

# REALTEK

## RTL8761ATV-CG

### BLUETOOTH 2.1/3.0/4.0 CONTROLLER, UART INTERFACE

### DATASHEET

(CONFIDENTIAL: Development Partners Only)

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REALTEK

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**USING THIS DOCUMENT**

This document is intended for the software engineer’s reference and provides detailed programming information.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

**REVISION HISTORY**

Revision	Release Date	Summary
1.0	2013/05/18	First release.

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# 1. General Description

The Realtek RTL8761ATV is a highly integrated single-chip Bluetooth 2.1/3.0/4.0 controller with a UART interface. It combines a BT Protocol Stack (LM, LL, and LE), BT Baseband, modem, and BT RF in a single chip.

The RTL8761ATV Bluetooth controller complies with Bluetooth core specification v4.0, and supports dual mode (BR/EDR + AMP + Low Energy Controllers). It is compatible with previous versions, including v2.1 + EDR and v3.0 + HS. For BR/EDR, it supports scatternet topology and allows four active links in slave mode, and seven active links in master mode. For Low Energy, it supports multiple states and allows eight active links in master mode. The links in BR/EDR and LE can be active simultaneously.

## 2. Features

### General

- 32-pin QFN
- Bluetooth single chip

### Host Interface

- Complies with HS-UART with configurable baud rate for Bluetooth

### Bluetooth Controller

- Compatible with Bluetooth v2.1 and v3.0 Systems
- Supports Bluetooth 4.0 Low Energy(BLE)
- HS-UART interface for Bluetooth data transmission compliant with H4 and H5 specification
- PCM interface for audio data transmission via Bluetooth controller
- Integrated MCU to execute Bluetooth protocol stack
- Supports all packet types in basic rate and enhanced data rate
- Supports SCO/eSCO link (allows one link for PCM interface and three links for HS-UART)
- Supports 4 piconets in a scatternet
- Supports Secure Simple Pairing
- Supports Low Power Mode (Sniff/Sniff Sub-rating/Hold/Park)

- Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles
- Bluetooth 4.0 Dual Mode support: Simultaneous LE and BR/EDR
- Supports multiple Low Energy states

### Bluetooth Transceiver

- Fast AGC control to improve receiving dynamic range
- Supports AFH to dynamically detect channel quality to improve transmission quality
- Integrated internal Class 1, Class 2, and Class 3 PA
- Bluetooth 3.0+HS compliant
- Supports Power Control/Enhanced Power Control
- Bluetooth Low Energy Support
- Integrated 32K oscillator for power management

### Peripheral Interfaces

- Configurable LED pin

### 3. Pin Assignments

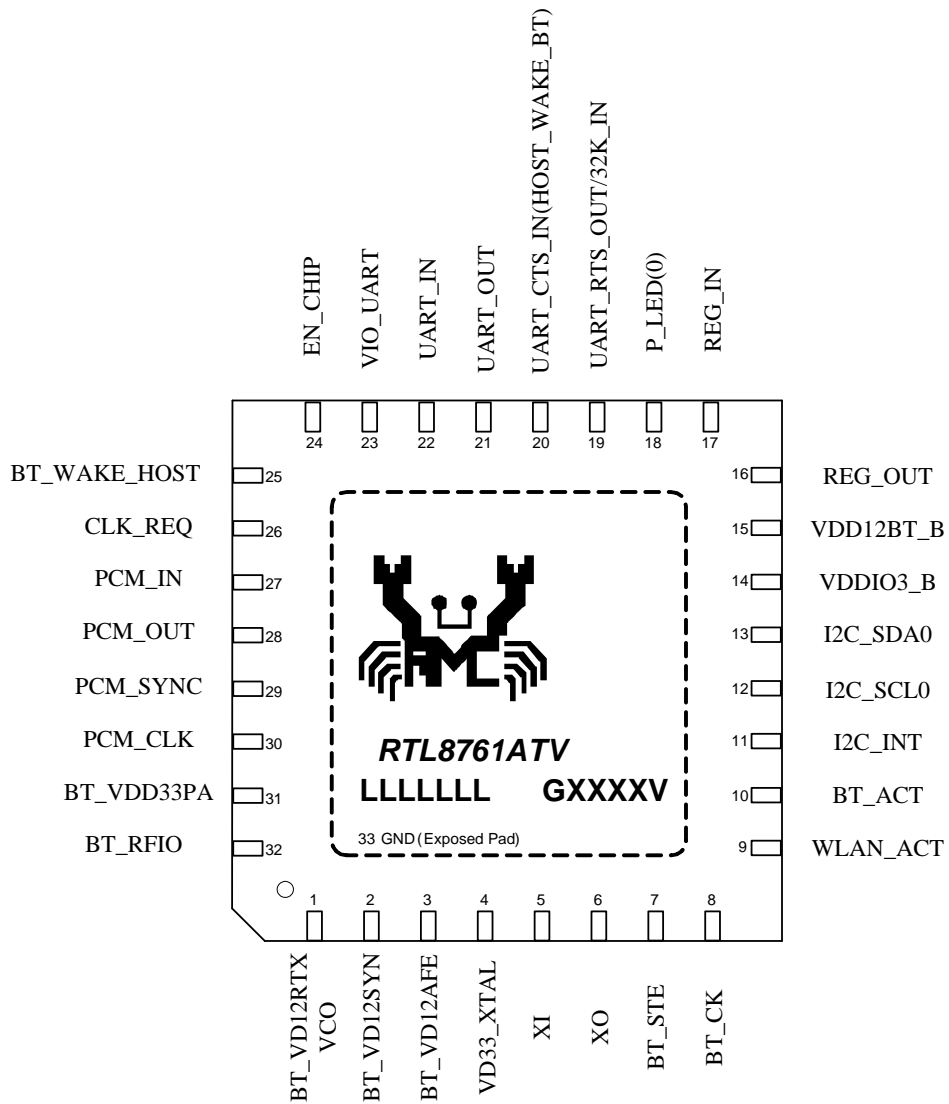


Figure 1. Pin Assignments

#### 3.1. Package Identification

Green package is indicated by the 'G' in GXXXXV (Figure 1).

## 4. Pin Descriptions

The following signal type codes are used in the tables:

I: Input

O: Output

P: Power

### 4.1. Power-On Trap Pins

**Table 1. Power On Trap Pins**

Symbol	Type	Pin No	Description
BT_STE	I	7	0: Normal operation mode 1: Enter into EEPROM mode
WLAN_ACT	I	9	0: Normal operation mode 1: Enter into TEST mode
BT_ACT	-	10	0: TBD 1: TBD
BT_WAKE_HOST	I	25	0: TBD 1: TBD
PCM_OUT	I	28	0: Internal switching regulator select 1: Internal LDO select

### 4.2. RF Interface

**Table 2. RF Interface**

Symbol	Type	Pin No	Description
BT_RFIO	IO	32	RF Path

### 4.3. LED Interface

**Table 3. LED Interface**

Symbol	Type	Pin No	Description
P_LED(0)	O	18	LED Pin (Active Low)



## 4.4. Power Management Handshake Interface

**Table 4. Power Management Handshake Interface**

Symbol	Type	Pin No	Description
BT_WAKE_HOST	O	25	BT wakeup host signal.
CLK_REQ	O	26	Clock request signal
HOST_WAKE_BT	I	20	Host wakeup BT signal.
EN_CHIP	I	24	Enable BT signal

## 4.5. Clock and Other Pins

**Table 5. Clock and Other Pins**

Symbol	Type	Pin No	Description
XI	I	5	Input of Crystal Clock Reference
XO	O	6	Output of Crystal Clock Reference (OSC Input)

## 4.6. Power Pins

**Table 6. Power Pins**

Symbol	Type	Pin No	Description
REG_OUT	P	16	Regulator Output
REG_IN	P	17	Regulator Input
BT_VD33PA	P	31	VDD 3.3V for Bluetooth
VD33_XTAL	P	4	VDD 3.3V for XTAL
BT_VD12SYN	P	2	VDD1.2V for synthesizer
VDDIO3_B	P	14	VDD 3.3V for IO
VDD12BT_B	P	15	VDD 1.2V for digital
BT_VD12AFE	P	3	VDD1.2V for AFE
VIO_UART	P	23	IO supply
BT_VD12RTXVCO	P	1	VDD1.2V for VCO RTX

## 4.7. PTA

**Table 7. PTA Pins**

Symbol	Type	Pin No	Description
BT_STE	O	7	State signal
BT_CK	O	8	Clock signal
WLAN_ACT	I	9	WLAN active signal
BT_ACT	O	10	BT active signal
I2C_INT	O	11	I2C interrupt signal
I2C_SCL0	I	12	I2C clock signal
I2c_SDA0	IO	13	I2C data signal

## 5. Electrical and Thermal Characteristics

### 5.1. Temperature Limit Ratings

**Table 8. Temperature Limit Ratings**

Parameter	Minimum	Maximum	Units
Storage Temperature	-55	+125	°C
Ambient Operating Temperature	0	70	°C
Junction Temperature	0	125	°C

### 5.2. Power Supply DC Characteristics

**Table 9. Power Supply DC Characteristics**

Symbol	Parameter	Minimum	Typical	Maximum	Units
VD33_XATL, VDDIO3B, SWR_IN, VIO_UART, BT_VDD33PA	3.3V Supply Voltage	3.0	3.3	3.6	V
BT_VD12SYN, VDD12BT_B, BT_VD12VCO/R TX	1.2V Supply Voltage	1.10	1.2	1.32	V

### 5.3. Digital IO Pin DC Characteristics

**Table 10. 3.3V IO DC Characteristics**

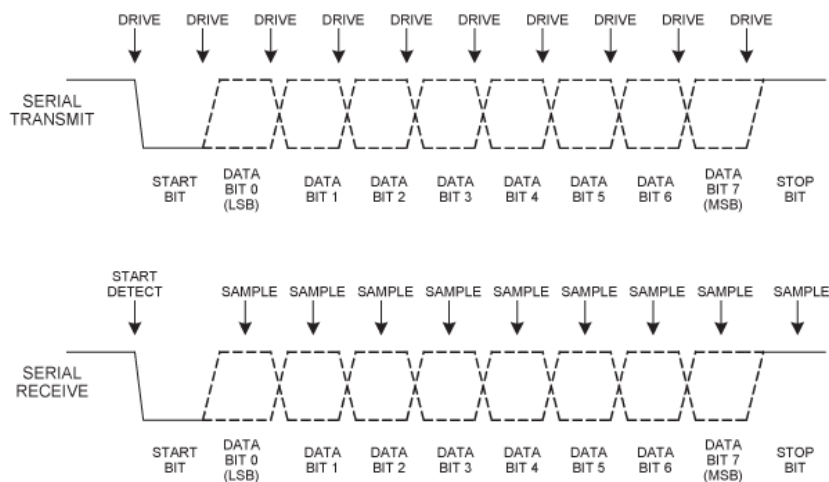
Symbol	Parameter	Minimum	Normal	Maximum	Units
V <sub>IH</sub>	Input high voltage	2.0	3.3	3.6	V
V <sub>IL</sub>	Input low voltage	-	0	0.9	V
V <sub>OH</sub>	Output high voltage	2.97	-	3.3	V
V <sub>OL</sub>	Output low voltage	0	-	0.33	V

## 5.4. UART Interface Characteristics

The RTL8761ATV UART interface is a standard 4-wire interface with RX, TX, CTS, and RTS. The interface supports the Bluetooth 2.0 UART HCI H4 and H5 specifications. The default baud rate is 115.2 kbaud. In order to support high and low speed baud rate, the RTL8761ATV provides multiple UART clocks.

**Table 11. UART Interface Power-On Timing Parameters**

Desired Baud Rate	Actual Baud Rate	Error (%)	Desired Baud Rate	Actual Baud Rate	Error (%)
300	300	0.00%	153600	153061	-0.35%
600	600	0.00%	230400	229167	-0.54%
900	900	0.00%	460800	458333	-0.54%
1200	1200	0.00%	500000	500000	0.00%
1800	1800	0.00%	921600	916667	-0.54%
2400	2400	0.00%	1000000	1000000	0.00%
3600	3601	0.03%	1382400	1375000	-0.54%
4800	4798	-0.04%	1444444	1437500	-0.48%
7200	7198	-0.03%	1500000	1500000	0.00%
9600	9603	0.03%	1843200	1833333	-0.54%
14400	14395	-0.03%	2000000	2000000	0.00%
19200	19182	-0.09%	2100000	2083333	-0.79%
28800	28846	0.16%	2764800	2777778	0.47%
38400	38462	0.16%	3000000	3000000	0.00%
56000	55970	-0.05%	3250000	3250000	0.00%
57600	57692	0.16%	3692300	3703704	0.31%
76800	76531	-0.35%	3750000	3750000	0.00%
115200	115385	0.16%	4000000	4000000	0.00%
128000	127119	-0.69%			



**Figure 2. UART Interface Waveform**

### 5.4.1. UART Interface Signal Levels

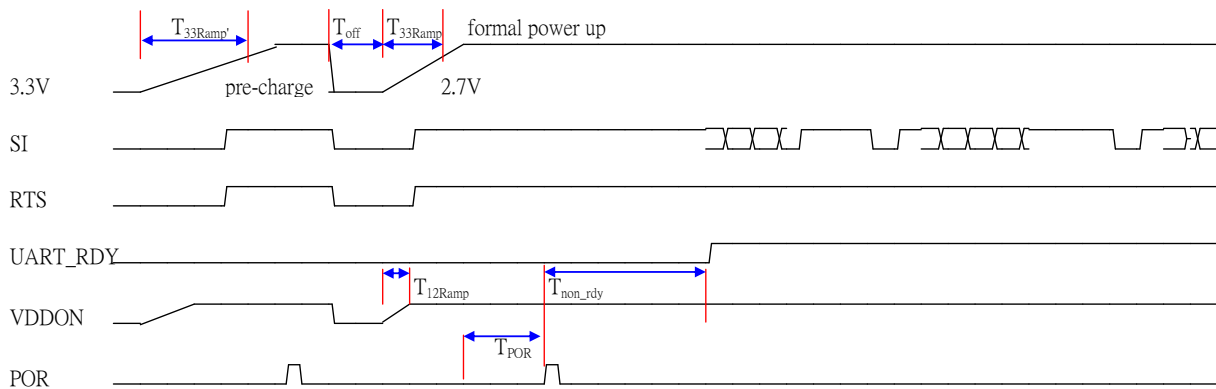
The UART signal level ranges from 1.8V to 3.3V. The host provides the power source with the targeted power level to the RTL8761ATV UART interface.

The 3.3V, 2.8V, and 1.8V DC characteristics of typical signal levels are shown in section 5.3 Digital IO Pin DC Characteristics, page 7.

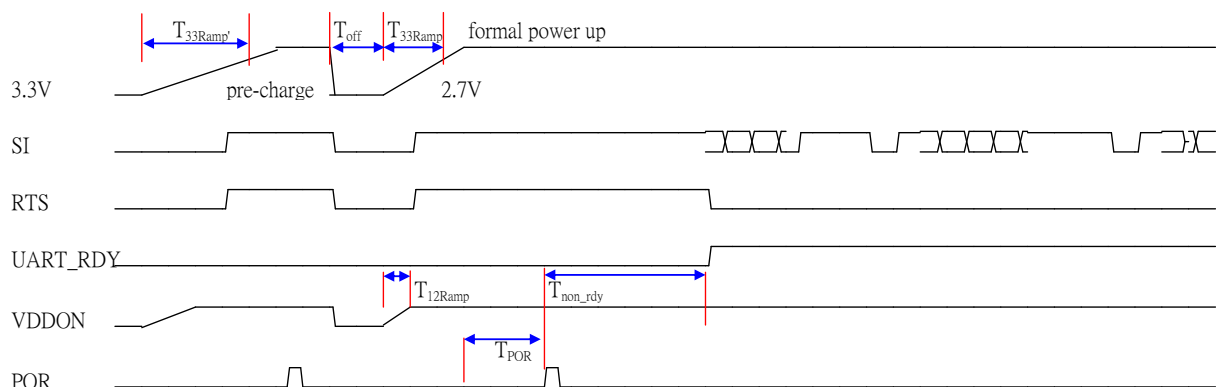
### 5.4.2. UART Interface Power-On Sequence

The UART interface power-on sequence differs depending on whether or not host flow control is supported.

#### UART Hardware Flow Control Not Supported


**Figure 3. UART Power-On Sequence without Hardware Flow Control**

#### UART Hardware Flow Control Supported



**Figure 4. UART Power On Sequence with Hardware Flow Control**
**Table 12. UART Interface Power-On Sequence**

Symbol	Description
$T_{33ramp}$	3.3V Power Pre-Charge Ramp Up Duration Before Formal Power Up. We recommend that a 3.3V power-on and then power-off sequence is executed by the host controller before the formal power on sequence. This procedure can eliminate host card detection issues when power ramp up duration is too long, or when a system warm reboot fails.
$T_{off}$	The duration 3.3V is cut off before formal power up.
$T_{33ramp}$	The 3.3V main power ramp up duration.
$T_{12ramp}$	The internal 1.2V ramp up duration.
$T_{POR}$	The duration from when the power-on reset releases and the power management unit executes power on tasks. A power on reset will detect both 3.3V and 1.2V power ramp up after a predetermined duration.
$T_{non\_rdy}$	UART Not Ready Duration. In this state, the RTL8761ATV will not respond to any commands.

We recommend that the card detection procedures are divided into two phases: A 3.3V power pre-charge phase and a formal power-up phase.

During the 3.3V power pre-charge phase, the power ramp up duration is not limited. The 3.3V power is cut off and is turned on after the  $T_{off}$  period. The ramp up time is specified in the  $T_{33ramp}$  duration.

After main 3.3V ramp up and 1.2V ramp up, the power management unit is enabled by the power ready detection circuit. The power management unit enables the Bluetooth block. The Bluetooth firmware then initializes all circuits, included the UART. In addition to waiting the  $T_{non\_rdy}$  time, if the host supports UART hardware flow control it can detect RTS signals and follow the formal UART flow control handshake.

**Table 13. UART Interface Power On Timing Parameters**

	Min	Typical	Max	Unit
$T_{33ramp}$	-	-	No Limit	ms
$T_{off}$	250	500	1000	ms
$T_{33ramp}$	0.1	0.5	2.5	ms
$T_{12ramp}$	0.1	0.5	1.5	ms
$T_{por}$	2	2	8	ms
$T_{non\_rdy}$	1	2	10	ms

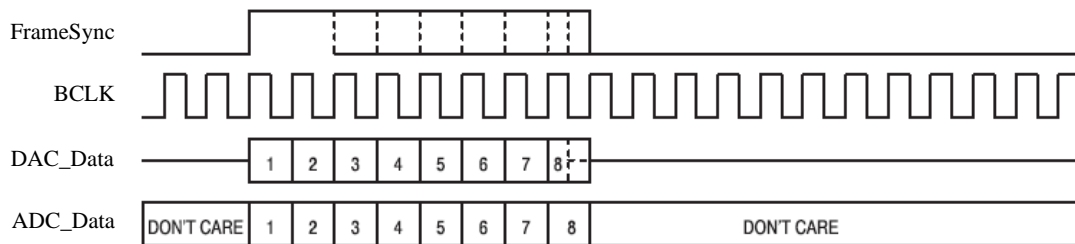
## 5.5. PCM Interface Characteristics

The RTL8761ATV supports a PCM digital audio interface that is used for transmitting digital audio/voice data to/from the Audio Codec. Features are supported as below:

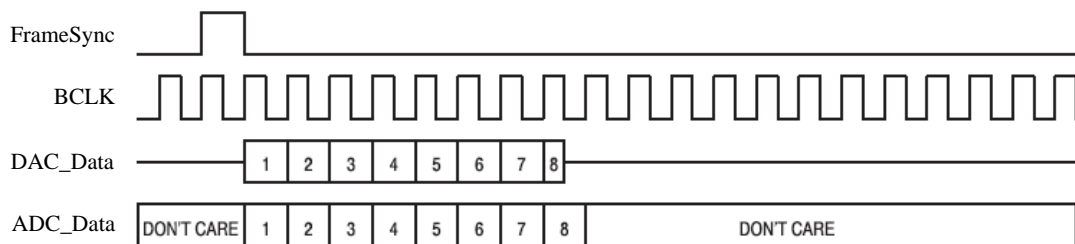
- Supports Master and Slave mode
- Programmable long/short Frame Sync
- Supports 8-bit A-law/ $\mu$ -law, and 13/16-bit linear PCM formats
- Supports sign-extension and zero-padding for 8-bit and 13-bit samples
- Supports padding of Audio Gain to 13-bit samples
- PCM Master Clock Output: 64, 128, 256, or 512kHz
- Supports SCO/ESCO link

### 5.5.1. PCM Format

FrameSync is the synchronizing function used to control the transfer of DAC\_Data and ADC\_Data. A Long FrameSync indicates the start of ADC\_Data at the rising edge of FrameSync (Figure 5), and a Short FrameSync indicates the start of ADC\_Data at the falling edge of FrameSync (Figure 6).



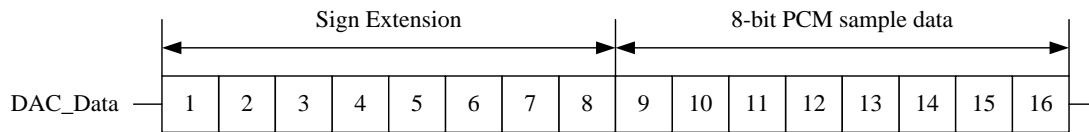
**Figure 5. Long FrameSync**



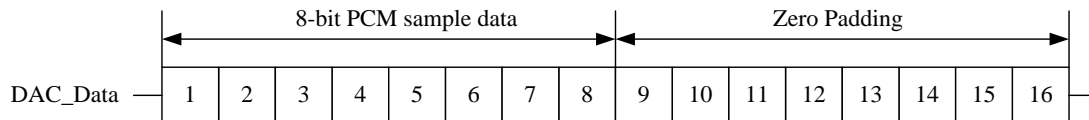
**Figure 6. Short FrameSync**

### 5.5.2. Sign Extension and Zero Padding for 8-Bit and 13-Bit Samples

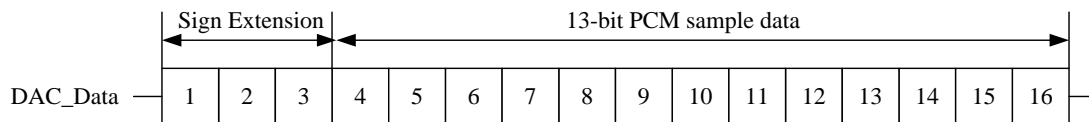
For 16-bit linear PCM output, 3 or 8 unused bits may be sign extended/zero padded.



**Figure 7. 16-Bit Output Data with 8-Bit PCM Sample Data and Sign Extension**

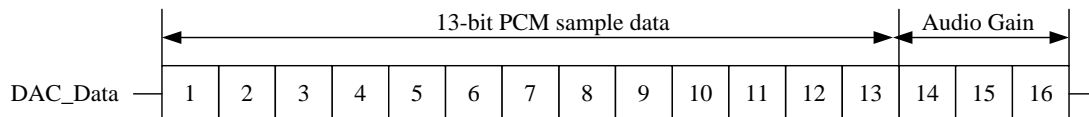


**Figure 8. 16-Bit Output Data with 8-Bit PCM Sample Data and Zero Padding**



**Figure 9. 16-Bit Output Data with 13-Bit PCM Sample Data and Sign Extension**

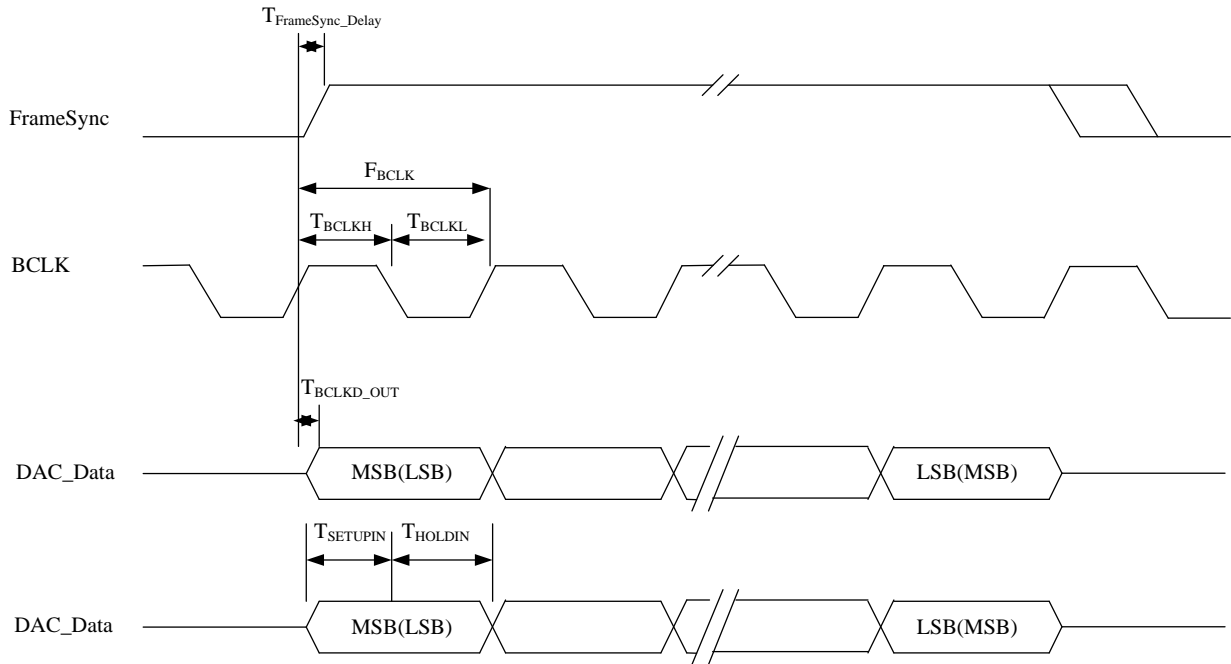
For 16-bit linear PCM output, 3-bit programmable audio gain value can be padded to 13-bit sample data.



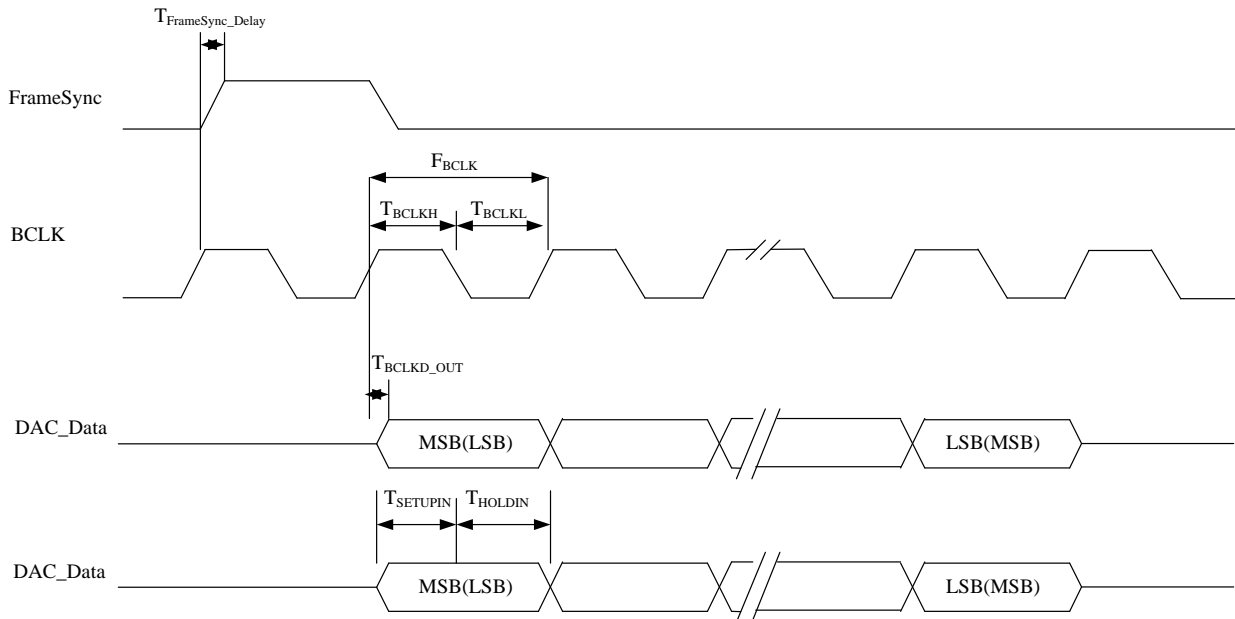
**Figure 10. 16-Bit Output Data with 13-Bit PCM Sample Data and Audio Gain**



### 5.5.3. PCM Interface Timing



**Figure 11. PCM Interface (Long FrameSync)**



**Figure 12. PCM Interface (Short FrameSync)**

**Table 14. PCM Interface Clock Specifications**

Symbol	Description	Min.	Typ.	Max.	Unit
$F_{BCLK}$	Frequency of BCLK (Master)	64	-	512	kHz
$F_{FrameSync}$	Frequency of Frame Sync (Master)	-	8	-	kHz
$F_{BCLK}$	Frequency of BCLK (Slave)	64	-	512	kHz
$F_{FrameSync}$	Frequency of Frame Sync (Slave)	-	8	-	kHz
D	Data Size	8	8	16	bits
N	Number of Slots Per Frame	1	1	1	Slots

**Table 15. PCM Interface Timing**

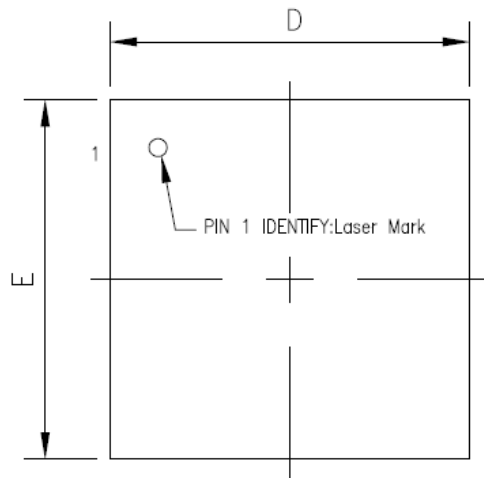
Symbol	Description	Min.	Typ.	Max.	Unit
$T_{BCLKH}$	High Period of BCLK	980	-	-	ns
$T_{BCLKL}$	Low Period of BCLK	970	-	-	ns
$T_{FrameSync\_Delay}$	Delay Time from BCLK High to Frame Sync High	-	-	75	ns
$T_{BCLKD\_OUT}$	Delay Time from BCLK High to Valid DAC_Data	-	-	125	ns
$T_{SETUPIN}$	Set-up Time for ADC_Data Valid to BCLK Low	10	-	-	ns
$T_{HOLDIN}$	Hold Time for BCLK Low to ADC_Data Invalid	125	-	-	ns

#### 5.5.4. PCM Interface Signal Levels

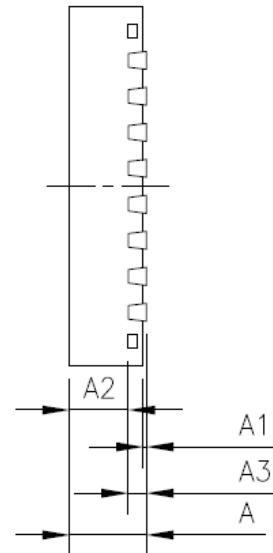
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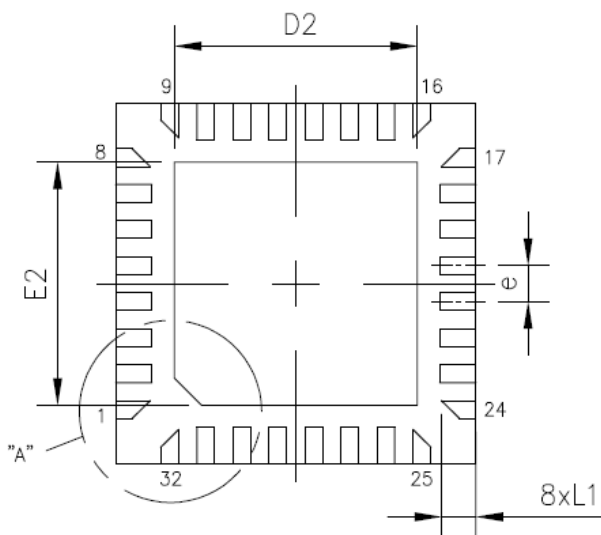
## 6. Mechanical Dimensions



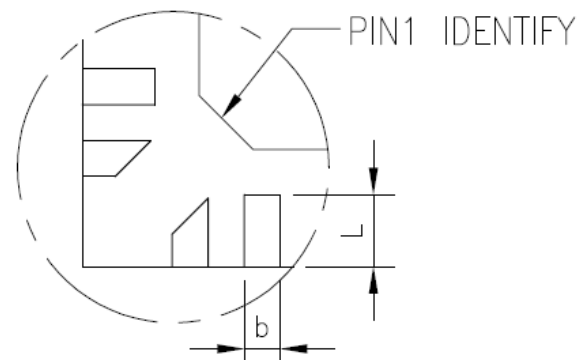
TOP VIEW



SIDE VIEW



BOTTOM VIEW



DETAIL : "A"

## 6.1. Mechanical Dimensions Notes

Symbol	Dimension in mm			Dimension in inch		
	Min	Nom	Max	Min	Nom	Max
A	0.80	0.85	0.90	0.031	0.033	0.035
A1	0.00	0.02	0.05	0.000	0.001	0.002
A2	—	0.65	0.70	—	0.026	0.028
A3	0.20 REF			0.008 REF		
b	0.15	0.20	0.25	0.006	0.080	0.010
D/E	4.00 BSC			0.157 BSC		
D2/E2	2.45	2.70	2.95	0.096	0.106	0.116
e	0.40 BSC			0.016 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020
L1	0.282	0.382	0.482	0.011	0.015	0.019

Note 1: CONTROLLING DIMENSION: MILLIMETER (mm).

Note 2: REFERENCE DOCUMENT: JEDEC MO-220.

## 7. Ordering Information

Table 16. Ordering Information

Part Number	Package	Status
RTL8761ATV-CG	QFN-32, 'Green' Package	Mass Production

Note: See page 3 for package identification.

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