

## Soundwire Audio CODEC

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### FEATURES

#### System

- Soundwire v1.2
- SDCA v1.0
- 2.4/4.8/9.6/19.2 MHz, 32/64/128/192/256/384/512Fs, 12/24 MHz audio system clocks
- Support multi-stream

#### ADC

- 24-bit, 8 to 96 kHz sampling frequency
- 101 dB signal to noise ratio, -90 dB THD+N
- Low noise pre-amplifier
- Auto level control (ALC) and noise gate
- Support DMIC

#### DAC

- 24-bit, 8 to 192 kHz sampling frequency
- Ground centered headphone driver
- Headphone 102 dB signal to noise ratio, -85 dB THD+N
- 2x2W class D speak amplifier
- Class D 10 uV idle noise, -80 dB THD+N
- Headset OMTP and CTIA auto switch
- Headset four button detection
- Pop and click noise suppression

### APPLICATIONS

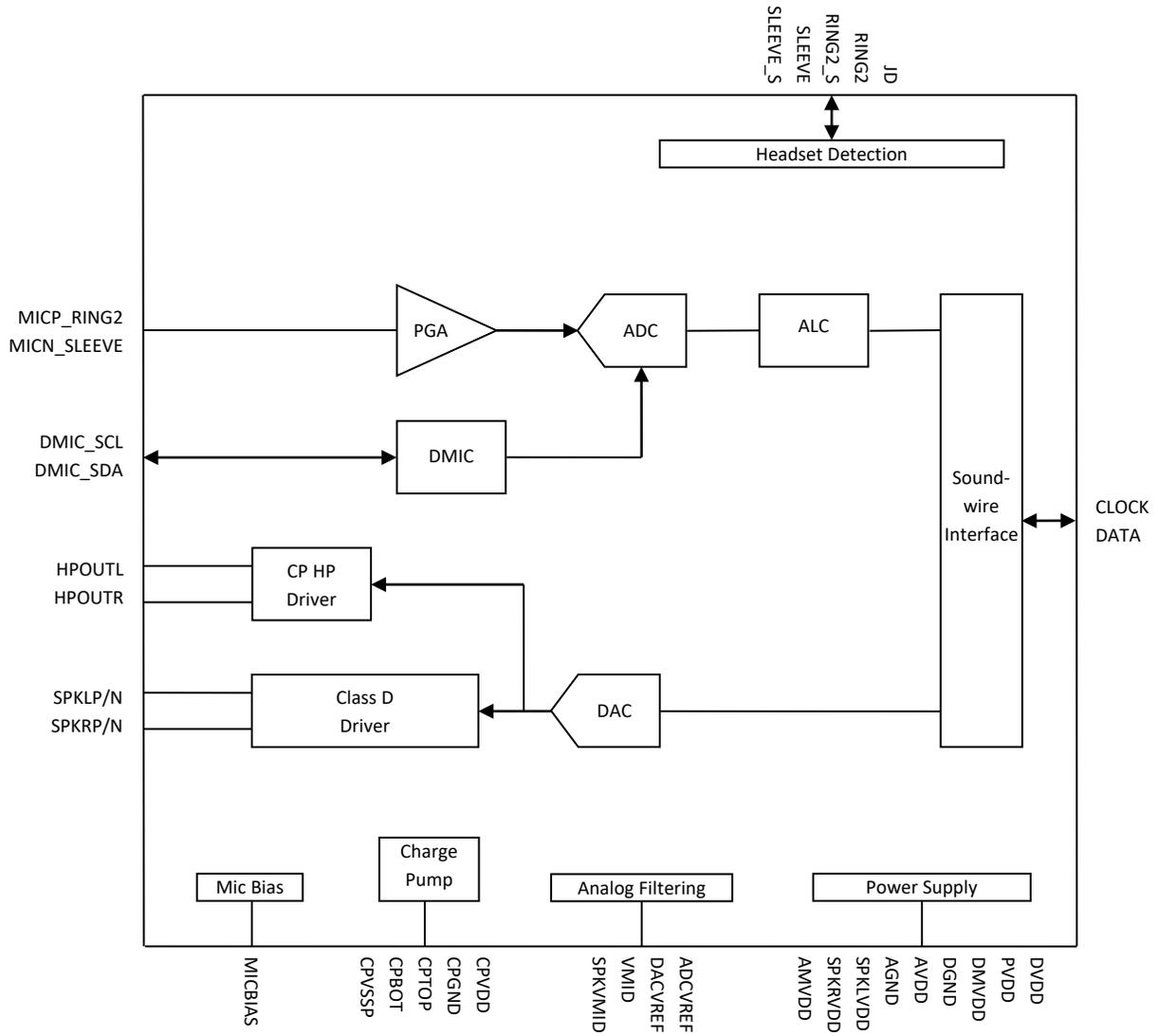
- Notebook
- PC

### ORDERING INFORMATION

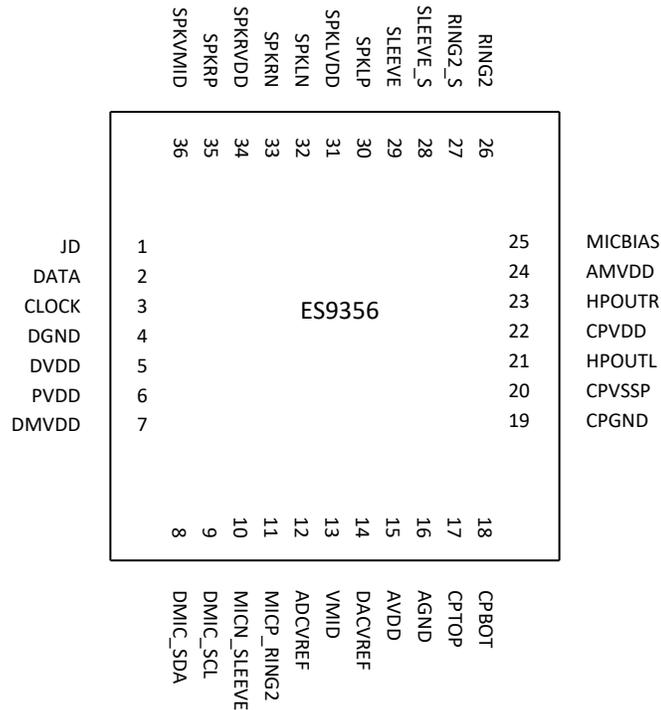
ES9356 -40°C ~ +105°C  
QFN-36 4x4

|    |  |    |
|----|--|----|
| 1. | <i>BLOCK DIAGRAM</i> .....                                     | 3  |
| 2. | <i>PIN OUT AND DESCRIPTION</i> .....                           | 4  |
| 3. | <i>TYPICAL APPLICATION CIRCUIT</i> .....                       | 5  |
| 4. | <i>ELECTRICAL CHARACTERISTICS</i> .....                        | 6  |
|    | ABSOLUTE MAXIMUM RATINGS.....                                  | 6  |
|    | RECOMMENDED OPERATING CONDITIONS .....                         | 6  |
|    | ADC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS ..... | 6  |
|    | DAC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS ..... | 7  |
|    | DC CHARACTERISTICS .....                                       | 7  |
|    | SOUNDWIRE INTERFACE SWITCHING SPECIFICATIONS .....             | 8  |
|    | DMIC INTERFACE SWITCHING SPECIFICATIONS .....                  | 12 |
| 5. | <i>PACKAGE (UNIT: MM)</i> .....                                | 13 |
| 6. | <i>LAND PATTERN</i> .....                                      | 14 |
| 7. | <i>CORPORATE INFORMATION</i> .....                             | 15 |
| 8. | <i>IMPORTANT NOTICE AND DISCLAIMER</i> .....                   | 15 |

### 1. BLOCK DIAGRAM



## 2. PIN OUT AND DESCRIPTION



| Pin Name                         | Pin Number     | Input or Output | Pin Description                               |
|----------------------------------|----------------|-----------------|---|
| JD                               | 1              | I               | Jack detection                                |
| DATA, CLOCK                      | 2, 3           | I/O, I          | Soundwire data and clock                      |
| DVDD, DGND                       | 5, 4           | Analog          | Digital power supply                          |
| PVDD                             | 6              | Analog          | Power supply for the digital input and output |
| DMVDD                            | 7              | Analog          | Power supply for the DMIC input and output    |
| DMIC_SDA, DMIC_SCL               | 8, 9           | I, O            | DMIC data and clock                           |
| MICN_SLEEVE, MICP_RING2          | 10, 11         | Analog          | Mic input (single ended or differential)      |
| ADCVREF, VMID, DACVREF           | 12, 13, 14     | Analog          | Filtering capacitor connection                |
| AVDD, AGND                       | 15, 16         | Analog          | Analog power supply                           |
| CPTOP, CPBOT                     | 17, 18         | Analog          | Charge pump capacitor top and bottom          |
| CPGND, CPVDD                     | 19, 22         | Analog          | Charge pump power supply                      |
| CPVSSP                           | 20             | Analog          | Charge pump filtering capacitor connection    |
| HPOUTL, HPOUTR                   | 21, 23         | Analog          | DAC stereo ground centered headphone output   |
| AMVDD                            | 24             | Analog          | Power supply for the AMIC                     |
| MICBIAS                          | 25             | Analog          | Mic bias                                      |
| RING2, RING2_S, SLEEVE_S, SLEEVE | 26, 27, 28, 29 | Analog          | Headset detection                             |
| SPKLP/N, SPKRP/N                 | 30, 32, 35, 33 | Analog          | DAC stereo speaker class D output             |
| SPKLVDD, SPKRVDD, SPKGND         | 31, 34, 37     | Analog          | Speaker power supply                          |
| SPKVMID                          | 36             | Analog          | Speaker filtering capacitor connection        |



## 4. ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS

Continuous operation at or beyond these conditions may permanently damage the device.

| PARAMETER                   | MIN       | MAX       |
|-----------------------------|-----------|-----------|
| Analog Input Voltage Range  | AGND-0.3V | AVDD+0.3V |
| Digital Input Voltage Range | DGND-0.3V | PVDD+0.3V |
| Operating Temperature Range | -40°C     | +105°C    |
| Storage Temperature         | -65°C     | +150°C    |

### RECOMMENDED OPERATING CONDITIONS

| PARAMETER        | MIN | TYP       | MAX | UNIT |
|------------------|-----|-----------|-----|------|
| DVDD             | 1.6 | 1.8       | 2.0 | V    |
| PVDD             | 1.1 | 1.2/1.8   | 2.0 | V    |
| DMVDD            | 1.6 | 1.8/3.3/5 | 5.5 | V    |
| AVDD             | 1.6 | 1.8       | 2.0 | V    |
| SPKLVDD, SPKRVDD | 3   | 3.3/4.2/5 | 5.5 | V    |
| AMVDD            | 3   | 3.3       | 3.6 | V    |
| CPVDD            | 1.6 | 1.8       | 2.0 | V    |

### ADC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS

Test conditions are as the following unless otherwise specify: AVDD=1.8V, DVDD=1.8V, AGND=0V, DGND=0V, Ambient temperature=25°C, Fs=48 KHz, CLOCK/LRCK=256.

| PARAMETER                               | MIN    | TYP | MAX    | UNIT |
|---|--------|-----|--------|------|
| ADC Performance                         |        |     |        |      |
| Signal to Noise ratio (A-weight)        | 97     | 101 | 103    | dB   |
| THD+N                                   | -93    | -90 | -87    | dB   |
| Gain Error                              |        |     | ±5     | %    |
| Filter Frequency Response               |        |     |        |      |
| Passband                                | 0      |     | 0.4535 | Fs   |
| Stopband                                | 0.5465 |     |        | Fs   |
| Passband Ripple                         |        |     | ±0.05  | dB   |
| Stopband Attenuation                    | 70     |     |        | dB   |
| Analog Input                            |        |     |        |      |
| Full Scale Input (differential P and N) |        | 1   |        | Vrms |
| Input Impedance                         |        | 6   |        | KΩ   |

**DAC ANALOG AND FILTER CHARACTERISTICS AND SPECIFICATIONS**

Test conditions are as the following unless otherwise specify: AVDD=1.8V, DVDD=1.8V, AGND=0V, DGND=0V, Ambient temperature=25°C, Fs=48 KHz, CLOCK/LRCK=256.

| PARAMETER                        | MIN             | TYP | MAX    | UNIT |    |
|----------------------------------|-----------------|-----|--------|------|----|
| <b>DAC Performance</b>           |                 |     |        |      |    |
| Signal to Noise ratio            | HPOUT (A-weigh) | 100 | 102    | 104  | dB |
|                                  | Class D         | 8   | 10     | 12   | uV |
| THD+N                            | HPOUT           | -88 | -85    | -82  | dB |
|                                  | Class D         | -83 | -80    | -77  | dB |
| Gain Error                       |                 |     | ±5     | %    |    |
| <b>Filter Frequency Response</b> |                 |     |        |      |    |
| Passband                         | 0               |     | 0.4535 | Fs   |    |
| Stopband                         | 0.5465          |     |        | Fs   |    |
| Passband Ripple                  |                 |     | ±0.05  | dB   |    |
| Stopband Attenuation             | 53              |     |        | dB   |    |
| <b>Analog Output</b>             |                 |     |        |      |    |
| Full Scale Output                | HPOUT           |     | 1      | Vrms |    |
|                                  | Class D         |     | 2      | W    |    |

**DC CHARACTERISTICS**

| PARAMETER  | MIN       | TYP   | MAX       | UNIT |
|--|-----------|-------|-----------|------|
| <b>Normal Operation Mode</b>                               |           |       |           |      |
| DVDD=1.8V, PVDD=1.8V, DMVDD=1.8V,<br>AVDD=1.8V, AMVDD=3.3V | 18        | 20    | 22        | mW   |
| <b>Standby Mode (Note 1)</b>                               |           |       |           |      |
| DVDD=1.8V, PVDD=1.8V, DMVDD=1.8V,<br>AVDD=1.8V, AMVDD=3.3V |           | 500   |           | uA   |
| <b>Power Down Mode (Note 2)</b>                            |           |       |           |      |
| DVDD=1.8V, PVDD=1.8V, DMVDD=1.8V,<br>AVDD=1.8V, AMVDD=3.3V |           | 0     |           | uA   |
| <b>Digital Voltage Level (CLOCK/DATA)</b>                  |           |       |           |      |
| High-level Input Voltage                                   | 0.8*PVDD  |       |           | V    |
| Low-level Input Voltage                                    |           |       | 0.2*PVDD  | V    |
| High-level Output Voltage                                  |           | PVDD  |           | V    |
| Low-level Output Voltage                                   |           | 0     |           | V    |
| <b>Digital Voltage Level (DMIC_SDA/DMIC_SCL)</b>           |           |       |           |      |
| High-level Input Voltage                                   | 0.7*DMVDD |       |           | V    |
| Low-level Input Voltage                                    |           |       | 0.3*DMVDD | V    |
| High-level Output Voltage                                  |           | DMVDD |           | V    |
| Low-level Output Voltage                                   |           | 0     |           | V    |

Note 1: CLOCK stop and HP detection is running on internal oscillator.

Note 2: CLOCK and all function stop.

**SOUNDWIRE INTERFACE SWITCHING SPECIFICATIONS**

| PARAMETER                        | Symbol            | MIN      | MAX  | UNIT |
|----------------------------------|-------------------|----------|------|------|
| CLOCK frequency                  | f_CLOCK           |          | 13   | MHz  |
| CLOCK duty cycle                 |                   | 45       | 55   | %    |
| CLOCK slew time                  | t_Slew_CLOCK      |          | 5    | ns   |
| CLOCK High time                  | t_High_CLOCK      | 36       |      | ns   |
| CLOCK Low time                   | t_Low_CLOCK       | 36       |      | ns   |
| Data driver disable time         | t_DZ_DATA         |          | 4    | ns   |
| Delay from clock to active state | t_ZD_DATA         | 7.9      |      | ns   |
| Time for data hold time          | t_OV_DATA         |          | 27.6 | ns   |
| Data input minimum setup time    | t_ISetup_DATA     |          | 0    | ns   |
| Data input minimum hold time     | t_IHold_DATA      |          | 4    | ns   |
| Bus Keeper settling time         | t_Keeper_Settle   |          | 2.5  | ns   |
| Hysteresis voltage               | V <sub>HYST</sub> | 0.1*PVDD |      | v    |

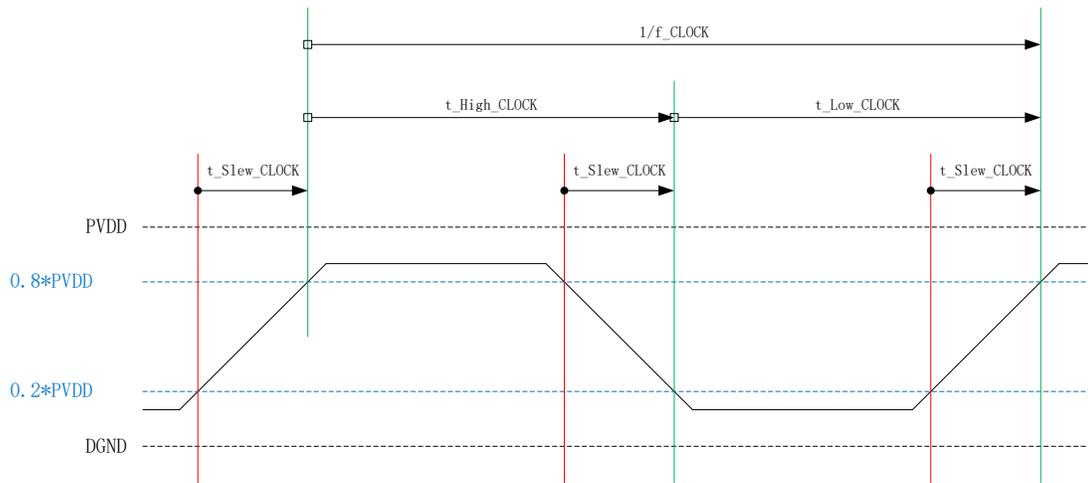


Figure 1 CLOCK

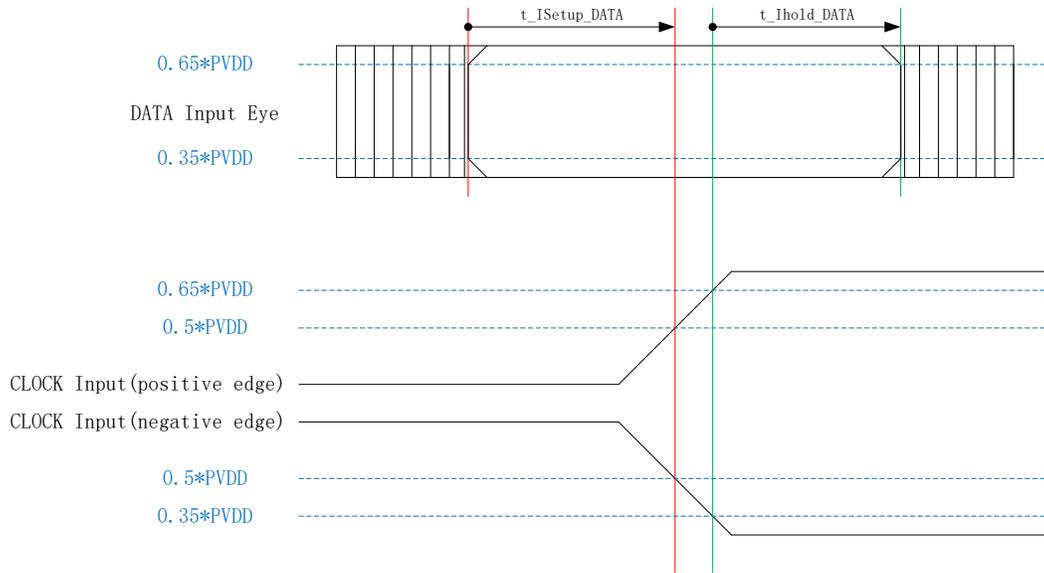


Figure 2 DATA - Input

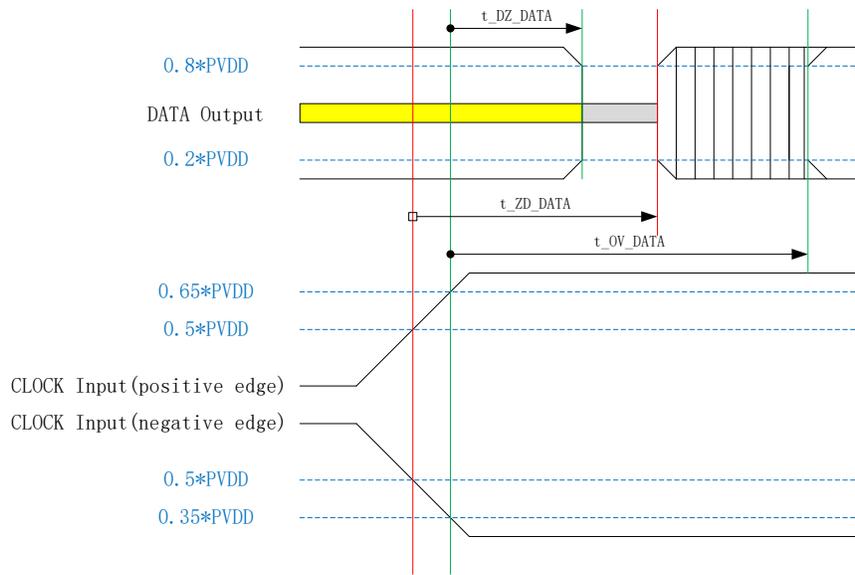


Figure 3 DATA - Output

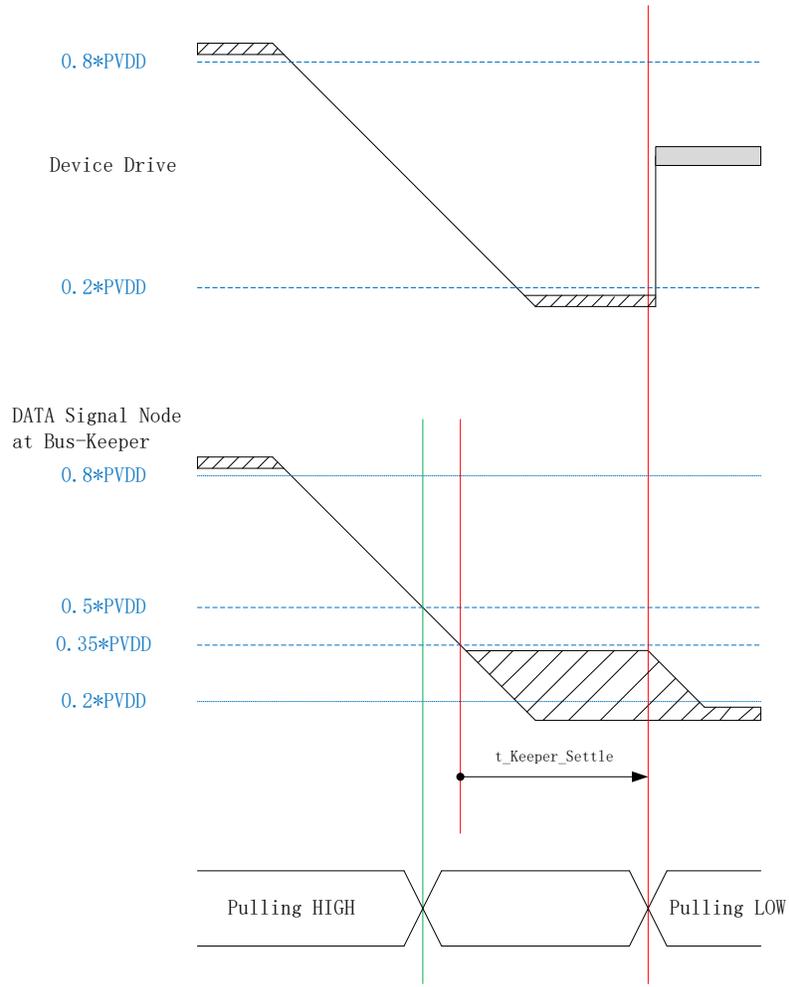


Figure 4 Bus Keeper (High to Low)

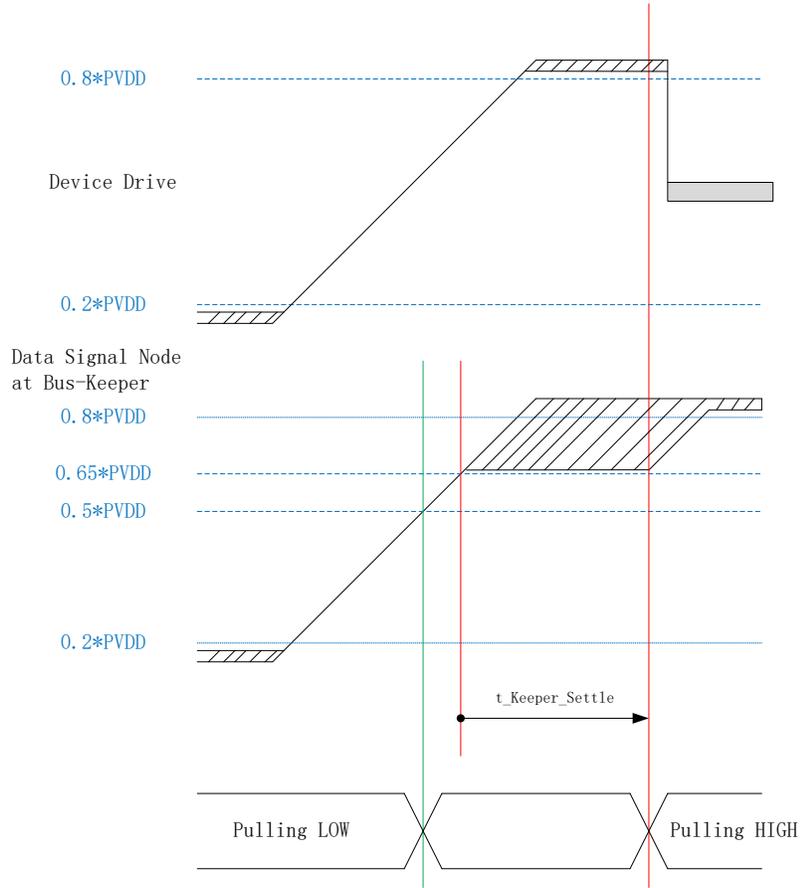


Figure 5 Bus Keeper (Low to High)

**DMIC INTERFACE SWITCHING SPECIFICATIONS**

| PARAMETER                 | Symbol                        | MIN | MAX | UNIT |
|---------------------------|-------------------------------|-----|-----|------|
| DMIC_SDA input setup time | $t_{Isetup\_time\_DMIC\_SDA}$ | 4   |     | ns   |
| DMIC_SDA input hold time  | $t_{Ihold\_time\_DMIC\_SDA}$  | 1   |     | ns   |
| DMIC_SCL slew time        | $t_{Slew\_DMIC\_SCL}$         |     | 5   | ns   |

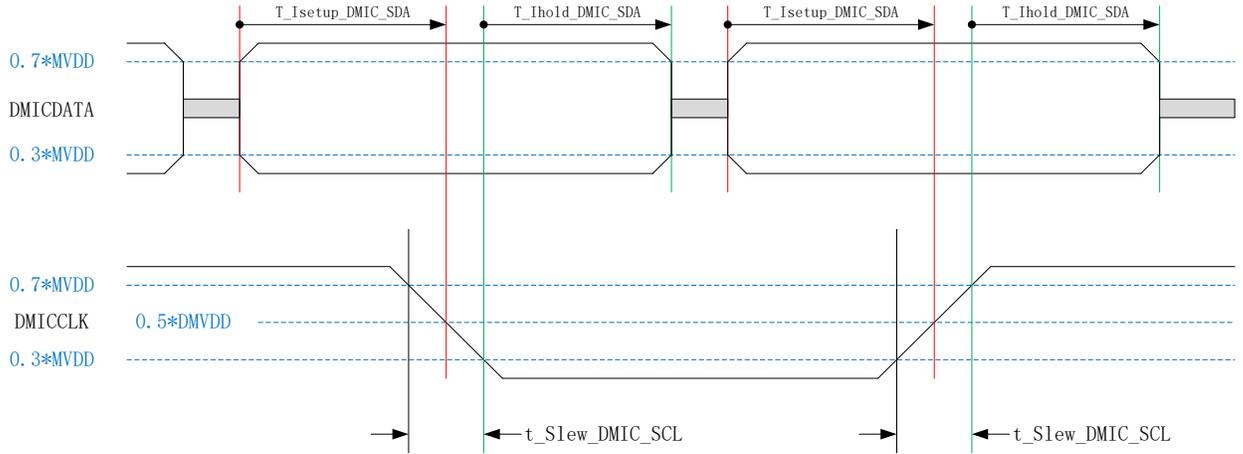
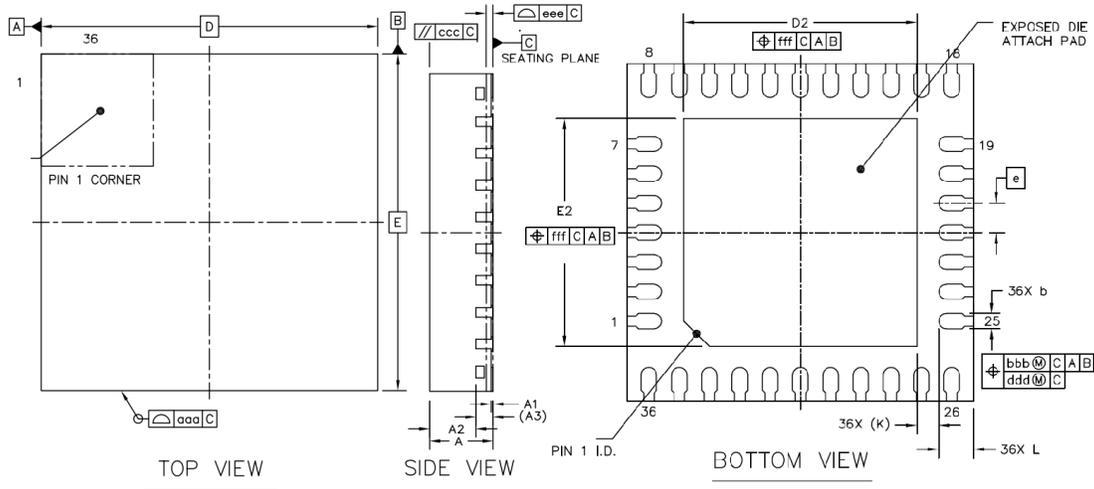


Figure 6 DMIC

## 5. PACKAGE (UNIT: MM)

### QFNWB4X4-36L(P0.35T0.55) Package Outline



| Item                    | Symbol | Minimum   | Normal | Maximum |
|-------------------------|--------|-----------|--------|---------|
| Total Thickness         | A      | 0.50      | 0.55   | 0.60    |
| Stand Off               | A1     | 0         | 0.02   | 0.05    |
| Molding Thickness       | A2     | ---       | 0.40   | ---     |
| LF Thickness            | A3     | 0.152 REF |        |         |
| Lead Width              | b      | 0.13      | 0.18   | 0.23    |
| Body Size               | D      | 4 BSC     |        |         |
|                         | E      | 4 BSC     |        |         |
| Lead Pitch              | e      | 0.35 BSC  |        |         |
| Exposed Pad Size        | D2     | 2.60      | 2.70   | 2.80    |
|                         | E2     | 2.60      | 2.70   | 2.80    |
| Lead Length             | L      | 0.30      | 0.40   | 0.50    |
| Lead tip to Exposed Pad | K      | 0.25 REF  |        |         |
| Package Edge Tolerance  | aaa    | 0.10      |        |         |
| Molding Flatness        | ccc    | 0.10      |        |         |
| Coplanarity             | eee    | 0.08      |        |         |
| Lead Offset             | bbb    | 0.07      |        |         |
| Exposed Pad Offset      | fff    | 0.10      |        |         |



## 7. CORPORATE INFORMATION

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