

FAN3852

Microphone Pre-Amplifier with Digital Output

Description

The FAN3852 integrates a pre-amplifier, LDO, and ADC that converts Electret Condenser Microphone (ECM) outputs to digital Pulse Density Modulation (PDM) data streams. The pre-amplifier accepts analog signals from the ECM and drives an over-sampled sigma delta Analog-to-Digital Converter (ADC) and outputs PDM data. The PDM digital audio has the advantage of noise rejection and easy interface to mobile handset processors.

The FAN3852 features an integrated LDO and is powered from the system supply rails up to 3.63 V, with low power consumption of only 0.85 mW and less than 20 μ W in Power-Down Mode.

Features

- Optimized for Mobile Handset and Notebook PC Microphone Applications
- Accepts Input from Electret Condenser Microphones (ECM)
- Pulse Density Modulation (PDM) Output
- Standard 5-Wire Digital Interface
- Low Input Capacitance, High PSR, 20 kHz Pre-Amplifier
- Low-Power 1.5 μ A Sleep Mode
- Typical 420 μ A Supply Current
- SNR of 62 dB (A) for 16 dB Gain
- Total Harmonic Distortion 0.02%
- Input Clock Frequency Range of 1–4 MHz
- Integrated Low Drop-Out Regulator (LDO)
- Small 1.242 mm \times 0.842 mm 6-Ball, 0.400 mm pitch standard WLCSP Package
- 1.5 kV HBM ESD on MIC Input

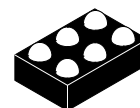
Typical Applications

- Electret Condenser Microphones with Digital Output
- Mobile Handset
- Headset Accessories
- Personal Computer (PC)

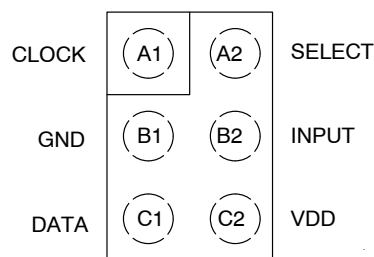


ON Semiconductor®

www.onsemi.com



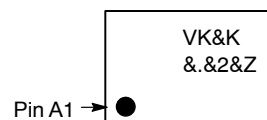
WLCSP-6
CASE 567TS



Top View

PIN CONFIGURATION

MARKING DIAGRAM



VK	= Device Identifier
K	= Lot Run Code
.	= Pin A1 Mark
2	= Date Code
Z	= Plant Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

FAN3852

ORDERING INFORMATION

Part Number	Operating Temperature Range	Package	Packing Method†
FAN3852UC16X	-40°C to 85°C	6 Ball, Wafer-Level Chip-Scale Package (WLCSP)	3000 Units/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

INTERNAL BLOCK DIAGRAM

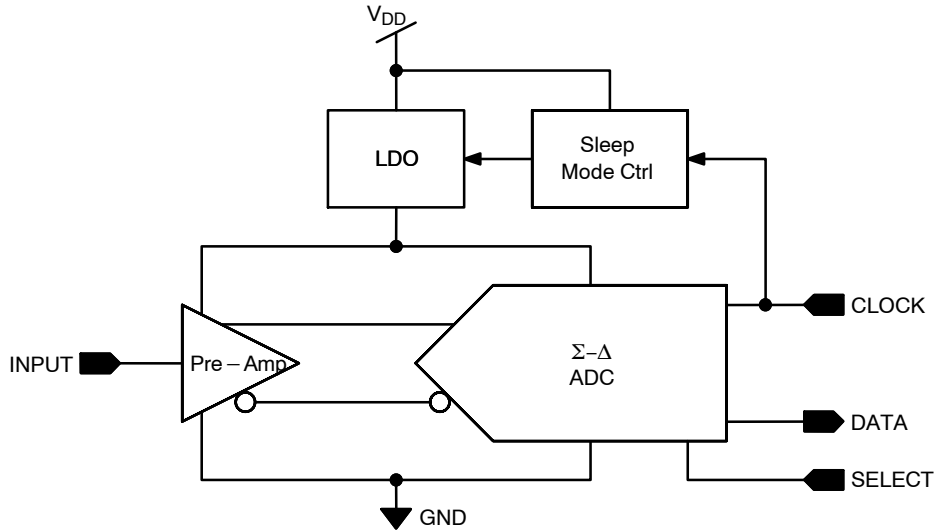


Figure 1. Block Diagram

Table 1. PIN DEFINITIONS

Pin #	Name	Type	Description
A1	CLOCK	Input	Clock Input
B1	GND	Input	Ground Pin
C1	DATA	Output	PDM Output – 1 Bit ADC
A2	SELECT	Input	Rising or Falling Clock Edge Select
B2	INPUT	Input	Microphone Input
C2	VDD	Input	Device Power Pin

Table 2. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min.	Max.	Unit
V_{DD}	DC Supply Voltage	-0.3	4.0	V
V_{IO}	Digital I/O	-0.3	$V_{DD} + 0.3$	V
	Microphone Input	-0.3	2.2	
ESD	Human Body Model, JESD22-A114, All Pins Except Microphone Input	±8		kV
	Human Body Model, JESD2-A114 – Microphone Input	±1.5		

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. This device is fabricated using CMOS technology and is therefore susceptible to damage from electrostatic discharges. Appropriate precautions must be taken during handling and storage of this device to prevent exposure to ESD.

FAN3852

Table 3. RELIABILITY INFORMATION

Symbol	Rating	Min.	Typ.	Max.	Unit
T _J	Junction Temperature			+150	°C
T _{STG}	Storage Temperature Range	-65		+125	°C
T _{RFLW}	Peak Reflow Temperature			+260	°C
θ _{JA}	Thermal Resistance, JEDEC Standard, Multilayer Test Boards, Still Air		90		°C/W

2. T_A = 25°C unless otherwise specified

Table 4. RECOMMENDED OPERATING CONDITIONS

Symbol	Rating	Min.	Typ.	Max.	Unit
T _A	Operating Temperature Range	-400		+85	°C
V _{DD}	Supply Voltage Range	1.64	1.80	3.63	V
T _{RF-CLK}	Clock Rise and Fall Time			10	ns

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Table 5. DEVICE SPECIFIC ELECTRICAL CHARACTERISTICS

Symbol	Value	FAN3852UC16X			Unit
		Min.	Typ.	Max.	
SNR	Signal-to-Noise Ratio f _{IN} = 1 kHz (1 Pa), A-Weighted		62		dB (A)
e _N	Total Input RMS Noise 20 Hz to 20 kHz, A-Weighted		5.74	6.80	μV _{RMS}
V _{IN}	Maximum Input Signal f _{IN} = 1 kHz, THD + N < 10%, Level = 0 V			448	mV _{PP}

3. Guaranteed by characterization and/or design. Not production tested.

Table 6. ELECTRICAL CHARACTERISTICS

Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V_{DD} = 1.8 V, V_{IN} = 94 dB (SPL) and f_{CLK} = 2.4 MHz.
Duty Cycle = 50% and C_{MIC} = 15 pF

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
V _{DD}	Supply Voltage Range		1.64	1.80	3.63	V
I _{DD}	Supply Current	INPUT = AC Coupled to GND, CLOCK = On, No Load		420		μA
I _{SLEEP}	Sleep Mode Current	f _{CLK} = GND		1.50	8.0	μA
PSR	Power Supply Rejection (Note 5)	INPUT = AC Coupled to GND, Test Signal on V _{DD} = 217 Hz, Square Wave and Broadband Noise (Note 4), Both 100 mV _{P-P}		-74		dBFS
IN _{NOM}	Nominal Sensitivity (Note 6)	INPUT = 94 dB SPL (1 Pa)		-26		dBFS
THD	Total Harmonic Distortion (Note 7)	f _{IN} = 1 KHz, INPUT = -26 dBFS		0.02	0.20	%
THD+N	THD and Noise (Note 5)	50 Hz ≤ f _{IN} ≤ 1 kHz, INPUT = -20 dBFS		0.2	1.0	%
		f _{IN} = 1 KHz, INPUT = -5 dBFS		1.0	5.0	
		f _{IN} = 1 KHz, INPUT = 0 dBFS		5.0	10.0	
C _{IN}	Input Capacitance (Note 8)	INPUT		1.3		pF
R _{IN}	Input Resistance (Note 8)	INPUT	>10			GΩ
V _{IL}	CLOCK & SELECT Input Logic LOW Level				0.3	V

FAN3852

Table 6. ELECTRICAL CHARACTERISTICS (continued)

Unless otherwise specified, all limits are guaranteed for $T_A = 25^\circ\text{C}$, $V_{DD} = 1.8\text{ V}$, $V_{IN} = 94\text{ dB (SPL)}$ and $f_{CLK} = 2.4\text{ MHz}$.
Duty Cycle = 50% and $C_{MIC} = 15\text{ pF}$

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
V_{IH}	CLOCK & SELECT Input Logic HIGH Level		1.5		$V_{DD}+0.3$	V
V_{OL}	Data Output Logic LOW Level				$0.35 \cdot V_{DD}$	V
V_{OH}	Data Output Logic HIGH Level		$0.65 \cdot V_{DD}$			V
V_{OUT}	Acoustic Overload Point (Note 8)	THD+N < 10%	120			dB SPL
t_A	Time from CLOCK Transition to Data becoming Valid	On Falling Edge of CLOCK, SELECT = GND, $C_{LOAD} = 15\text{ pF}$	18	43		ns
t_B	Time from CLOCK Transition to Data becoming HIGH-Z	On Rising Edge of CLOCK, SELECT = GND, $C_{LOAD} = 15\text{ pF}$	0	5	16	ns
t_A	Time from CLOCK Transition to Data becoming Valid	On Rising Edge of CLOCK, SELECT = V_{DD} , $C_{LOAD} = 15\text{ pF}$	18	58		ns
t_B	Time from CLOCK Transition to Data becoming HIGH-Z	On Falling Edge of CLOCK, SELECT = V_{DD} , $C_{LOAD} = 15\text{ pF}$	0	5	16	ns
f_{CLK}	Input CLOCK Frequency (Note 9)	Active Mode	1.0	2.4	4.0	MHz
CLK_{dc}	CLOCK Duty Cycle (Note 5)		40	50	60	%
t_{WAKEUP}	Wake-Up Time (Note 10)	$f_{CLK} = 2.4\text{ MHz}$		0.35	2.00	ms
$t_{FALLASLEAP}$	Fall-Asleep Time (Note 11)	$f_{CLK} = 2.4\text{ MHz}$	0	0.01	1.00	ms
C_{LOAD}	Load Capacitance on Data				100	pF

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Pseudo-random noise with triangular probability density function. Bandwidth up to 10 MHz.
5. Guaranteed by characterization. Not production tested.
6. Assuming that 120 dB (SPL) is mapped to 0 dBFS.
7. Assuming an input of -45 dBV.
8. Guaranteed by design. Not production tested.
9. All parameters are tested at 2.4 MHz. Frequency range guaranteed by characterization.
10. Device wakes up when $f_{CLK} \geq 300\text{ kHz}$.
11. Device falls asleep when $f_{CLK} \leq 70\text{ kHz}$.

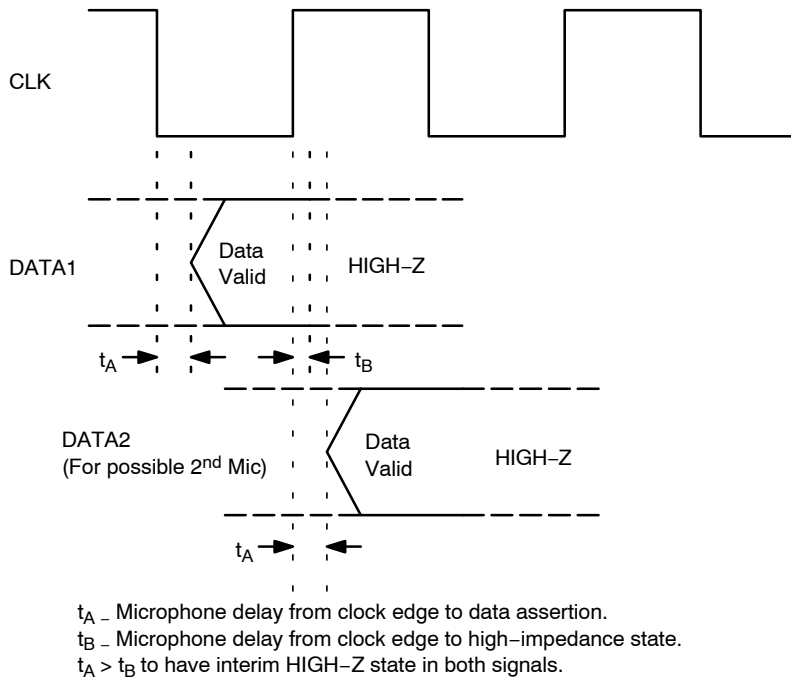


Figure 2. Interface Timing

FAN3852

TYPICAL PERFORMANCE CHARACTERISTICS

Unless otherwise specified, all limits are guaranteed for $T_A = 25^\circ\text{C}$, $V_{DD} = 1.8\text{ V}$, $V_{IN} = 94\text{ dB (SPL)}$, $f_{CLK} = 2.4\text{ MHz}$ and duty Cycle = 50%.

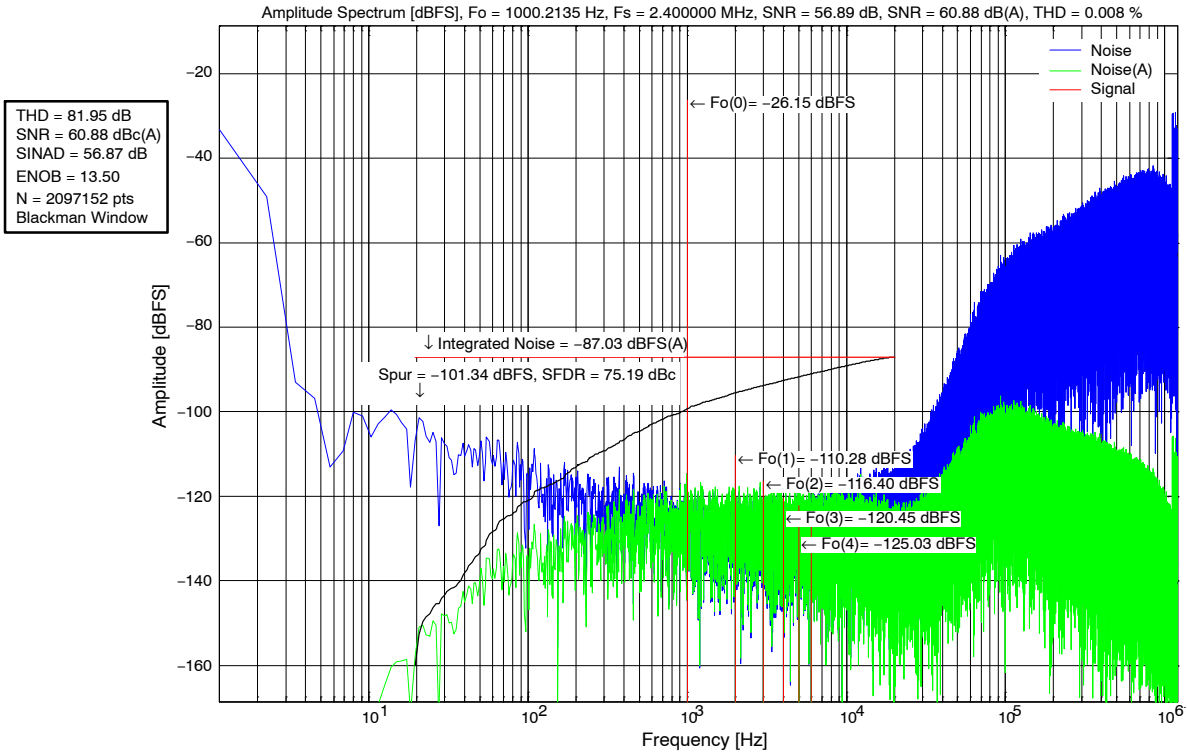


Figure 3. Noise vs. Frequency

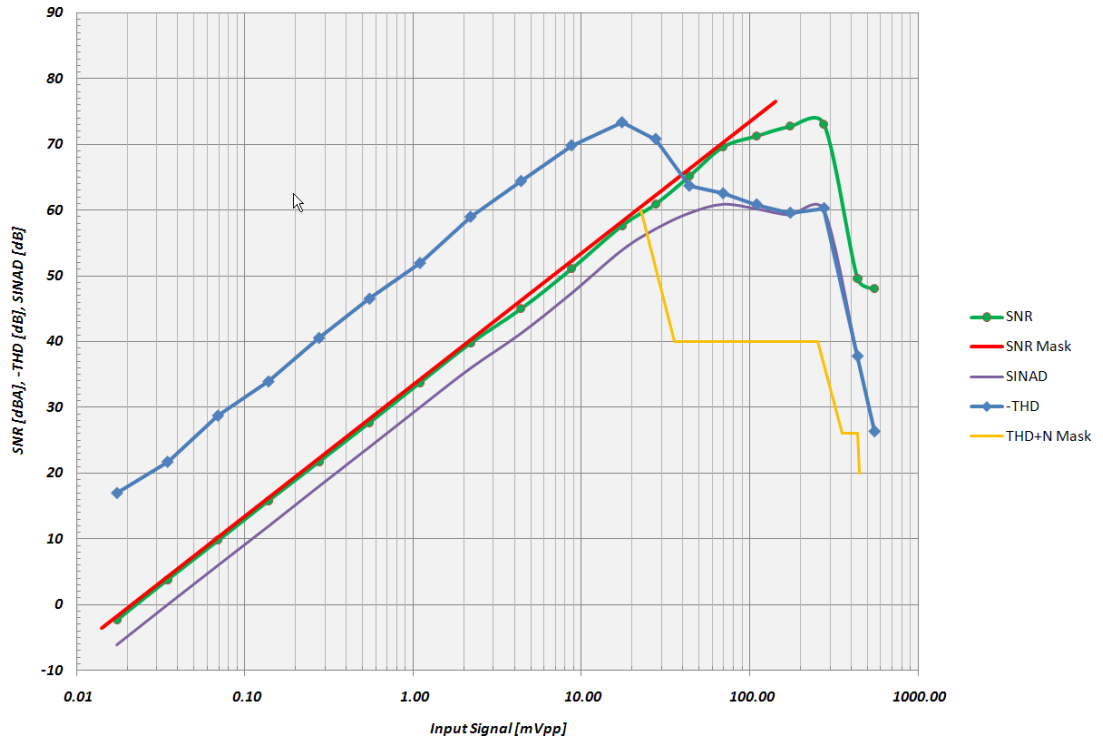


Figure 4. THD, SINDA, and SNR vs. Input Amplitude

FAN3852

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Unless otherwise specified, all limits are guaranteed for $T_A = 25^\circ\text{C}$, $V_{DD} = 1.8\text{ V}$, $V_{IN} = 94\text{ dB (SPL)}$, $f_{CLK} = 2.4\text{ MHz}$ and duty Cycle = 50%.

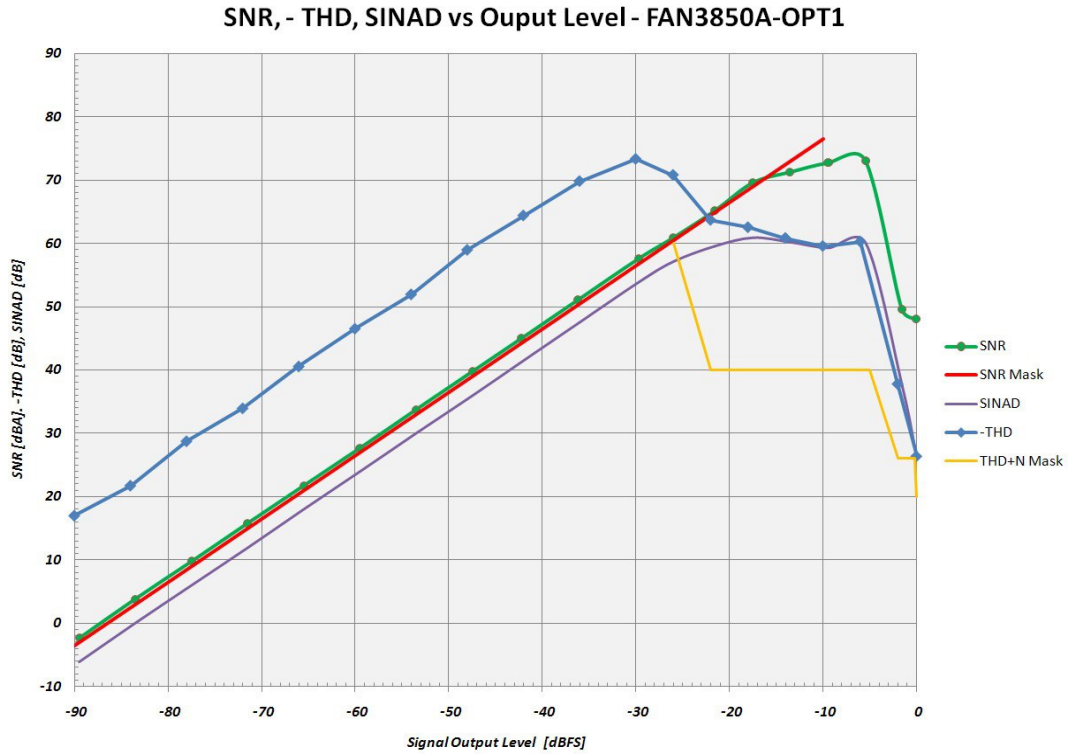


Figure 5. THD, SINAD and SNR vs. Output Level

Temp (°C)	Delta (dB)
-40	0.1971
-30	0.1644
-20	0.1260
-10	0.0954
0	0.0657
10	0.0359
20	0.0139
25	0.0000
30	-0.0097
40	-0.0344
50	-0.0514
60	-0.0739
70	-0.0998
80	-0.1183
85	-0.1271

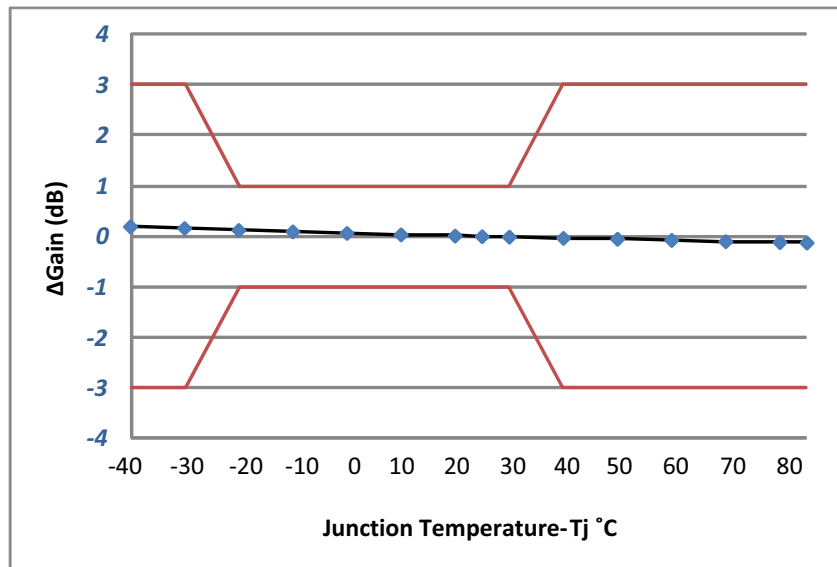


Figure 6. Δ Gain vs. Temperature (Nominal Temperature = 25°C)

APPLICATIONS INFORMATION

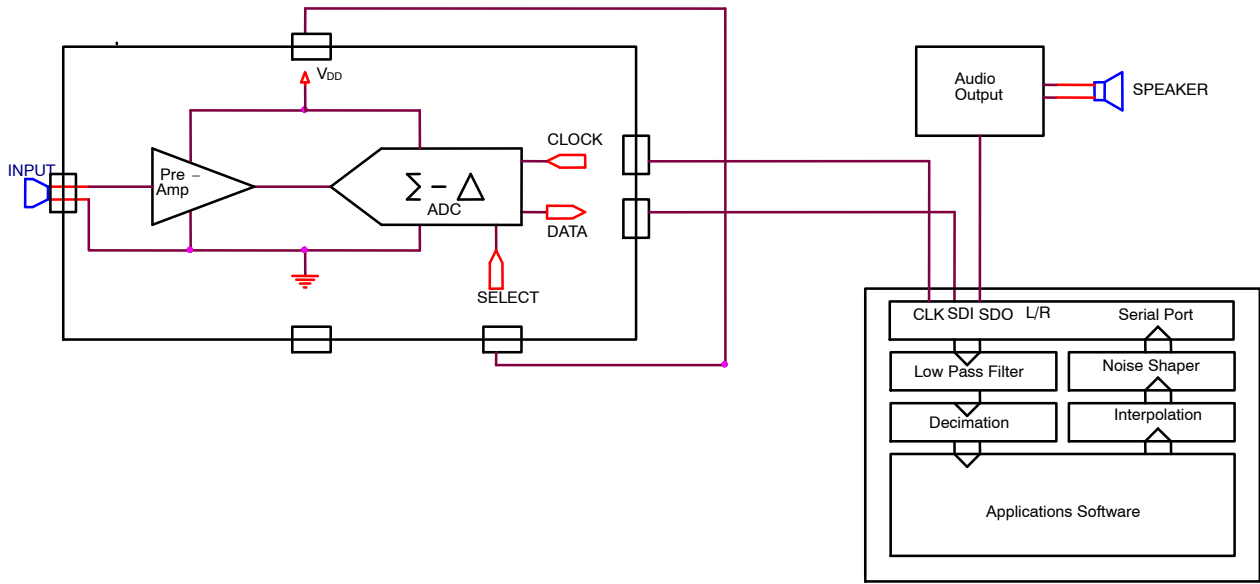


Figure 7. Mono Microphone Application Circuit

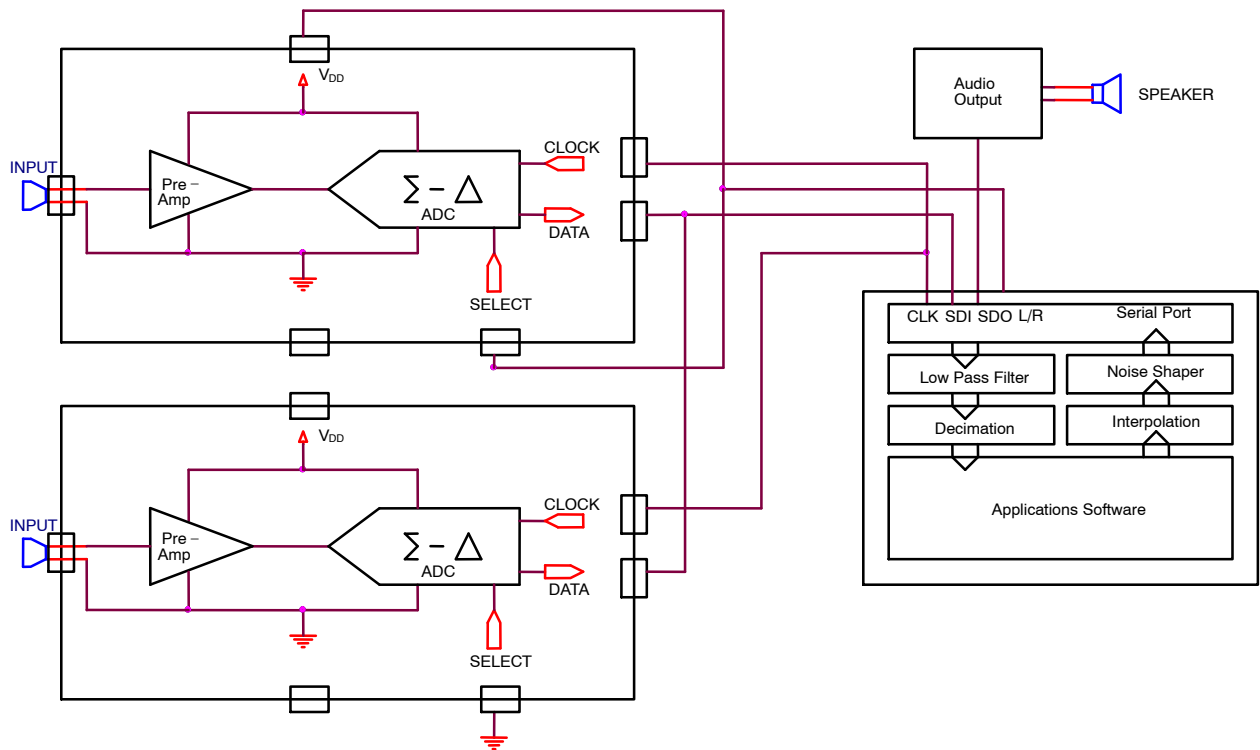


Figure 8. Stereo Microphone Application Circuit

FAN3852

APPLICATIONS INFORMATION (continued)

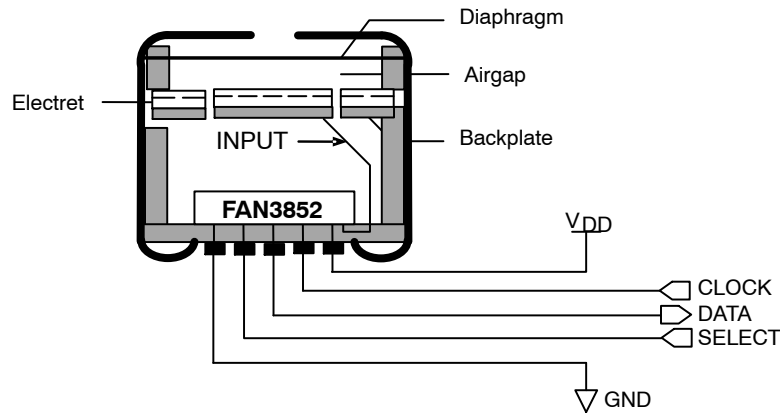


Figure 9. MIC Element Drawing

A 0.1 μF decoupling capacitor is required for VDD. It can be located inside the microphone or on the PCB very close to the VDD pin.

Due to high input impedance, care should be taken to remove all flux used during the reflow soldering process.

A 100 Ω resistance is recommended on the clock output of the device driving the FAN3852 to minimize ringing and improve signal integrity.

For optimal PSR, route a trace to the VDD pin. Do not place a VDD plane under the device.

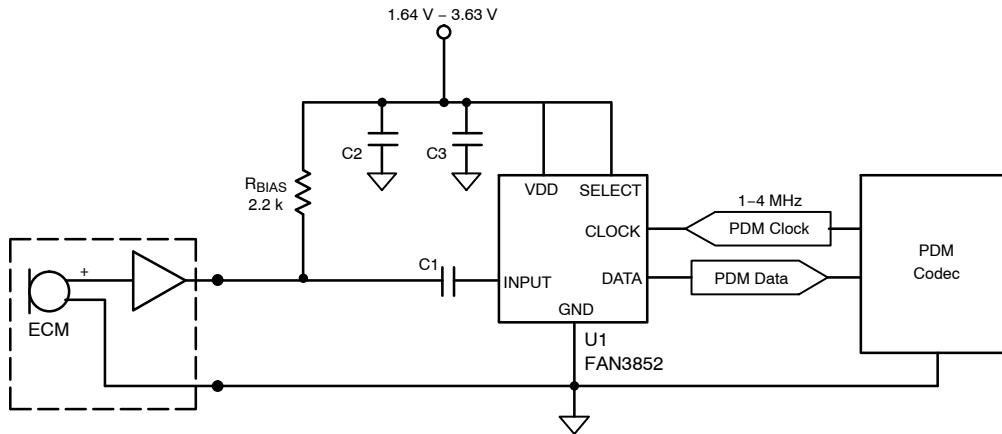


Figure 10. Example Hardware Implementation

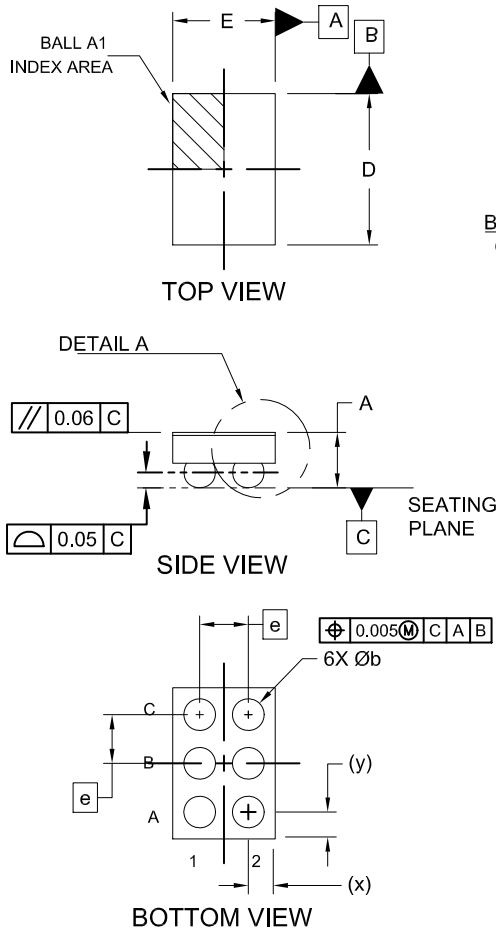
Table 7. RECOMMENDED COMPONENTS

Ref Des	Qty	Description of Options	Package	Manufacturer	Mfg PIN
U1	1	FAN3852 Microphone Pre-Amplifier with Digital Output	WLCSP6	ON Semiconductor	FAN3852UC16X
C1	1	Input AC Coupling Capacitor; 1 nF/1000 pF, ≥ 6.3 V, low-leakage	0402	Johansen Dielectrics	500R07W102KV4T
			0402	Murata	GCM155R71H102KA37D
			0603	Taiyo Yuden	UMK107SD102KA-T
C2	1	Primary VDD Decoupling Capacitor; 0.1 μF , MLCC, ≥ 6.3 V	0402	Samsung	CL05B104K05NNNC
			0402	Yageo	CC0402KRX7R7BB104
			0603	AVX	06033C104KAT4A
C3	1	Optional VDD Decoupling Capacitor; 0.01 μF , MLCC, ≥ 6.3 V	0402	Samsung	CL05B103KB5VPNC
			0402	Murata	GCM155R71H103KA55J
			0603	Yageo	CC0603KRX7R7BB103

FAN3852

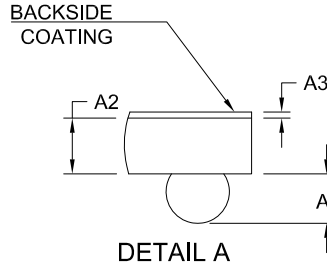
PACKAGE DIMENSIONS

WLCSP6 1.242x0.842x0.457
CASE 567TS
ISSUE A

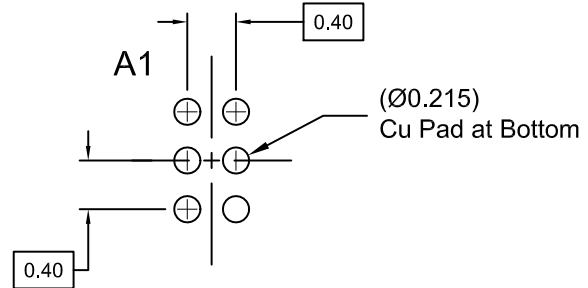


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DATUM C APPLIES TO THE SPHERICAL CROWN OF THE SOLDER BALLS



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.419	0.457	0.495
A1	0.183	0.203	0.223
A2	0.214	0.229	0.244
A3	0.022	0.025	0.028
b	0.24	0.26	0.28
D	1.212	1.242	1.272
E	0.812	0.842	0.872
e	0.40 BSC		
x	0.206	0.221	0.236
y	0.206	0.221	0.236



RECOMMENDED MOUNTING FOOTPRINT* (NSMD PAD TYPE)

* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
 Literature Distribution Center for ON Semiconductor
 19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
 USA/Canada
Europe, Middle East and Africa Technical Support:
 Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.