

DESCRIPTION

The HS-100LX is a highly integrated USB 2.0 audio codec controller designed for USB headset, headphone applications, delivering high-quality audio performance with compact and low-power system integration.

The HS-100LX integrates stereo DAC and mono ADC audio engines. It achieves the audio performance with DAC SNR up to 98 dB and ADC SNR up to 98 dB at 48 kHz / 16-bits operation.

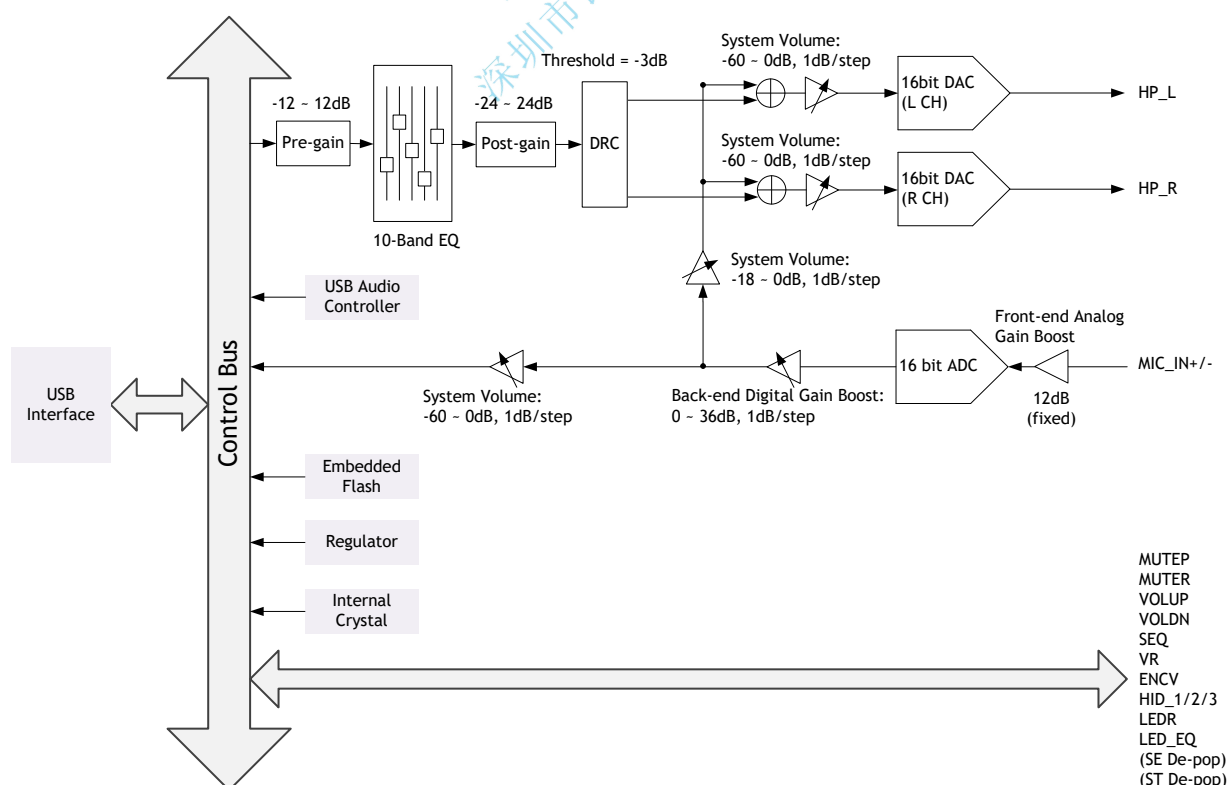
To enable flexible acoustic tuning and sound differentiation, the HS-100LX features a hardware-based DAC 10-band equalizer and Xear-EQ software application. The device supports external EQ mode selection keys, allowing real-time audio effect switching without host-side software dependency.

Compliant with USB Audio Device Class specifications, the HS-100LX operates as a USB 2.0 Full-Speed device and offers driver-free compatibility with mainstream operating systems. Packaged in a compact QFN-20 (3 × 3 mm) package and optimized for low power consumption, the HS-100LX helps reduce PCB area and overall BOM cost, making it well suited for compact and cost-effective USB audio designs.

FEATURES

- USB 2.0 Spec. Full-Speed compliant
- USB Audio Device Class Spec. 1.0 compliant
- USB HID Device Class Spec. 1.1 compliant
- 2-channel DACs and 1-channel ADC
- 16-bits data resolution and 48 kHz sample rate
- Hardware-based DAC 10-band equalizer with peak filter, high/low pass filter, high/low shelf filter and notch filter
- Supports Dynamic Range Control (DRC)
- Supports Xear-EQ (10-band equalizer) software application
- USB suspend/resume/remote wakeup
- Embedded oscillator for crystal-less design
- Independent voltage bias pin for microphone and side-tone function
- Featured with usual HID hot key controls
- Supports external EQ mode selection key
- Supports variable resistor or rotary encoder with push-button switch for playback volume control
- Implemented LED indicators control for EQ mode and recording mute status
- Small size (3mm x 3mm) of 20-pin QFN Package

BLOCK DIAGRAM



Release notes

Revision	Date	Description
0.90	2026/2/9	- Preliminary release
0.91	2026/4/30	- Update Block Diagram - Update Features - Update Pin Description
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1 Description and Overview

The HS-100LX is a highly integrated USB 2.0 Full-Speed audio codec controller designed for USB headset and headphone applications, delivering high-quality audio performance with compact size and low-power system integration.

The HS-100LX integrates two-channel DACs with single-ended outputs and common-mode voltage bias, and one-channel ADC supporting both single-ended and differential input modes. It supports 16-bits audio resolution with a sampling rate of 48 kHz. The device provides better audio performance, achieving DAC (DAC in common-mode voltage bias mode, VC mode) and ADC (ADC in differential mode) SNR up to 98 dB at 48 kHz / 16-bits operation, making it suitable for high-quality audio playback and voice capture applications.

To enable flexible acoustic tuning and product differentiation, the HS-100LX features a hardware-based DAC 10-band equalizer, supporting various filter types including peak, notch, high-pass, low-pass, and high/low shelf filters. In addition, the device supports the Xear-EQ software application to allow users to adjust gain values for individual frequency bands. External EQ mode selection key and LED for EQ mode indicator are supported, allowing real-time audio effect switching through device-side control without reliance on host-side software processing.

The HS-100LX is compliant with USB Audio Device Class Specification 1.0 and USB HID Device Class Specification 1.1, and operates as a USB 2.0 Full-Speed device, ensuring driver-free compatibility with mainstream operating systems. Standard USB functions such as suspend, resume, and remote wakeup are supported.

Designed for compact and cost-sensitive applications, the HS-100LX is packaged in a 20-pin QFN (3 × 3 mm) package and optimized for low power consumption. The device also integrates an embedded oscillator for crystal-less design, dedicated voltage bias pin for microphone and side-tone functions, GPIO-based LED indicator control, and flexible external control interfaces such as variable resistors and rotary encoders with push-button switch for playback volume adjustment. These features help reduce PCB area and overall BOM cost, making the HS-100LX well suited for compact and cost-effective USB audio designs.

2 Ordering Information

Part Number	Package Marking	Package Type	Transport Media
HS-100LX	HS-100LX	QFN-20 (3mm x 3mm)	Tape and Reel

3 Features

3.1 USB Compliance

- USB 2.0 full-speed compliant
- USB audio class 1.0 compliant
- USB human interface devices (HID) class 1.1 compliant
- Supports USB suspend/resume/remote wakeup functions
- Supports control, interrupt and isochronous data transfers

3.2 Audio Engine and Codec

- Playback Stream:
 - Stereo DAC with Headphone Output:
 - Sample Rates: 48 kHz
 - Bit Depth: 16 bits
 - THD+N (VC Mode): -85 dB
 - SNR (VC Mode): -97 dB
 - Dynamic Range (VC Mode): -97 dB
 - System Volume Range: -60 dB ~ 0 dB, 1 dB/step
 - Single-ended/Common-Mode Voltage Bias Mode (VC Mode) Selection for Output
- Recording Stream:
 - Mono ADC with Microphone Input
 - Sample Rates: 48 kHz
 - Bit Depth: 16 bits
 - THD+N (Differential Mode): -75 dB
 - SNR (Differential Mode): -99 dB
 - Dynamic Range (Differential Mode): -99 dB
 - System Volume Range: -60 dB ~ 0 dB, 1 dB/step
 - Front-end analog gain boost: up to +12 dB (fixed)
 - Back-end digital gain boost: 0 dB ~ 36 dB, 1dB/step (adjustable)
 - Single-ended/Differential Mode Selection for Input
 - Independent Microphone Bias
- Side-tone:
 - Internal mixer path with independent physical digital gain control: -30 dB ~ -12 dB (mapping with system volume range is -18 dB ~ 0 dB), 1 dB/step

Side-tone System Volume Range and Physical Digital Gain Control			
System Volume Range (dB)	Physical Digital Gain (dB)	System Volume Range (dB)	Physical Digital Gain (dB)
0	-12	-12	-24
-1	-13	-13	-25
-2	-14	-14	-26
-3	-15	-15	-27
-4	-16	-16	-28
-5	-17	-17	-29
-6	-18	-18	-30
-7	-19		
-8	-20		
-9	-21		
-10	-22		
-11	-23		

3.3 Hardware EQ Capabilities

- Provides 10-band hardware-based equalizer for DAC audio playback
- Supports up to 3 selectable EQ modes
- Each EQ band supports programmable center frequency, gain, Q factor, and filter type
- Supported filter types include:
 - Low-Pass Filter (LPF)
 - High-Pass Filter (HPF)
 - Peak Filter
 - Low Shelf Filter
 - High Shelf Filter
 - Notch Filter
- Each band supports independent reset to default settings
- Supports Pre-gain control (-12 dB ~ +12dB) of signal attenuation before EQ processing
- Supports Post-gain control (-24dB ~ +24dB) of signal compensation after EQ processing
- Supports USB-based EQ parameter update with real-time (online) effect
- Supports external EQ mode selection key for instant preset switching, enabling true standalone hardware EQ operation without any software dependency
- EQ settings can be stored in internal flash memory

3.4 Xear-EQ Software Application

- Graphical 10-band EQ gain control interface for EQ gain parameter download to device hardware
- Supports up to 3 selectable EQ modes
- User-friendly EQ configuration software for audio tuning
- Real-time adjustment of gain
- Visual frequency response curve display
- Support for preset EQ profiles with user-defined EQ settings (for Option)
- Supports LED indication (RGB LED) for preset EQ mode switching
- Supports external Switching EQ hot key (SEQ) control integrated with Xear-EQ, allowing users to conveniently switch different EQ modes.

3.5 General

- Embedded USB 2.0 transceiver and Power-On reset circuit
- On-Chip oscillator and crystal-less design
- Supports Dynamic Range Control (DRC) with enable/disable before DAC output (Threshold = -3dB)
- Optional configuration for the specific USB VID/PID/Product String/Manufacture String/Serial Number, and Initial/Minimum/Maximum volume settings
- Single 5V power supply with embedded 5V to 1.8V / 3.3V regulator

- HID hot-key control (volume up/volume down/playback mute/record mute)
- Supports up to three (3) external HID hot keys (refer to the reference schematic), enabling customization and interaction with host software functions
- Supports variable resistor or rotary encoder with push-button switch for playback volume control
- 2 general LED driver outputs for EQ mode status and record mute indicators respectively
- Compliant with USB IF certification
- Small size (3mm x 3mm) of standard 20-Pin QFN Package

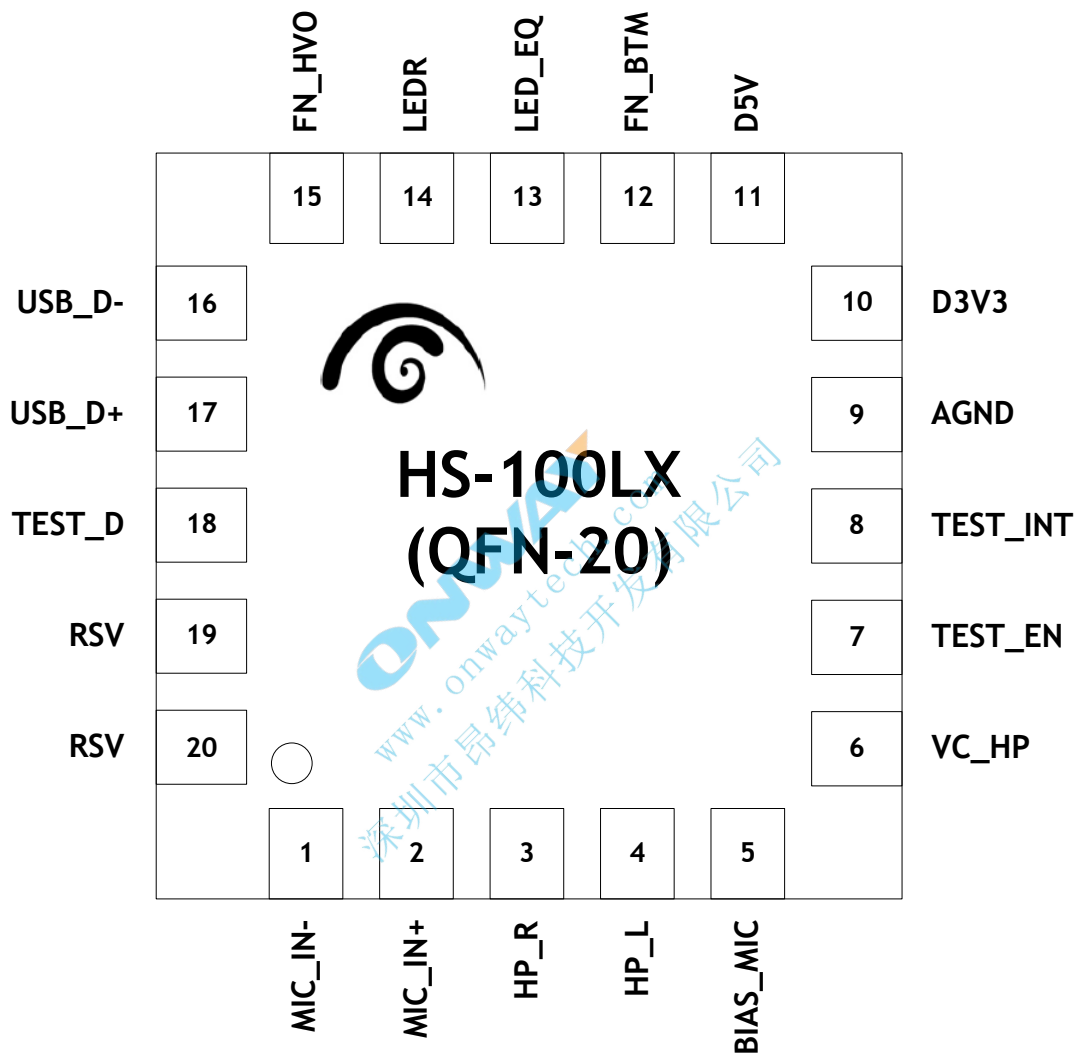
4 Applications

- USB Generic Headset
- USB Generic Headphone and Speaker
- USB Audio Dongle
- USB Featured Consumer Audio Applications


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5 Pin Assignment

5.1 Pin-out Diagram



5.2 Pin Description

Pin No.	Pin Name	I/O	Description
USB2.0 Bus Interface			
17	USB_D+	AIO	3.3V USB 2.0 Data Positive (USB D+ Signal) Without external pull high/low resistance
16	USB_D-	AIO	3.3V USB 2.0 Data Negative (USB D- Signal) Without external pull high/low resistance
Power/Ground			
9	AGND	GND	Analog GND
10	D3V3	AO	3.3V Regulator Output
11	D5V	AI	5V Power Input
Analog Audio Interface			
1	MIC_IN-	AI/DO	This pin is primarily used as the negative microphone input (MIC_IN-), and can also be configured as a shared multifunction pin. It supports two selectable modes as follows: MIC_IN- (Negative microphone input): In normal operation, when the ADC is configured in differential input mode, this pin functions as the negative microphone input. SE De-pop (Single-Ended De-pop): De-pop control signal for DAC single-ended mode (refer to the reference schematic), When the ADC is configured in single-ended input mode, this pin becomes available and can be configured as a de-pop control signal based on application requirements. When the DAC operates in single-ended mode, plug-in/out or power-off events may introduce audible pop noise. An optional de-pop control signal output is provided to <u>interface with the shutdown pin</u> of an external headphone amplifier or de-pop circuit, enabling hardware-level pop noise suppression through external component design.
2	MIC_IN+	AI	This pin serves as the primary microphone input signal source and is used in both single-ended and differential modes. MIC IN: When the ADC is configured in single-ended mode, this pin is used as the microphone input. MIC_IN+ (Positive microphone input): When the ADC is configured in differential mode, this pin functions as the positive input of the microphone.
3	HP_R	AO	Headphone Out: Right Channel

4	HP_L	AO	Headphone Out: Left Channel
5	BIAS_MIC	AO	Microphone Bias Output
6	VC_HP	AO	1.28V Common-Mode Voltage Output Provides a mid-supply reference voltage for Headphone Out
ADC/GPIO/HID Interface			
12	FN_BTMM	DI	This is a multifunction ADC pin that simultaneously supports external hot key and Jack detect: ● MUTEP: Playback mute / un-mute key input ● MUTER: Recording mute key input ● VOLUP: Volume up key input ● VOLDN: Volume down key input ● SEQ: EQ mode select key input ● JACK_DET: Jack detect input pin. Used to detect the insertion or removal of a 3.5 mm audio plug. This signal can be used to control audio path switching or to enable/disable side-tone, helping prevent audio feedback (howling). If side-tone is always disabled, this function can be ignored and is not required for USB headset applications.
13	LED_EQ	DO	LED Indication (RGB LED) for Preset EQ Mode Switching: An external RGB LED device is used for preset EQ mode indication. A single-wire communication interface is recommended. The device includes three pins: VDD, GND, and DIN ● DIN data format including: ➢ R[7:0]: Red intensity ➢ G[7:0]: Green intensity ➢ B[7:0]: Blue intensity ● Timing Waveform: ➢ T0: Represents logic “0” ○ One bit = short high pulse + long low pulse ➢ T1: Represents logic “1” ○ One bit = long high pulse + short low pulse ➢ H: High-level duration ➢ L: Low-level duration

			● Timing Parameters: ➤ T0H: High-level time for logic “0” = 0.35 μs ➤ T0L: Low-level time for logic “0” = 0.9 μs ➤ T1H: High-level time for logic “1” = 0.85 μs ➤ T1L: Low-level time for logic “1” = 0.4 μs ● The output data sequence, for Example:<table><tr><td>G7 G6 G0</td><td>R7 R6 R0</td><td>B7 B6 B0</td></tr><tr><td>8 bits Green</td><td>8 bits Red</td><td>8 bits Blue</td></tr></table> The 24-bit color data is transmitted in the following order: G7 (first outupt) → G0 → R7 → R0 → B7 → B0 (last output)	G7 G6 G0	R7 R6 R0	B7 B6 B0	8 bits Green	8 bits Red	8 bits Blue
G7 G6 G0	R7 R6 R0	B7 B6 B0							
8 bits Green	8 bits Red	8 bits Blue							
14	LEDR	DO	LED Indicator for Record Mute Output High when Record is Muted						
15	FN_HVO	AI/DI	Selectable Function (3-in-1):  HID Key / ENCV / VR This pin is a shared pin and can be configured to operate as one of the following functions: ● HID Key: When configured for this function, the pin supports up to three (3) external HID hot keys (refer to the reference schematic), enabling customization and interaction with host software-specific functions. ● ENCV: When configured for this function, the pin serves as a rotary encoder input (refer to the reference schematic), specifically used for playback volume control ● VR: When configured for this function, the pin serves as a variable resistor (potentiometer) input (refer to the reference schematic) for local/device-side playback volume control. This control operates independently from the system (no synchronization) and uses a dedicated digital gain, with a gain range of -60 dB ~ 0 dB						
Test Mode									
7	TEST_EN	DI	Test purpose with inernal pull low						
8	TEST_INT	DI	Test purpose with inernal pull low						
18	TEST_D	DIO	Test purpose with inernal pull low						
19	RSV	DI	Reserved pin						
20	RSV	DI	Reserved pin						

NOTES:

AI: Analog Input

AO: Analog Output

AIO: Analog Input and Output

DI: Digital Input

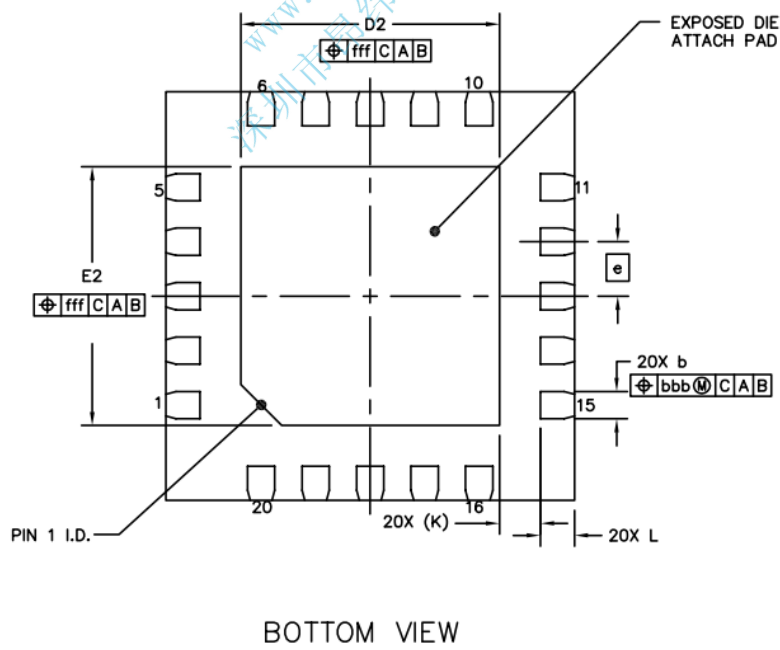
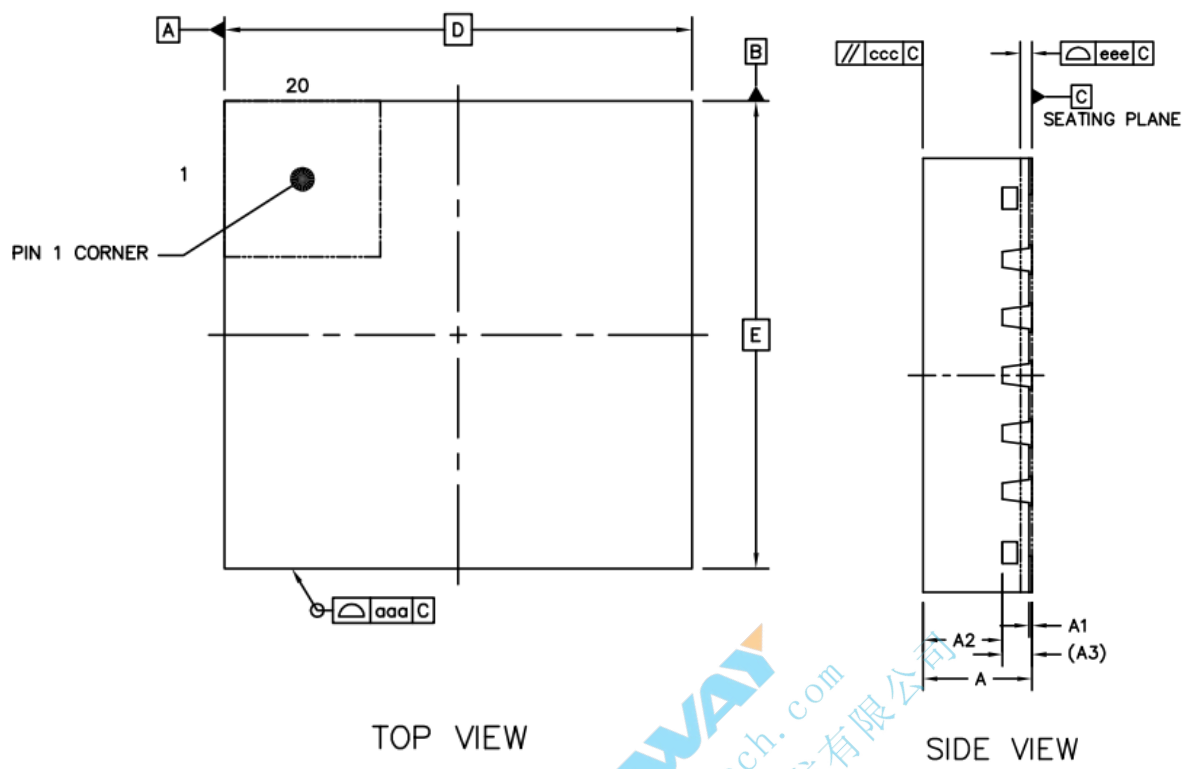
DO: Digital Output

DIO: Digital Input and Output

GND: Ground

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6 Package Dimension (QFN-20, 3mm x 3mm)



Parameter		Symbol	Min	Nom	Max
Total thickness		A	0.7	0.75	0.8
Stand off		A1	0	0.02	0.05
Mold thickness		A2	—	0.55	—
L/F thickness		A3	0.203 REF		
Lead width		b	0.15	0.2	0.25
Body size	X	D	3 BSC		
	Y	E	3 BSC		
Lead pitch		e	0.4 BSC		
EP size	X	D2	1.8	1.9	2
	Y	E2	1.8	1.9	2
Lead length		L	0.15	0.25	0.35
Lead tip to exposed pad edge		K	0.3 REF		
Package edge tolerance		aaa	0.1		
Mold flatness		ccc	0.1		
Coplanarity		eee	0.08		
Lead offset		bbb	0.07		
Exposed pad offset		fff	0.1		

Unit: mm. BSC = Basic Spacing between Centers; REF = Reference only.

— End of Datasheet —



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