S_SDATA_3_OR _DSD_4_IN	32		I/O	***I2S serial data3 input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial data4 input:*** 3.3V TTL input, refer to DSD Specification.
DSD_5_IN	33		I/O	***DSD serial data5 input:*** 3.3V TTL input, refer to DSD Specification.
I2S_SLR_OR _DSD_LEFT_SDATA_IN	34	21	I/O	***I2S left/right input :*** 3.3V TTL input, refer to I2S Specification. ***DSD serial left data (channel 0) input:*** 3.3V TTL input, refer to DSD Specification.
I2S_MCLK_ADC _GPIO_A5	35	22	I/O	***I2S master clock output:*** 3.3V TTL output, refer to ADC Document. ***General purpose input/output pin bank_A[5] :*** 3.3V TTL input/output pin, define by internal control register.
DVDD_33_PAD_B	36	23	P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
DVSS_PAD_B	37	24	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
I2S1_SLR_OR _DSD1_LEFT_SDATA_OUT	38		O	***I2S1 left/right output :*** 3.3V TTL output, refer to I2S Specification. ***DSD1 serial left data (channel 0) output:*** 3.3V TTL output, refer to DSD Specification.
I2S1_SDATA_OR _DSD1_RIGHT_SDATA_OUT	39		O	***I2S1 serial data0 output :*** 3.3V TTL output, refer to I2S Specification. ***DSD1 serial right data (channel 1) output:*** 3.3V TTL output, refer to DSD Specification.
I2S1_SCLK_OR _DSD1_SCLK_OUT	40		O	***I2S1 serial clock output:*** 3.3V TTL output, refer to I2S Specification. ***DSD1 serial clock output:*** 3.3V TTL output, refer to DSD Specification.
I2S1_MCLK_DAC	41		O	***I2S1 master clock output:*** 3.3V TTL output, refer to DAC Document.
DVSS_PAD_C1	42	25	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
DVDD_33_PAD_C1	43	26	P	***SPDIF input channel 1:*** 200mV ~ 3.3 V single-end input, refer to SPDIF Specification.
I2S0_SLR_OR _DSD0_LEFT_SDATA_OUT	44	27	O	***I2S0 left/right output :*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial left data (channel 0) output:*** 3.3V TTL output, refer to DSD Specification.
DSD0_5_OUT	45		O	***DSD0 serial data 5 output:*** 3.3V TTL output, refer to DSD Specification.
I2S0_SDATA_3 _OR_DSD0_4_OUT	46		O	***I2S0 serial data 3 output :*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial data 4 output:*** 3.3V TTL output, refer to DSD

Pin Name	80Pin No.	48Pin No.	Type	Description
				Specification.
I2S0_SDATA_2 _OR_DSD0_3_OUT	47		O	***I2S0 serial data 2 output :*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial data 3 output:*** 3.3V TTL output, refer to DSD Specification.
I2S0_SDATA_1 _OR_DSD0_2_OUT	48		O	***I2S0 serial data 1 output :*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial data 2 output:*** 3.3V TTL output, refer to DSD Specification.
I2S0_SDATA_0_OR _DSD0_RIGHT_SDATA_OUT	49	28	O	***I2S0 serial data 0 output :*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial right data (channel 1) output:*** 3.3V TTL output, refer to DSD Specification.
I2S0_SCLK_OR _DSD0_SCLK_OUT	50	29	O	***I2S0 serial clock output:*** 3.3V TTL output, refer to I2S Specification. ***DSD0 serial clock output:*** 3.3V TTL output, refer to DSD Specification.
I2S0_MCLK_DAC	51	30	O	***I2S0 master clock output:*** 3.3V TTL output, refer to DAC Document.
DVDD_33_PAD_C2	52	31	P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
DVSS_PAD_C2	53	32	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVSS_LPLL	54	33	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVDD_12_LPLL	55	34	P	***1.2V Core Power Connection:*** Power supply for all digital and audio PLL function. Connect to 1.2V.
UART_TX _GPIO_A6	56	35	I/O	***UART transmitter output:*** 3.3V TTL output, refer to RS232 Specification. ***General purpose input/output pin bank_A[6] :*** 3.3V TTL input/output pin, define by internal control register.
UART_RX _GPIO_A7	57	36	I/O	***UART receiver input:*** 3.3V TTL input, refer to RS232 Specification. ***General purpose input/output pin bank_A[7] :*** 3.3V TTL input/output pin, define by internal control register.
CODEC_POWER_DOWN	58		O	***Play 0 or Play 1kernel fast mute control to next device:*** 3.3V TTL output
GPIO_B3	59		I/O	***General purpose input/output pin bank_B[3] :*** 3.3V TTL input/output pin, define by internal control register.
GPIO_B4	60		I/O	***General purpose input/output pin bank_B[4] :*** 3.3V TTL input/output pin, define by internal control register.
PWM_LIGHT_LEFT	61		O	***USB Play channel 0 audio left channel PWM light control output :*** refer to programming guide
PWM_LIGHT_RIGHT	62		O	***USB Play channel 0 audio right channel PWM light control output :*** refer to programming guide
GPIO_B5	63		I/O	***General purpose input/output pin bank_B[5] :*** 3.3V TTL input/output pin, define by internal control register.
SPI_CLK_AND _POR_0	64	37	I/O	***SPI interface clock :*** 3.3V TTL output, refer to SPI flash memory Specification. ***Power on latch selection pin 0:*** 3.3V TTL input, reserved for internal software
SPI_DATA_W_AND _POR_1	65	38	I/O	***SPI interface data output :*** 3.3V TTL output, refer to SPI flash memory Specification. ***Power on latch selection pin 1:*** 3.3V TTL input, reserved for internal software
SPI_WP_Z_AND _POR_2	66	39	I/O	***SPI interface write protected (low active):*** 3.3V TTL output, refer to SPI flash memory Specification. ***Power on latch selection pin 2:*** 3.3V TTL input, reserved for internal software

Pin Name	80Pin No.	48Pin No.	Type	Description
SPI_DATA_R	67	40	I	***SPI interface data input:*** 3.3V TTL input, refer to SPI flash memory Specification.
SPI_CS_Z_AND _POR_3	68	41	I/O	***SPI interface chip selection (low active):*** 3.3V TTL output, refer to SPI flash memory Specification. ***Power on latch selection pin 3:*** 3.3V TTL input, reserved for internal software
DVSS_PAD_D	69		G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
DVDD_33_PAD_D	70	42	P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
SPDIF_0_OUT	71	43	O	***SPDIF play channel 0 output:*** 3.3V TTL output, refer to SPDIF Specification.
GPIO_B6	72		I/O	***General purpose input/output pin bank_B[6] :*** 3.3V TTL input/output pin, define by internal control register.
GPIO_B7	73		I/O	***General purpose input/output pin bank_B[7] :*** 3.3V TTL input/output pin, define by internal control register.
SPDIF_1_OUT	74		O	***SPDIF play channel 1 output:*** 3.3V TTL output, refer to SPDIF Specification.
DVDD_12_CORE	75	44	P	***1.2V Core Power Connection:*** Power supply for all digital function. Connect to 1.2V.
DVSS_CORE	76		G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVSS_SPDIF_RX	77	45	G	***Ground Connections:*** Connect all ground pins to the common system ground plane.
AVDD_33_SPDIF_RX	78	46	P	***3.3V Pad Power Connection:*** Power supply for I/O buffer. Connect to 3.3V.
SPDIF_IN	79	47	I	***SPDIF input channel 4P:*** 200mV ~ 3.3 V differential input, refer to SPDIF Specification.
SPDIF_C_EXT	80	48	I	***SPDIF input channel 4N:*** 200mV ~ 3.3 V differential input, refer to SPDIF Specification ***SPDIF input Vref :*** internal SPDIF Vref. While CR1A.6 = 1.

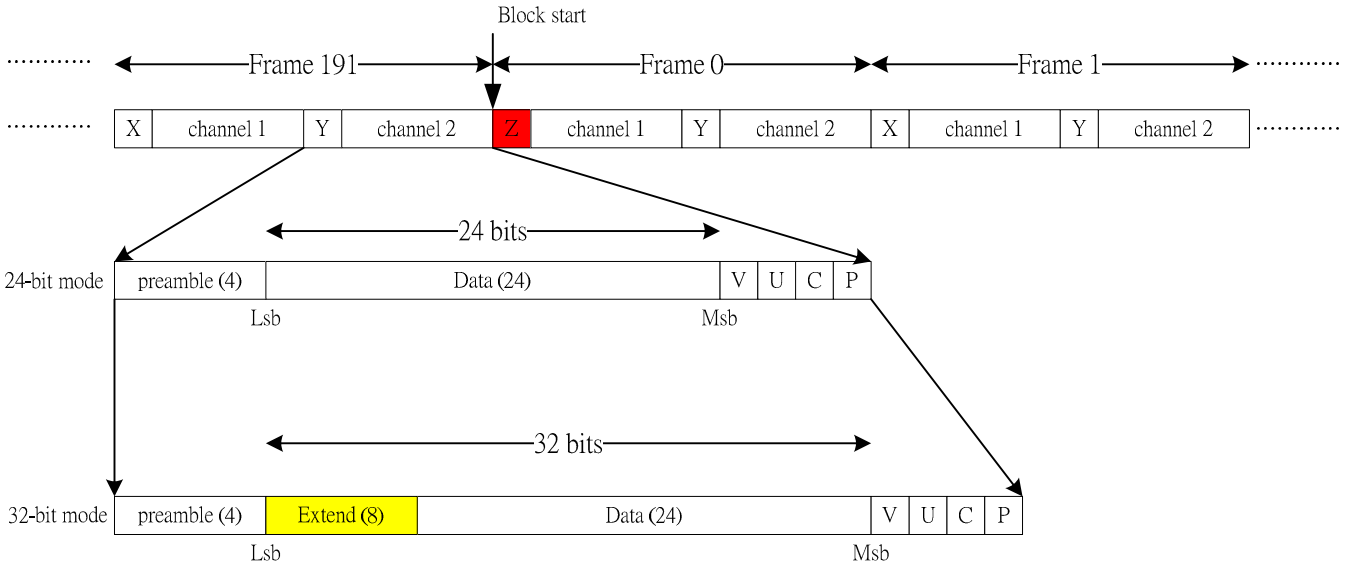
*Note: Internal 120K *pull-up or #pull down resistors present on inputs marked with *# respectively. Design should not rely solely on internal pull-up or pull down resistor to set I/O pins high or low respectively.*

ELECTRICAL CHARACTERISTICS

DC specifications

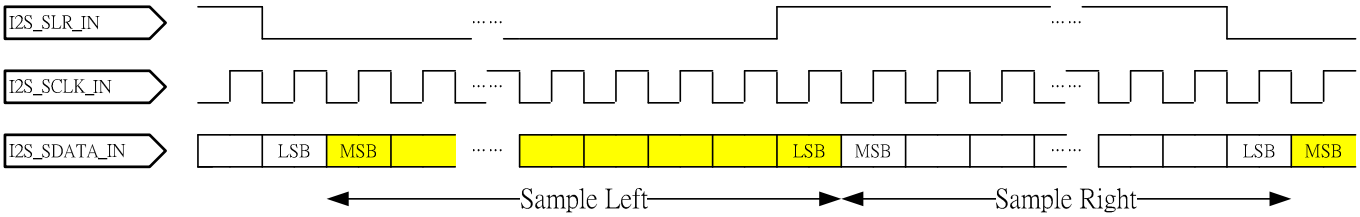
Symbol	Parameter	Min.	Max.	Units	Notes
Absolute VDD CORE	1.2V core supply Voltage	-0.5	1.32	V	
Absolute VDD I/O	3.3V I/O supply Voltage	-0.5	3.6	V	
Ts	Storage Temperature	-65	150	°C	
Ta	Ambient Temperature	0	70	°C	
Absolute Vih	3.3V input high voltage	-0.5	3.6	V	
Absolute Vil	3.3V input low voltage	-0.5		V	
ESD	Input ESD protection	2		KV	Human body mode
Operating Vdd CORE	1.2V core supply Voltage	1.08	1.32	V	
Operating Vdd I/O	3.3V I/O supply Voltage	3.135	3.465	V	
Operating Vih	3.3V input high voltage	2.0	Vdd+0.3	V	
Operating Vil	3.3V input low voltage	Vss-0.3	0.8	V	
Operating Iil	Input leakage current	-5	+5	uA	
Operating Voh	3.3V output high voltage	2.4		V	Ioh=-1mA
Operating Vol	3.3V output low voltage		0.4	V	Iol=1mA
Cin	Input pin capacitance		5	pF	
Cxtal	XTAL pin capacitance	13.5	22.5	pF	17..20 pF
Cout	Output pin capacitance		6	pF	
Lpin	Pin inductance		7	nH	
Operating Current	3.3V active supply current		17	mA	PCM 768K/32bit In/Out
	1.2V active supply current		33	mA	PCM 768K/32bit In/Out
Power down	3.3V supply current		0.29	mA	
	1.2V supply current		0.18	mA	
SPDIF Rx Input Sensitivity		0.100	1.500	3.300	V

SPDIF interface

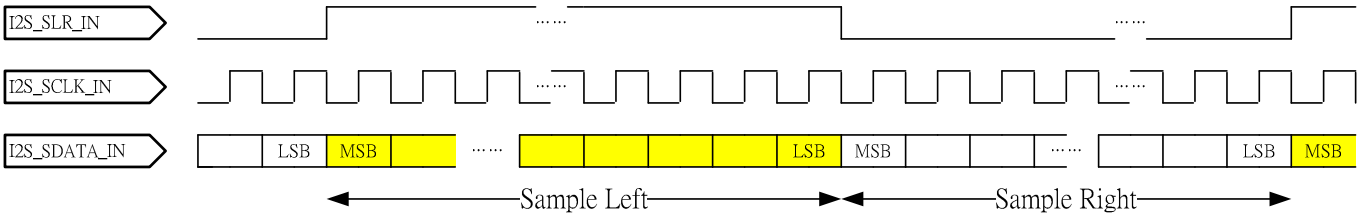


I2S interface

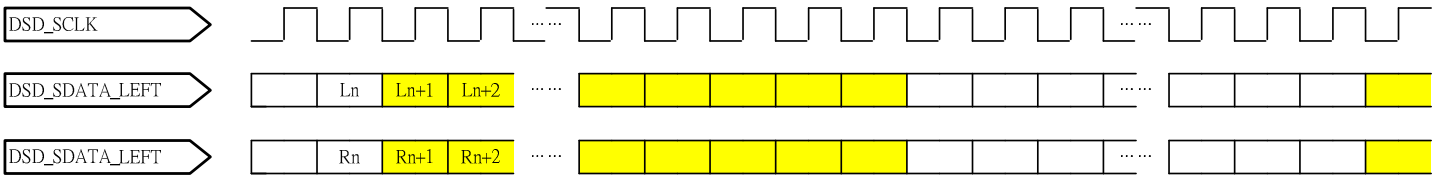
I2S standard format



I2S left justified format

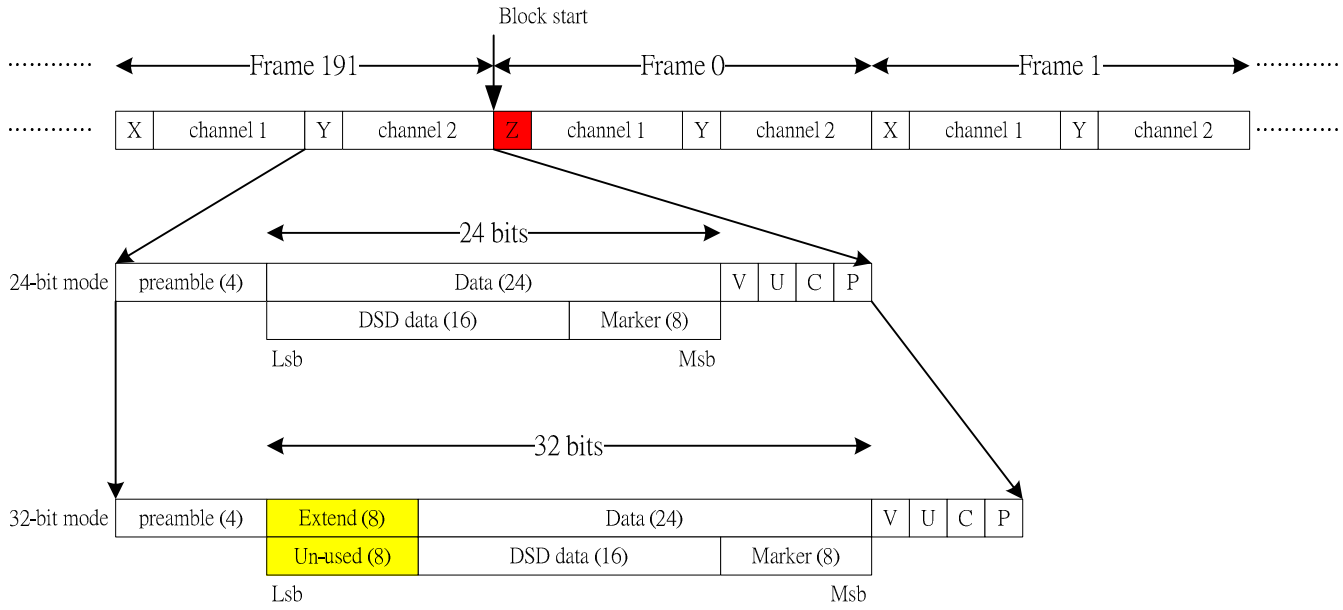


DSD interface



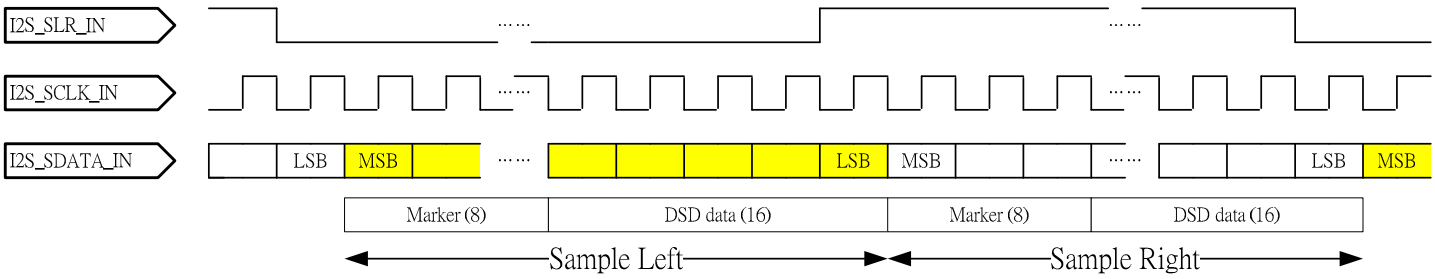
DoP interface

DSD over PCM through SPDIF

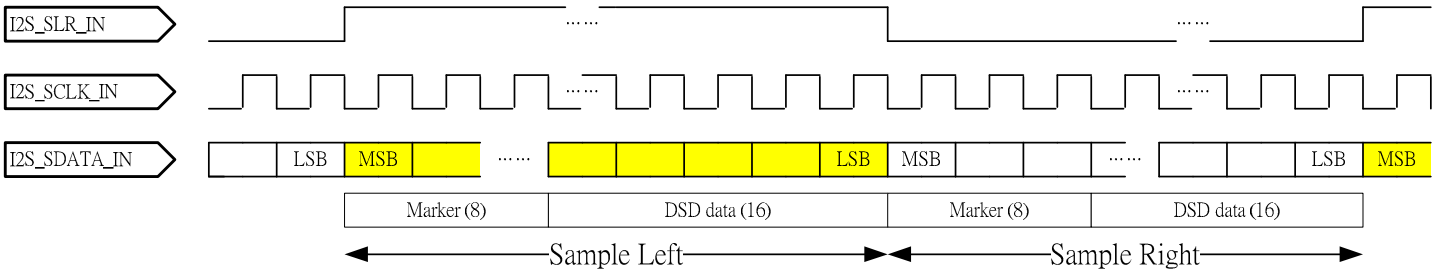


DSD over PCM through I2S

I2S standard format



I2S left justified format



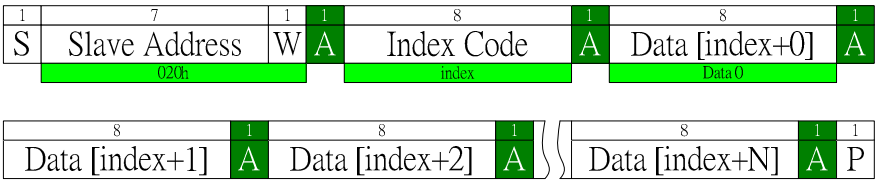
I2C interface

Register write command :

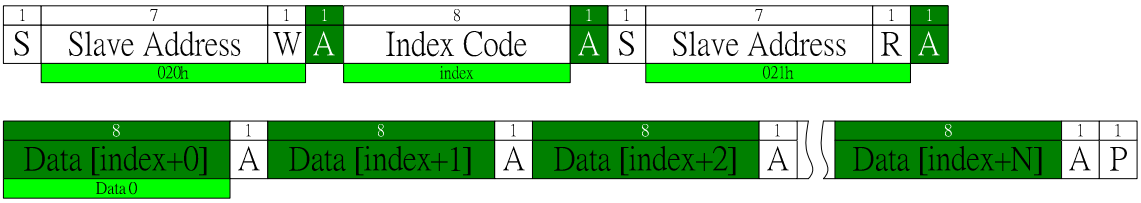
Slave address = 0x28

Register read command :

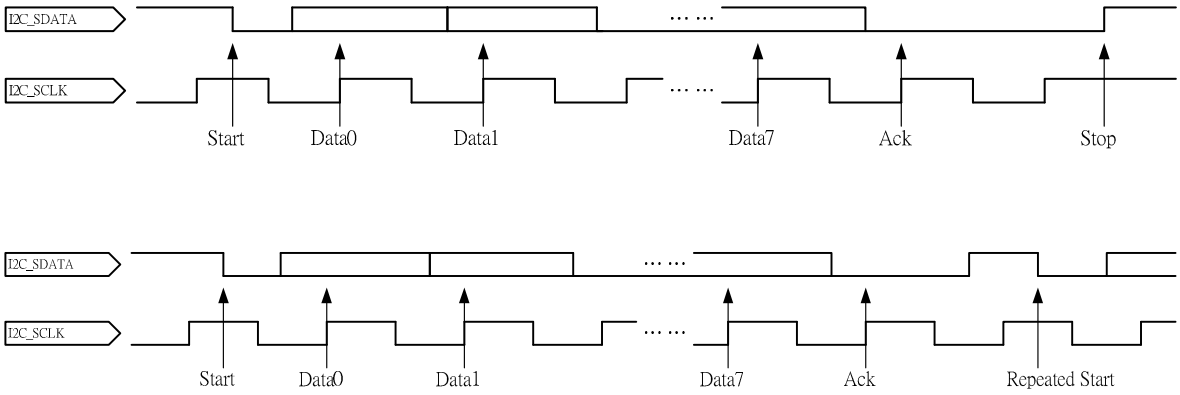
Slave address = 0x29



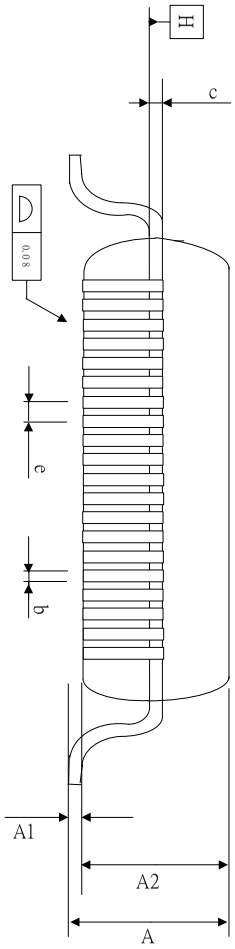
Block Write

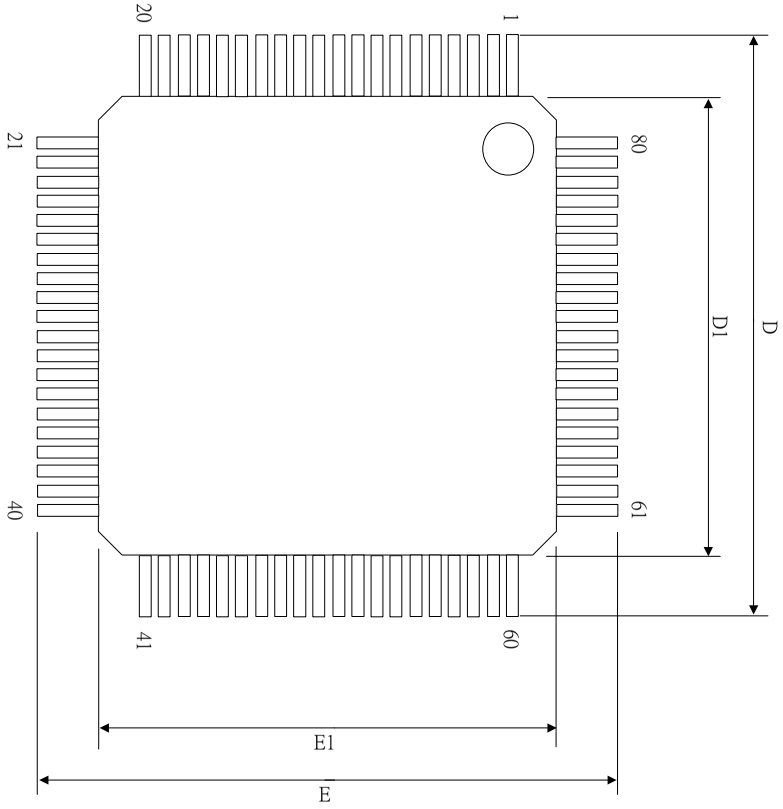


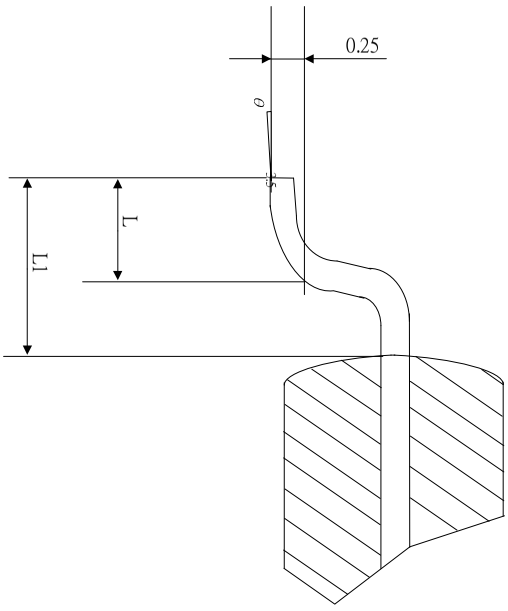
Block Read



Package outline LQFP 80 pins







VARIATIONS (All Dimensions Shown in mm)

Symbols	Min.	Nom.	Max.
A	--	--	1.60
A1	0.05	--	0.15
A2	1.35	1.40	1.45
b	0.13	0.18	0.23
c	0.09	--	0.20
D		12.00 BSC	
D1		10.00 BSC	
E		12.00 BSC	
E1		10.00 BSC	
e		0.40 BSC	
L	0.45	0.60	0.75
L1		1.00 REF	
θ	0°	3.5°	7°

Package outline QFN 48 pins

VARIATIONS (All Dimensions Shown in mm)

Symbols	Min.	Nom.	Max.
PKG CODE		WQFN(X648)	
Symbols	Min.	Nom.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.203 REF.	
b	0.15	0.20	0.25
D		6.00 BSC	
E		6.00 BSC	
e		0.40 BSC	
K	0.20	-	-

PAD SIZE	D2			E2			L		
	Min.	Nom.	Max.	Min.	Nom.	Max.	Min.	Nom.	Max.
185X18*MIL	4.45	4.50	4.55	4.45	4.50	4.55	0.35	0.40	0.45