Audio Amplifier
ISD8104
DataSheet

ISD8104 - Differential Input Pair

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

1 GENERAL DESCRIPTION

ISD8104 is a general purpose analog audio amplifier, capable of driving a 4Ω load with up to 2Wrms output power. This device includes output current limiting, chip enable, low standby current and excellent pop-and-click suppression.

Also included is the ability to configure the input as differential. Internal resistors set the device to have default 20dB gain, and with external resistors any gain less than this can be achieved. The device is unity gain stable, including use with external feedback resistors and external capacitors as may be optionally used for implementing simple filtering functions.

ISD8104:

The ISD8104 has differential inputs VIP & VIN which can be configured to accept either single ended or differential signals. CE pin controls the general chip function.

2 FEATURES

- Wide power supply range and excellent standby current
  - o 2.0Vdc – 5.5Vdc operation
  - o <1uA standby current
- High output power (cap-less BTL configuration)
  - o Up to 2W output into 4Ω load (<10% distortion) with 5.5Vdc supply voltage
  - o < 0.1% distortion at 600mW into 8-ohms with 5Vdc supply voltage
- Excellent pop-and-click performance
  - o Low to inaudible pop/click using Chip Enable
- Single-Ended or Differential signal inputs
  - o > 75dB common mode rejection in differential mode
  - o > 70dB power supply noise rejection
- Very fast start-up time
  - o Less than 1msec when using Chip Enable
- Current limiting for over-current conditions
- Package options:
- DIE, SOP-8 (thermal pad)
- Less BOM cost / Easy PCB layout
- Temperature Range: -40°C ~ +85°C
- Package is Halogen-free, RoHS-compliant and TSCA-compliant

Applications:

- Toys
- Feature Phones
- Portable Game Consoles
- GPS
- Portable Speakers
- Boom Box
- White Goods

3 BLOCK DIAGRAM

3.1 ISD8104 WITH DIFFERENTIAL INPUTS

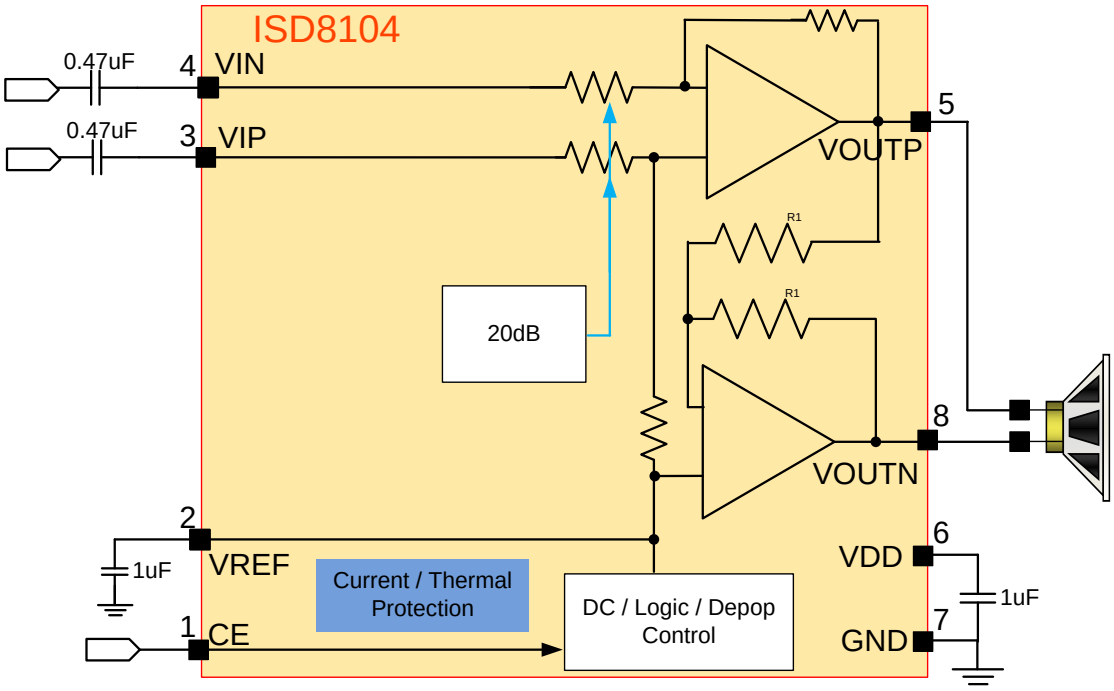


Figure 3-2 ISD8104 Differential Input Pair Block Diagram

4 PINOUT CONFIGURATION: SOP- 8

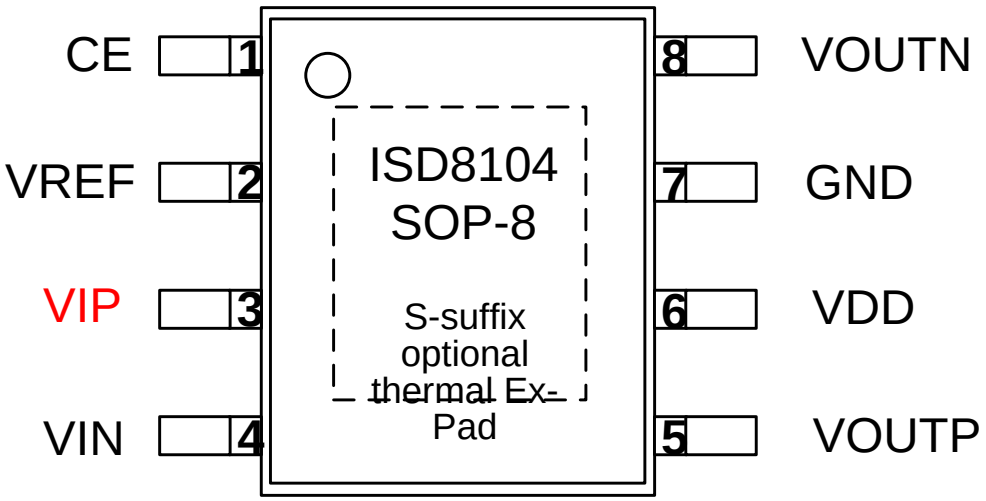


Figure 4-1 ISD8104 8-Lead SOP Pin Configuration

5 PIN DESCRIPTION

Pin Number	Pin Name	I/O	Function
1	CE	I	Chip Enable (High = Chip Power Up / Low = Chip Power Down)
2	VREF	O	Internal Reference Voltage (1/2 V_{DD})
3	VIP	I	Non-Inverting Signal Input
4	VIN	I	Inverting Signal Input
5	VOUTP	O	Non-Inverting Speaker Output
6	VDD	I	Supply Voltage
7	GND	I	Ground
8	VOUTN	O	Inverting Speaker Output
9	Ex-Pad	I	Thermal Tab (must be connected to Vss, SOP-8 package, only)

Table 5-1 ISD8104 8-Lead SOP Pin Description

6 ELECTRICAL CHARACTERISTICS

6.1 OPERATING CONDITIONS

OPERATING CONDITIONS (DIE)

CONDITIONS	VALUES
Operating temperature range [1]	-40°C to +85°C
Supply voltage (V_{DD})	+2.0V to +6.8V
Ground voltage (V_{SS})	0V
Input voltage (V_{DD})	Vss to V_{DD}
Voltage applied to any pins	(V_{SS} – 0.3V) to (V_{DD} + 0.3V)

OPERATING CONDITIONS (INDUSTRIAL PACKAGED PARTS)

CONDITIONS	VALUES
Operating temperature range (Case temperature) [1]	-40°C to +85°C
Supply voltage (V_{DD})	+2.0V to +6.8V
Ground voltage (V_{SS})	0V
Input voltage (V_{DD})	Vss to V_{DD}
Voltage applied to any pins	(V_{SS} – 0.3V) to (V_{DD} + 0.3V)

Notes: [1] Conditions V_{DD}=5V, T_A=25°C unless otherwise stated. Die temperature must at all times be kept less than 125°C by appropriate thermal design of the system.

6.2 DC PARAMETERS

PARAMETER	SYMBOL	MIN	TYP [1]	MAX	UNITS	CONDITIONS
Supply Voltage	V_{DD}	2.0		6.8	V	
Operating Current	I_{DD}		2.6		mA	V_{DD}= 5V, no load
Standby Current	I_{SB}		0.1	1	µA	V_{DD}= 5V
CE input resistance			20k		Ω	Internal pull-down @ 0dB
CE input current			120		µA	CE=2.3V, V_{DD}= 5V
CE threshold enabled	V_{ENL}		0.9		V	All supply voltages
CE threshold standby	V_{ENH}		1.5		V	All supply voltages
VREF Reference Voltage			V_{DD}/2		V	

Notes: [1] Conditions V_{DD}=5V, T_A=25°C unless otherwise stated. Die temperature must at all times be kept less than 125°C by appropriate thermal design of the system.

6.3 AC PARAMETERS

6.3.1 Analog Characteristics; Cref = 1uF / Cv_{DD} = 1uF

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	CONDITIONS
Input Voltage Range			0.3 – 6.5		V	V_{DD} = 6.8Vdc
			0.3 – 3.4		V	V_{DD} = 3.7Vdc
			0.3 - 1.7		V	V_{DD} = 2.0Vdc
Inverting Input Impedance			2kΩ			Gain = 20dB
Non-Inverting Input Impedance			22kΩ			Gain = 20dB
Power Supply Rejection Ratio	PSRR		75		dB	V_{DD} = 5Vdc
Common Mode Rejection Ratio	CMRR		70		dB	Signal at INP = INV
Voltage Gain			20		dB	Rinput = 0 Ω
Enable Time from Standby			0.5		msec	Single-ended
Enable Time from Standby			0.5		msec	Differential
Pop-and-Click from Standby [1]			10		mV	Single Ended
Pop-and-Click from Standby [1]			10		mV	Differential
Thermal Resistance			60		°C/W	SOP-8 (with Ex-Pad)
Thermal Resistance			150		°C/W	SOP-8

Notes: [1] Impulse voltage that is potentially audible. After impulse, there is a slow ramp from standby Vref to operating Vref, which is typically inaudible with Cref = 1uF

6.3.2 Speaker Outputs

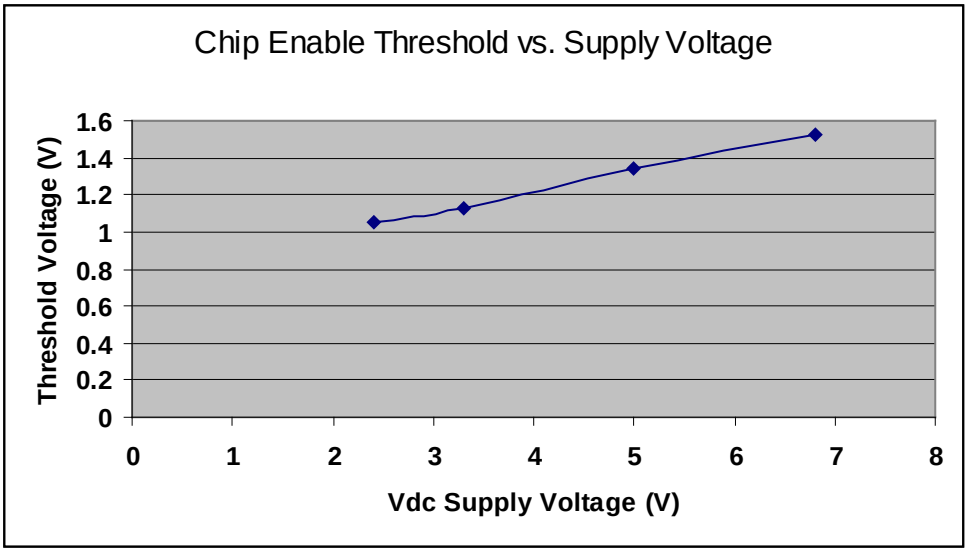
PARAMETER	SYMBOL	MIN	TYP[1]	MAX	UNITS	CONDITIONS
Signal-to-Noise Ratio	SNR		100		dB	0dB gain, 5Vdc
Load Impedance	$R_{L(SPK)}$		4		Ω	
Output Offset Voltage			8		mV	

PARAMETER	SYMBOL	MIN	TYP[1]	MAX	UNITS	CONDITIONS (THD+N)
Output Power (BTL mode)	P_{BTL}		600		mW	<0.1% distortion
Load 4Ω	P_{BTL}		1600		mW	<1% distortion
V_{DD}=5 Vdc / 0dB gain	P_{BTL}		2000		mW	<10% distortion

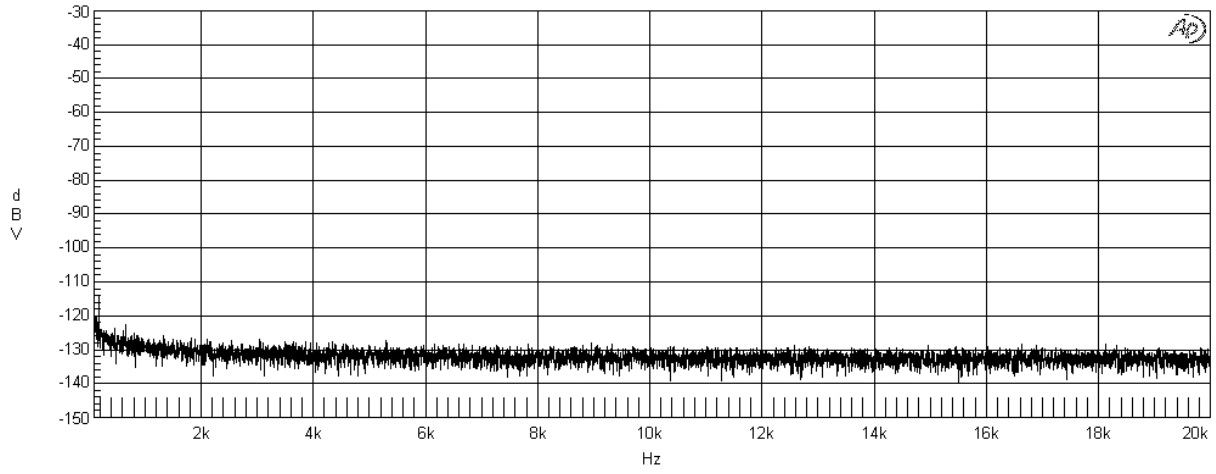
PARAMETER	SYMBOL	MIN	TYP[1]	MAX	Units	Conditions (THD+N)
Output Power (BTL mode)	P_{BTL}		600		mW	<0.1% distortion
Load 8Ω	P_{BTL}		1200		mW	<1% distortion
V_{DD}=5 Vdc / 0dB gain	P_{BTL}		1400		mW	<10% distortion

Notes: [1] Conditions V_{DD}=5V, T_A=25°C unless otherwise stated. Die temperature must at all times be kept less than 125°C by thermal design of the system.

6.3.3 Chip Enable Threshold Voltage

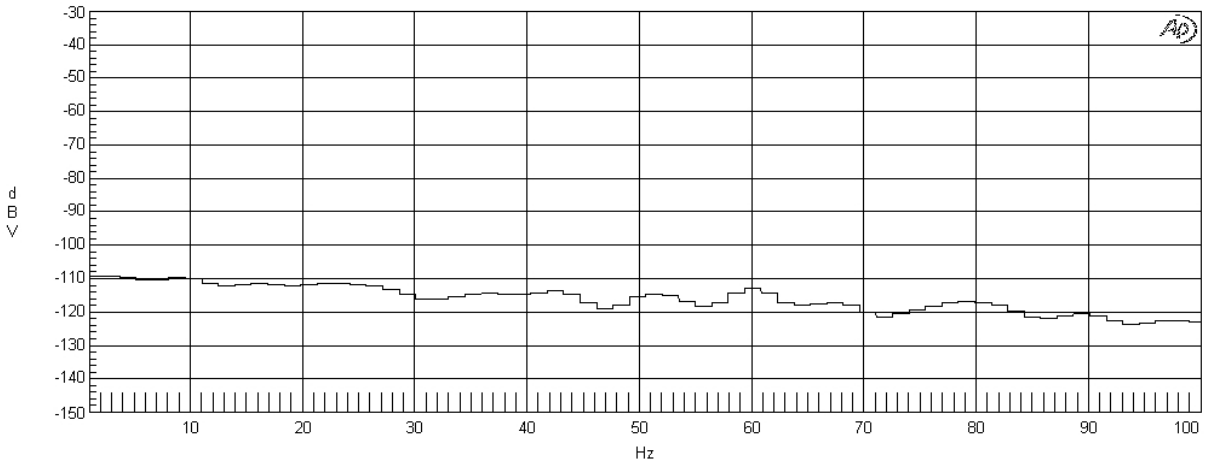


6.3.4 Output Noise Spectrum



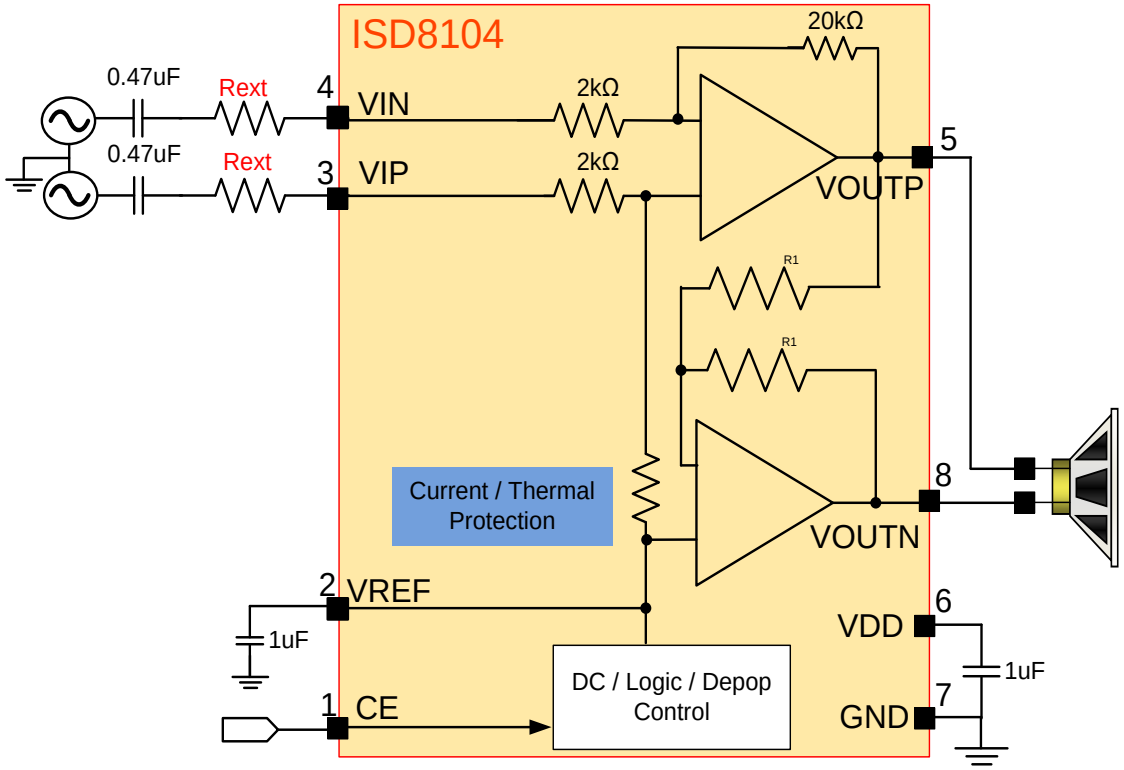
Noise spectrum at Vdd = 5.0Vdc, Gain = 0dB, BW<22kHz

Noise Spectrum at Vdd = 5.0Vdc, Gain = 20dB, BW<22kHz



7 APPLICATION

7.1 GAIN SETTING – ISD8104



Differential Output Gain (VOUTP – VOUTN) =

$$2 \times \frac{20k\Omega}{2k\Omega + Rext}$$

By default: Rext = 0Ω,

ISD8104 Differential Output Gain = 20

ISD8104 Differential Output Gain (in dB) = 20 x log (20) = 26dB

Example: Rext = 18kΩ

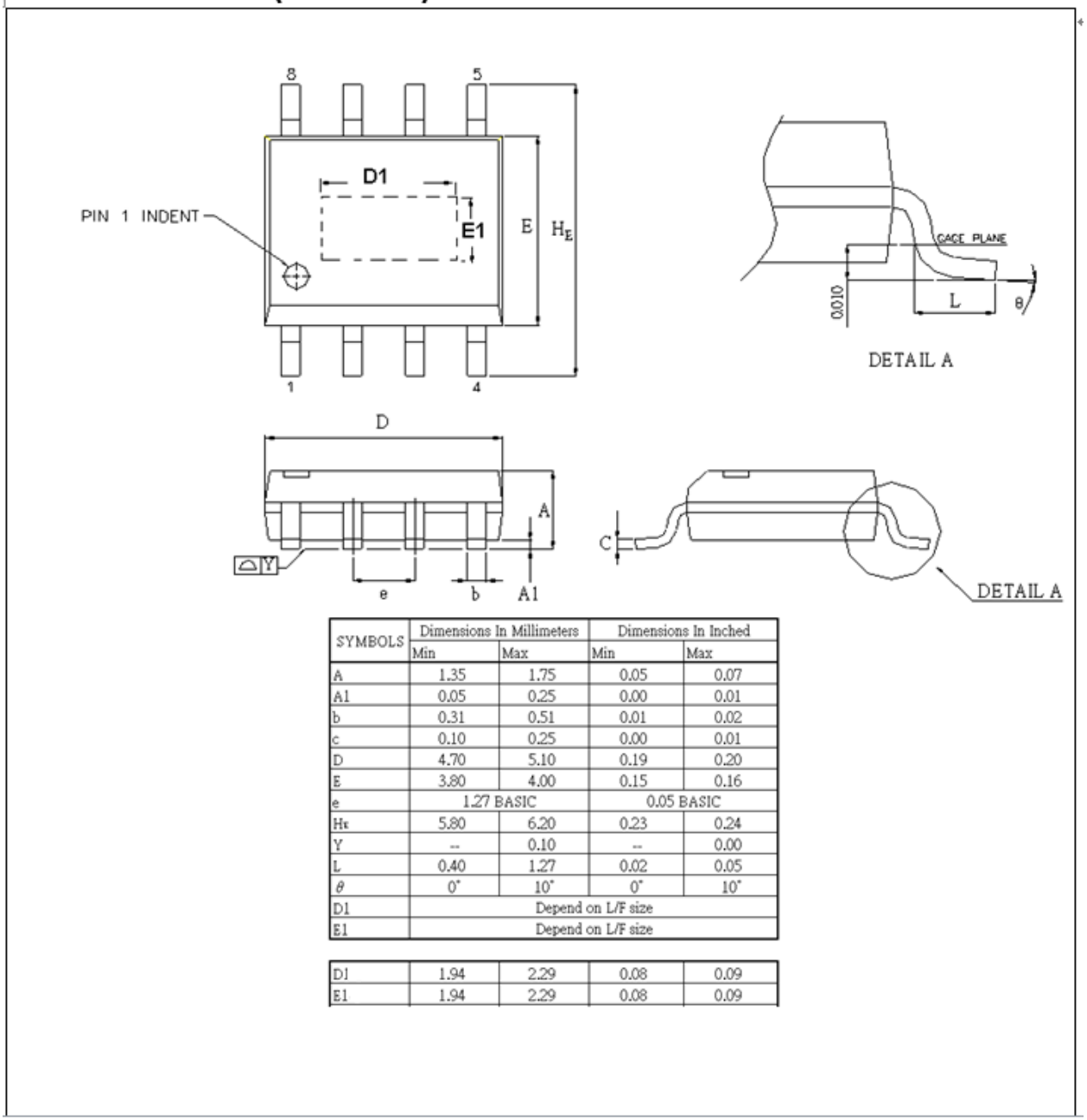
ISD8104 Differential Output Gain = 2

ISD8104 Differential Output Gain (in dB) = 20 x log (2) = 6dB

8 PACKAGE SPECIFICATION

8.1 SOP- 8 (THERMAL EX-PAD)

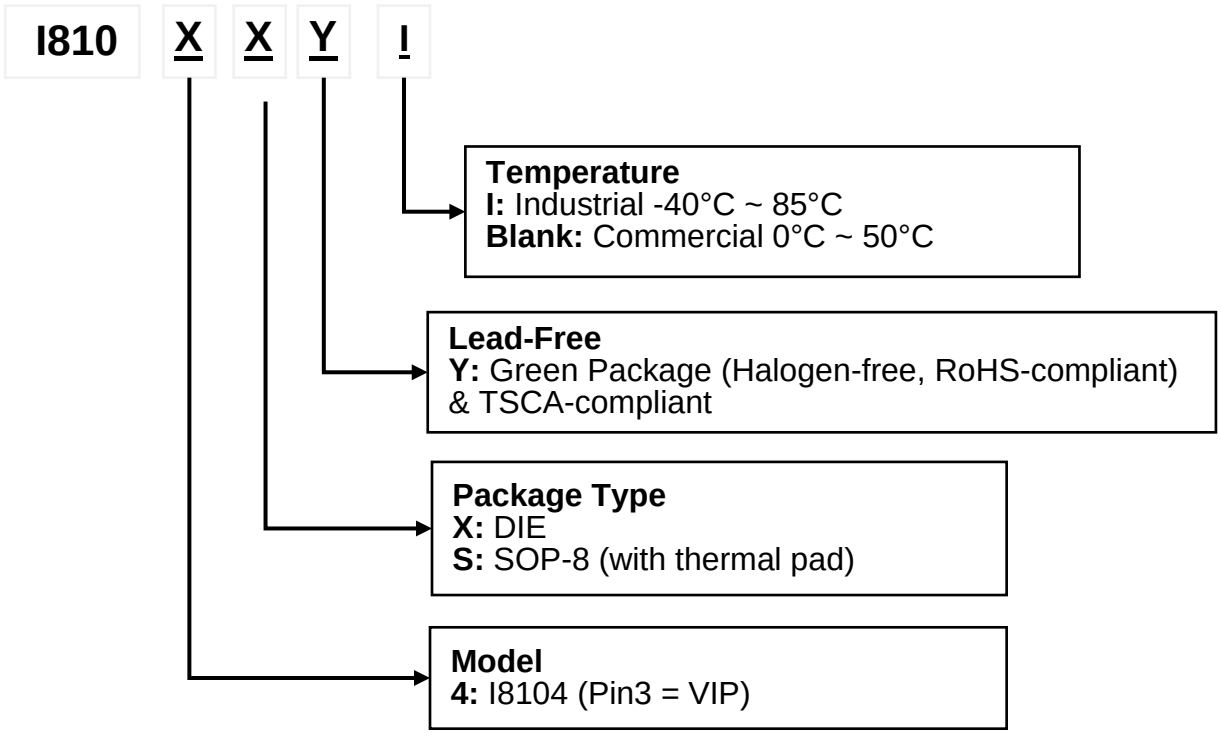
8L SOP-150mil (EX-PAD)



SYMBOLS	Dimensions In Millimeters		Dimensions In Inched	
	Min	Max	Min	Max
A	1.35	1.75	0.05	0.07
A1	0.05	0.25	0.00	0.01
b	0.31	0.51	0.01	0.02
c	0.10	0.25	0.00	0.01
D	4.70	5.10	0.19	0.20
E	3.80	4.00	0.15	0.16
e	1.27 BASIC		0.05 BASIC	
H_E	5.80	6.20	0.23	0.24
Y	--	0.10	--	0.00
L	0.40	1.27	0.02	0.05
θ	0°	10°	0°	10°
D1	Depend on L/F size			
E1	Depend on L/F size			

D1	1.94	2.29	0.08	0.09
E1	1.94	2.29	0.08	0.09

9 ORDERING INFORMATION



Part Number	Package	Temperature	Notes
I8104X	DIE	0°C ~ 50°C	
I8104SYI	SOP-8 (Thermal Pad)	-40°C ~ 85°C	

10 REVISION HISTORY

REVISION	DATE	DESCRIPTION
1.0	Apr 11, 2022	Initial Release
1.1	Feb 1, 2023	Update Halogen-free, RoHS-compliant and TSCA-compliant description

IMPORTANT NOTICE

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.