

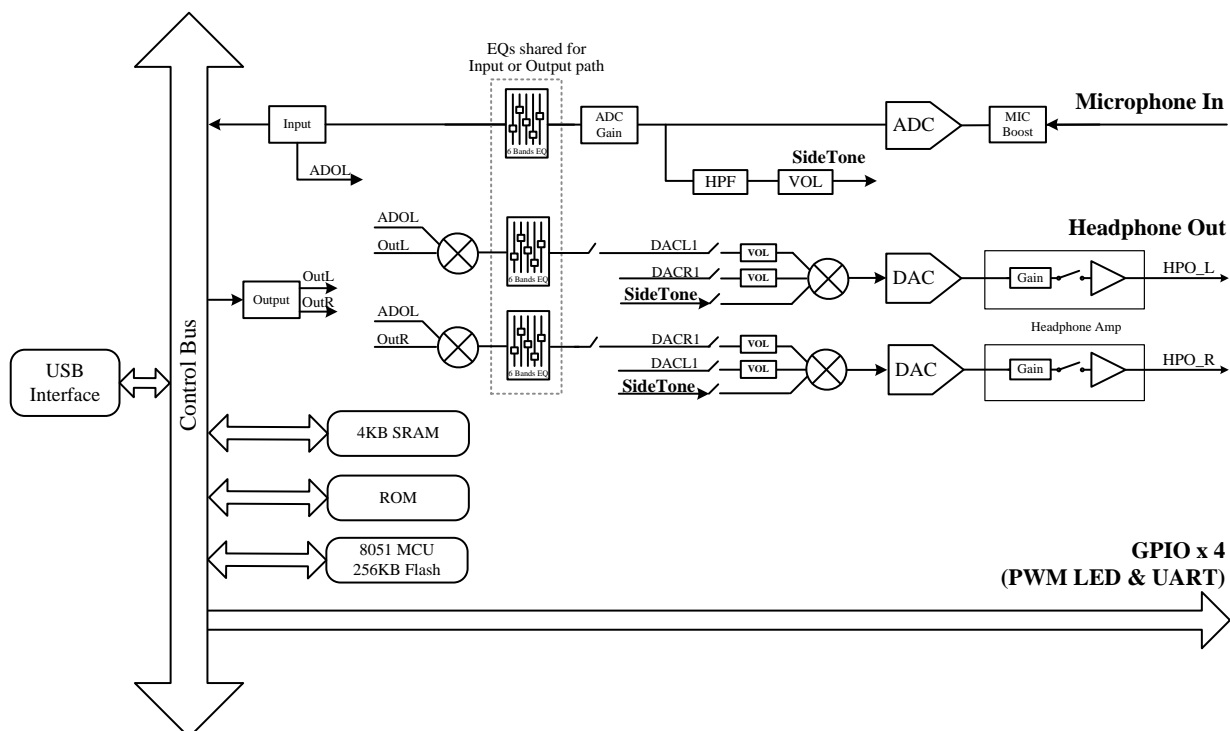
DESCRIPTION

The CM6648 is a USB 2.0 high-speed audio chip with high performance audio codec which is targeting high-end USB type-C headset, microphone and USB-to-3.5mm Jack audio device. It combines stereo DAC and mono ADC, audio interface I2S, control interface I2C, and embedded flash to provide a highly-integrated audio solution. The CM6648 also supports UAC3.0 LPM L1 and is equipped with a stereo low power cap-free Class-G headphone amplifier of 122dB SNR and 96dB THD+N performance, providing longer battery life and Hi-Fi listening experiences.

FEATURES

- USB 2.0 full-speed and high-speed compliant
- USB UAC1.0/2.0 and ADC3.0 with LPM L1 feature
- USB human interface device (HID) class 1.1 compliant
- Support USB suspend/resume/reset functions
- Support control/interrupt/isochronous data transfers
- Audio data supports up to 32-bits data length and 384K sampling rate
- Embedded 8051 MCU with internal 256KB flash
- 2-Ch DAC 122dB SNR; 1-Ch ADC 99dB SNR
- Parametric 12 bands (6+6 bands) equalizer shared for playback or record path
- Support Crystal-less and external crystal
- Supports OMTP and CTIA 4-ring combo jack auto switch and jack detection
- Support 4 in-line Google buttons headset detection
- Embedded DC/DC switching power regulator from 3.0V~5.5V to 1.8V~2.0V
- Ultra-low-power consumption design: 0.4mA @ suspend; 19mA @idle; 26mA @active
- CM6648 QFN-48 package (6.5X5mm)

BLOCK DIAGRAM



Release Notes

Revision	Date	Description
1.00	2023/06/12	Formal release

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1 Description and overview

The CM6648 is a USB 2.0 high-speed audio chip with high performance audio codec which is targeting high-end USB type-C headset, microphone and USB-to-3.5mm Jack audio device. It combines stereo DAC and mono ADC, audio interface I2S, control interface I2C, and embedded flash to provide a highly-integrated audio solution. The CM6648 also supports UAC3.0 LPM L1 and is equipped with a stereo low power cap-free Class-G headphone amplifier of 122dB SNR and 96dB THD+N performance, providing longer battery life and Hi-Fi listening experiences.

2 Package Dimension

Product	Package Marking	Package Type	Transport Media	Storage Temperature
CM6648	CM6648	48-Pin QFN (6.5mm x 5mm)	Tray	-55 to 125°C

3 Features

3.1 USB Compliance

- USB 2.0 full-speed and high-speed compliant
- USB UAC1.0/2.0 and ADC3.0 with LPM L1 feature
- USB human interface device (HID) class 1.1 compliant
- Supports USB suspend/resume/reset functions
- Supports control/interrupt/isochronous data transfers
- Audio data supports up to 32-bits data length and 384K sampling rate

3.2 Audio Paths and Interface

- Stereo DAC
 - ◆ Support 44.1K/48K/88.2K/96K/176.4K/192K/352.8K/384KHz sample rate
 - ◆ Support 16/24/32-bits data length
 - ◆ Gain range : -44 ~ 0dB, 1dB/step, -45dB is mute
- Mono ADC
 - ◆ Support 44.1K/48K/88.2K/96K/176.4K/192KHz sample rate
 - ◆ Support 16/24-bits data length
 - ◆ Gain range: 0 dB ~ 40 dB, 1 dB/step
- Side-Tone
 - ◆ Support 44.1K/48K/88.2K/96K/176.4K/192KHz sample rate
 - ◆ Support 16/24-bits data length
 - ◆ Gain range: 0 dB ~ 40 dB, 1 dB/step

3.3 Integrated 8051 Microprocessor

- Embedded 8051 microprocessor to handle comment/protocol transactions
- Embedded 256KB flash memory for firmware codes
- HID interrupts can be implemented via firmware codes
- Provides maximum HW configuration flexibility with firmware code upgrade
- VID/PID/product strings can be customized via firmware code programming

3.4 Control Interface

- I2C
 - ◆ Master I2C control interface for external audio devices access
 - ◆ Up to 1MHz clock rate

3.5 GPIOs

- GPIOs
 - ◆ Maximum of 4 GPIO pins can be configured via firmware programming
 - ◆ GPIOs could be set to HID key
 - ◆ Two of them could be programmed to PWM generator for LED dimming

3.6 General

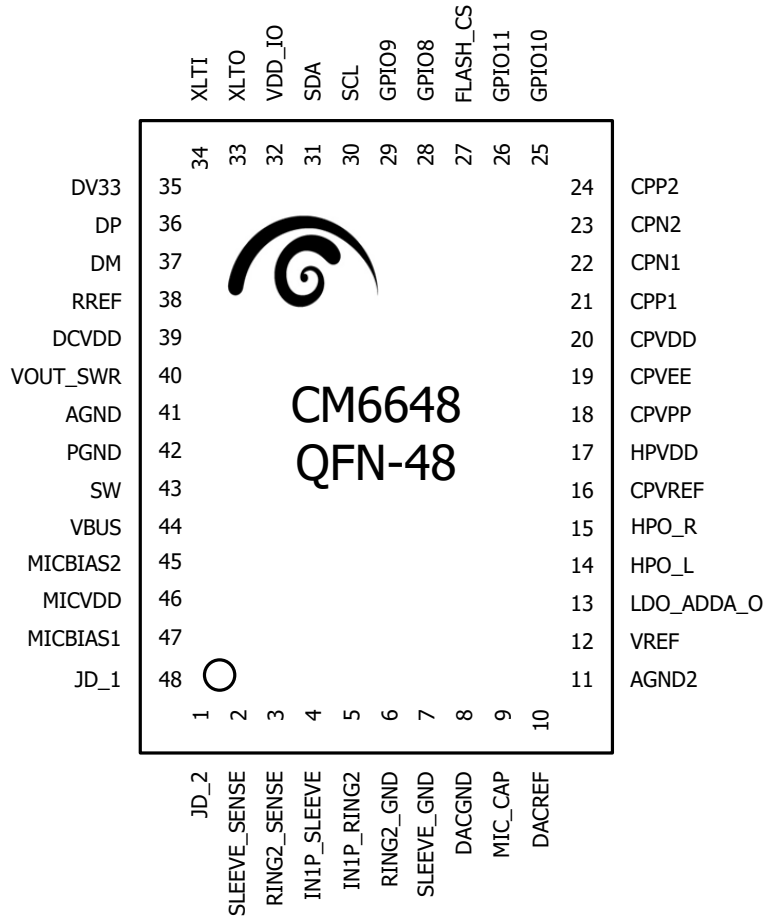
- Support Crystal-less and external crystal
- Support Jack detection Wake-up function
- Supports OMTP and CTIA 4-ring combo jack auto switch and jack detection
- Parametric 12 bands (6+6 bands) equalizer shared for playback or record path
- Embedded DC/DC switching power regulator from 3.0V-5.5V to 1.8V-2.0V

4 Applications

- High-end USB type-C headset/headphone
- High fidelity microphone
- USB-to-3.5mm jack audio applications

5 Pin Assignment

5.1 Pin-out Diagram



5.2 Pin Description

Pin	Symbol	I/O	Description	Characteristic Definition
USB 2.0 BUS Interface				
36	DP	AI	USB differential data positive	
37	DM	AI	USB differential data negative	
38	RREF	AO	External reference for USB function	6.25KOhm resistor with 1% precision is required
Power/Ground				
44	VBUS	PWRI	USB VBUS power	3.0V ~ 5.5V
40	VOUT_SWR	PWRO	DC-DC Buck converter output	1.8V ~ 2.0V
42	PGND	PGND	DC-DC Buck converter ground	
43	SW	AO	DC-DC Buck converter Switch node	
35	DV33	PWRO	LDO output	USB APHY 3.0V ~ 3.6V
32	VDD_IO	PWRO	Digital IO power	1.71V ~ 3.6V
39	DCVDD	PWRO	Digital core power	Core Power 0.9V ~ 1.9V
49	EPAD	DGND	Digital ground	
17	HPVDD	PWRI	Headphone amplifier power	1.71V ~ 1.9V
20	CPVDD	PWRI	Charge pump power	1.71V ~ 1.9V
18	CPVPP	PWRO	Charge pump positivity voltage output	
19	CPVEE	PWRO	Charge pump negative voltage output	
21	CPP1	AO	Charge pump bucket capacitor pin	
22	CPN1	AO	Charge pump bucket capacitor pin	
24	CPP2	AO	Charge pump bucket capacitor pin	
23	CPN2	AO	Charge pump bucket capacitor pin	
46	MICVDD	AO	MICBIAS power	3.0V ~ 5.5V
13	LDO_ADDA_O	PWRO	Analog power	1.71V ~ 1.9V
8	DACGND	AGND	Analog DAC ground	
41	AGND	AGND	Analog ground	
11	AGND2	AGND	Analog ground	
10	DACREF	AO	Analog DAC reference	
12	VREF	AO	Analog I/O reference	
Analog Audio Interface				
47	MICBIAS1	AO	Microphone bias output	
45	MICBIAS2	AO	Microphone bias output	
9	MIC_CAP	AI	Analog microphone input reference for combo jack mode	
14	HPO_L	AO	Headphone output left channel	

15	HPO_R	AO	Headphone output right channel	
16	CPVREF	AO	Headphone amplifier feedback reference	
2	SLEEVE_SENSE	AI	Headphone amplifier feedback reference for combo jack mode	
3	RING2_SENSE	AI	Headphone amplifier feedback reference for combo jack mode	
4	IN1P_SLEEVE	AI	Analog microphone input for combo jack mode	
5	IN1P_RING2	AI	Analog microphone input for combo jack mode	
6	RING2_GND	AGND	Reference ground for combo jack mode	
7	SLEEVE_GND	AGND	Reference ground for combo jack mode	
I2C/I2S/GPIO/JD Interface				
30	SCL	DIO	Master I ² C Serial Clock	
31	SDA	DIO	Master I ² C Serial Data	
48	JD_1	AI	Jack detection	
1	JD_2	AI	Jack detection	
28	GPIO8	DIO	PWN Generator UART receiver data GPIO function	
29	GPIO9	DIO	PWN Generator UART receiver data GPIO function	
25	GPIO10	DIO	UART request to send GPIO function	
26	GPIO11	DIO	UART clear to send GPIO function	
Others				
34	XLTI	AI	External XTAL Input	
33	XLTO	AO	External XTAL Output	
27	FLASH_CS	DI	Flash chip selection	Pull high 100k to VDD_IO

I/O Type	Description
AI	Analog Input
AO	Analog Output
AIO	Analog Input/Output
DO	Digital Output

PWRO	Power output pin
PWRI	Power input pin
PGND	Power Ground
DGND	Digital Ground
AGND	Analog Ground

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Parameter		Symbol	Min.	Typ	Max.	Unit
Power Supplies (USB Power)		VBUS	-0.3	-	7	V
Operating ambient temperature		T _A	-25	-	+85	°C
Storage temperature		T _S	-55	-	+125	°C
ESD Protection	Human Body Model (HBM)		±3500			V
	Machine model (MM)		100			V

6.2 Recommended Operation Conditions

Parameter	Symbol	Min.	Typ	Max.	Units
USB Supply Power	VBUS	4.5	5.0	5.5	V
DC-DC Buck Converter Output	VOUT_SWR	1.8	1.9	2.0	V
Microphone BIAS Power	MICVDD	3.0	3.3	5.5	V
Digital I/O Power	VDD_IO	1.71	1.8/3.3	3.6	V
LDO 3.3V output for USB APhy	DV33	3.0	3.3	3.6	V
Digital Core Power	DCVDD	0.9	1.4	1.9	V
Analog Core Power	LDO_ADDA_O	1.71	1.8	1.9	V
Charge Pump Power	CPVDD	1.71	1.8	1.9	V
HP Amplifier Power	HPVDD	1.71	1.8	1.9	V
Operating ambient temperature	-	-	25	-	°C

6.3 Power Consumption

Test Conditions: VBUS = 5.0V, AGND = 0V, T_A = +25°C, MCU Clock = 6MHz.

Sample Rate = 48kHz, 24Bits

Topology: Headphone output and Microphone input

Volume setting = Gain 0dB

Parameter	Symbol	Min.	Typ	Max.	Units
Active power consumption (Playback + Record)	-	-	35	-	mA
Active power consumption (Playback)	-	-	26	-	mA
Standby power consumption	-	-	19	-	mA
Suspend mode power consumption	-	-	0.4	-	mA

6.4 DC Characteristics

Parameter	Symbol	Min.	Typ	Max.	Units
Input Voltage Range	V _{IN}	-0.30	-	VDD_IO+0.30	V
Low Level Input Voltage	V _{IL}	-	-	0.35*VDD_IO	V
High Level Input Voltage	V _{IH}	0.65*VDD_IO	-	-	V
High Level Output Voltage	V _{OH}	0.9*VDD_IO	-	-	V
Low Level Output Voltage	V _{OL}	-	-	0.1*VDD_IO	V
Output Buffer High Drive Current	-	0.6	4	8	mA
Output Buffer Low Drive Current	-	0.7	4	8	mA

Input Buffer Pull-Up Resistor	-	55	110	270	K Ω
Input Buffer Pull-Down Resistor	-	63	130	300	K Ω

7 Audio Performance

7.1 DAC audio quality

Test Hardware Condition: CM6648_DEMOBOARD_V101 TA=25oC, Vbus=5V

Firmware rev. HS2.0-005

Test Platform: ASUS NB Intel I7-6700HQ, 16G RAM, Windows 10/64bit

Test AP: AP525

Items	Test Conditions		Test Values			Unit
			Min.	Typ.	Max.	
Full Scale Output Voltage	10KΩ loading			1000		mV
	32Ω loading			980		mV
Noise Level (1KHz)	10KΩ loading			-122.3		dBV
	32Ω loading			-122.2		dBV
THD + N -3dBFS 20Hz ~ 20KHz	10KΩ loading	44.1K/16bits		-89.7		dBrA
		48K/16bits		-90.0		dBrA
		88.2K/24bits		-95.2		dBrA
		96K/24bits		-95.99		dBrA
		176.4K/24bits		-95.2		dBrA
		192K/24bits		-95.7		dBrA
		384K/32bits		-94.0		dBrA
	32Ω loading	44.1K/16bits		-87.1		dBrA
		48K/16bits		-87.0		dBrA
		88.2K/24bits		-89.0		dBrA
		96K/24bits		-90.2		dBrA
		176.4K/24bits		-91.0		dBrA
		192K/24bits		-90.1		dBrA
		384K/32bits		-87.1		dBrA
Dynamic Range With A-Weighted, test by -60dBFS 1K sine wave	10KΩ loading	All sample rate/16bits		-100.6		dBrA
		All sample rate/24bits		-108.9		dBrA
		All sample rate/32bits		-108.7		dBrA
	32Ω loading	All sample rate/16bits		-102.5		dBrA
		All sample rate/24bits		-111.9		dBrA
		All sample rate/32bits		-105.5		dBrA
SNR (Noise level during active) With A-Weighted, test by -96dBFS 1K sine wave	10KΩ loading	All sample rate/16bits		-100.8		dBrA
		All sample rate/24bits		-122.0		dBrA
		All sample rate/32bits		-122.1		dBrA

	32Ω loading	All sample rate/16bits		-95.4		dBrA
		All sample rate/24bits		-121.8		dBrA
		All sample rate/32bits		-121.7		dBrA
Channel Separation (Cross-talk) 20Hz ~ 20KHz	10KΩ loading	44.1K/All bit depth		-115.3		dB
		48K/ All bit depth		-115.3		dB
		88.2K/ All bit depth		-118.2		dB
		96K/ All bit depth		-115.4		dB
		176.4K/All bit depth		-118.0		dB
		192K/ All bit depth		-116.4		dB
		384K/ All bit depth		-116.7		dB
	32Ω loading	44.1K/All bit depth		-94.4		dB
		48K/ All bit depth		-107.9		dB
		88.2K/ All bit depth		-94.4		dB
		96K/ All bit depth		-94.4		dB
		176.4K/All bit depth		-94.4		dB
		192K/ All bit depth		-94.4		dB
		384K/ All bit depth		-94.4		dB
Frequency Response 20Hz ~ 20KHz	10KΩ loading,	44.1K/16bits	-0.009 (20Hz)		-0.833 (20KHz)	dB (set 1K to 0)
		48K/16bits	-0.011		-0.049	dB
		88.2K/24bits	-0.033		-0.036	dB
		96K/24bits	-0.040		-0.038	dB
		176.4K/24bits	-0.127		-0.044	dB
		192K/24bits	-0.150		-0.044	dB
		384K/32bits	-0.567		-0.045	dB
	32Ω loading	44.1K/16bits	-0.009		-0.833	dB
		48K/16bits	-0.007		-0.044	dB
		88.2K/24bits	-0.032		-0.033	dB
		96K/24bits	-0.038		-0.034	dB
		176.4K/24bits	-0.126		-0.039	dB
		192K/24bits	-0.149		-0.040	dB
		384K/32bits	-0.565		-0.041	dB

7.2 ADC audio quality

Test Hardware Condition: CM6648_DEMOBOARD_V101 TA=25oC, Vbus=5V

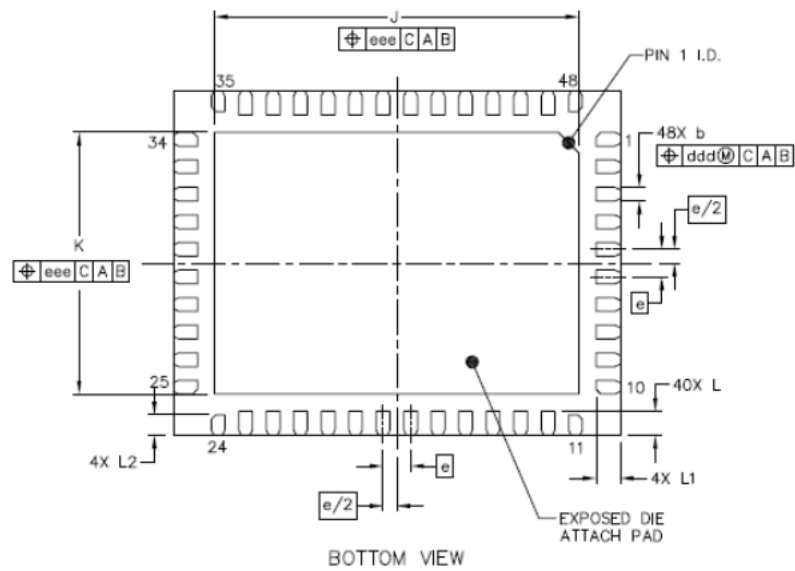
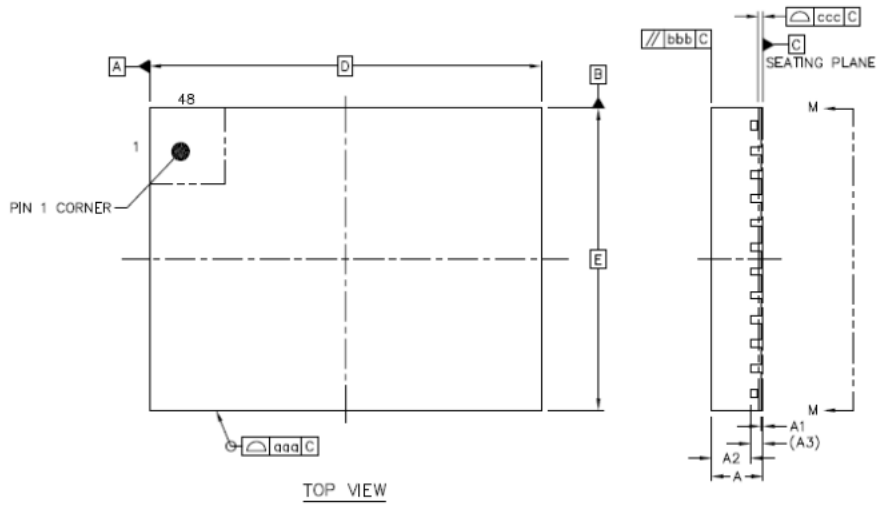
Firmware rev. HS2.0-005

Test Platform: ASUS NB Intel I7-6700HQ, 16G RAM, Windows 10/64bit

Test AP: AP525

Items	Test Conditions		Test Values			Unit
			Min.	Typ.	Max.	
Full Scale Input Voltage	BST Gain=0dB			550		mV
	BST Gain=20dB			55		mV
THD + N -3dBFS 20Hz ~ 20KHz	BST Gain=0dB	44.1K/16bits		-90.3		dBFS
		48K/16bits		-90.5		dBFS
		88.2K/24bits		-94.6		dBFS
		96K/24bits		-94.6		dBFS
		176.4K/24bits		-94.9		dBFS
		192K/24bits		-94.8		dBFS
	BST Gain=20dB	44.1K/16bits		-84.7		dBFS
		48K/16bits		-84.6		dBFS
		88.2K/24bits		-89.7		dBFS
		96K/24bits		-89.6		dBFS
		176.4K/24bits		-89.7		dBFS
		192K/24bits		-89.6		dBFS
Dynamic Range With A-Weighted, test by -60dBFS 1K sine wave	BST Gain=0dB	All sample rate/16bits		-96.9		dBFS
		All sample rate/24bits		-99.0		dBFS
	BST Gain=20dB	All sample rate/16bits		-89.9		dBFS
		All sample rate/24bits		-92.9		dBFS
SNR (Noise level during active) With A-Weighted, test by -96dBFS 1K sine wave	BST Gain=0dB	All sample rate/16bits		-96.9		dBFS
		All sample rate/24bits		-99.2		dBFS
	BST Gain=20dB	All sample rate/16bits		-90.2		dBFS
		All sample rate/24bits		-92.9		dBFS

8 Package Dimensions



	SYMBOL	MIN	NOM	MAX	
TOTAL THICKNESS	A	0.8	0.85	0.9	
STAND OFF	A1	0	0.035	0.05	
MOLD THICKNESS	A2	---	0.65	---	
L/F THICKNESS	A3		0.203 REF		
LEAD WIDTH	b	0.15	0.2	0.25	
BODY SIZE	X	D	6.5 BSC		
	Y	E	5 BSC		
LEAD PITCH	e	0.4 BSC			
EP SIZE	X	J	5.2	5.3	5.4
	Y	K	3.7	3.8	3.9
LEAD LENGTH	L	0.3	0.35	0.4	
	L1	0.25	0.35	0.4	
	L2	0.2	0.3	0.35	
PACKAGE EDGE TOLERANCE	aaa	0.1			
MOLD FLATNESS	bbb	0.1			
COPLANARITY	ccc	0.08			
LEAD OFFSET	ddd	0.1			
EXPOSED PAD OFFSET	eee	0.1			

— End of Datasheet —

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