

Description

The Voice Extreme™ IC (VE-IC), from the Interactive Speech™ family of products, is an 8-bit microcontroller designed specifically for speech applications in consumer electronic products.

Combined with a 2MB external flash memory, the VE-IC offers the flexibility of a microcontroller with advanced speech technology, including high-quality speech recognition, speech and music synthesis, speaker verification, and voice record and playback. Products can use one or all of the VE-IC features in a single application.

The VE-IC supports Sensory Speech™ 6, the latest speech recognition technology from Sensory, which includes a number of new techniques that significantly improve recognition performance over previous versions. Using sophisticated neural network technology, on-chip speech recognition algorithms reach an accuracy of greater than 97% for speaker-independent recognition and greater than 99% for speaker-dependent recognition.

The VE-IC can be purchased in DIE or TQFP packages, or fully assembled as a part of the *VE Module*. A low-cost development system, the *VE Toolkit*, contains all software and hardware to create voice activated products.

Features

Full Range of Sensory Speech™ 6 Capabilities

- ▶ Speaker-independent speech recognition
- ▶ Speaker-dependent speech recognition
- ▶ High quality speech synthesis and sound effects
- ▶ Speaker verification
- ▶ Three-voice music synthesis
- ▶ Voice record & playback

Integrated Single-Chip Solution

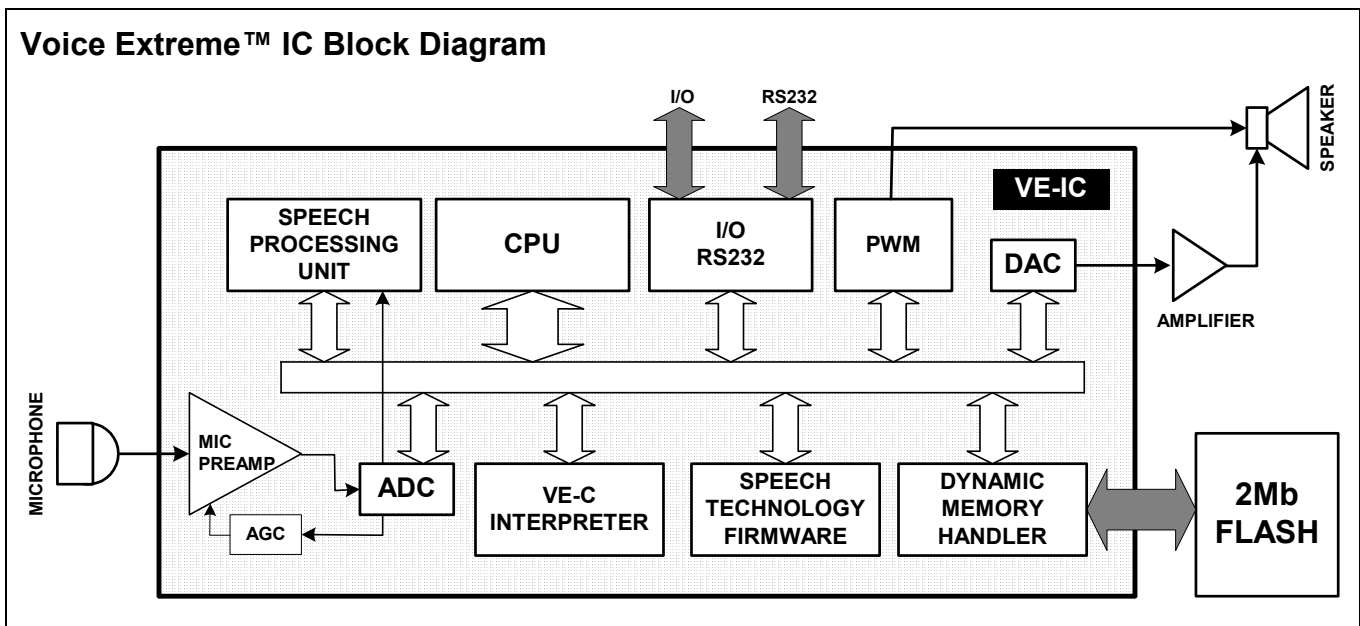
- ▶ 4 MIPS 8-bit microcontroller
- ▶ On-chip A/D and D/A converters, pre-amplifier, and AGC
- ▶ 32kHz clock for time keeping (DIE package only)
- ▶ Secondary Timer 2
- ▶ 14 I/O lines
- ▶ RS-232 serial interface (uses three I/O)
- ▶ 16-bit external memory bus
- ▶ 24x24 Multiplier for rapid recognition processing

Low Power Requirements

- ▶ 2.85 – 5.25V operation
- ▶ ~10mA operating current at 3V
- ▶ Power down mode; <5 µA standby current

The Voice Extreme™ System

- ▶ Built-in VE-C Interpreter (a subset of ANSI-C)
- ▶ Built-in Dynamic Memory Handler
- ▶ Built-in Speech Technology Firmware



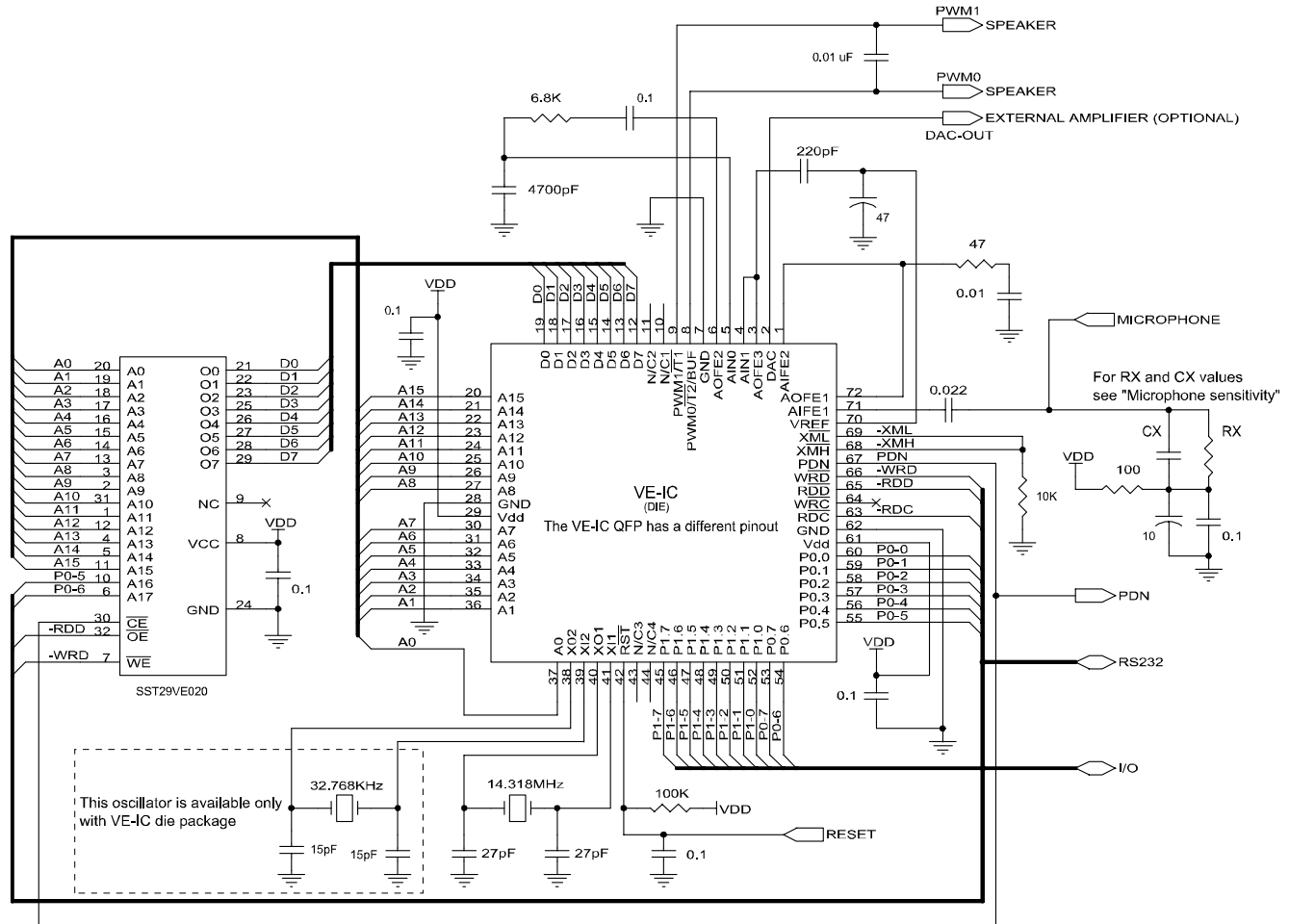
Using the VE-IC

Creating applications using the VE-IC requires the development of electronic circuitry, software code, and speech/music data files.

Software code for the VE-IC can be developed using the VE-C Language (a subset of ANSI-C). The Voice Extreme™ IDE offers a friendly environment for developing Voice Extreme™. For more information about the Voice Extreme™ development tools, please contact Sensory or Visit the web site www.voice-extreme.com.

The following sample circuit provides an example of how the VE-IC might be used in a consumer electronic product.

Sample Application Circuit (Die)



Microphone Sensitivity

RX determine the microphone sensitivity, by default the microphone gain is pre-set to a level suitable for arms-length user interfaces with a 2.2K resistor at RX and 4.7nF capacitor at CX. If a different microphone gain is desired, select the values of RX and CX from the table below:

R4	C28	Microphone Note
1K	10nF	Close range or headset
1.5K	6.8nF	
2.2K	4.7nF	
2.7K	3.3nF	Arms length
3.9K	2.7nF	
4.7K	2.2nF	Distance

2Mbit Flash Memory

This memory is required on the VE-IC and all VE applications. Because of the powerful dynamic memory handler of VE system software, this Flash is designed to store the application code, speaker independent weight sets, speech templates, record and playback data, program data, and music data.

These are the 2Mbit flash supported (for further information please refer to manufacturer documentation):

Manufacturer	+5 V _{dd}	+3 V _{dd}
SST	29EE020	29LE020 29LV020
WINBOND	29C020	29V020

4X5 Matrix Keypad Support

The VE-IC supports a 4x5 keypad that can be controlled using functions built into the VE-C language.

When the keypad is scanned, the columns are driven (active low), the rows are sensed (pulled high) and all previous configuration and output values for these pins are saved and restored.

The keypad I/O pinouts are as follows:

	P0.4	P1.4	P0.7	P1.7	P0.3
P0.2	1	2	3	A	E
P1.2	4	5	6	B	F
P0.5	7	8	9	C	G
P1.5	*	0	#	D	H

General Purpose I/O

The VE Module has 14 general-purpose I/O pins. Each line can be programmed as an input with a weak pull-up resistor (~150k ohm), input with a strong pull-up resistor (~10k ohm), input without pull-ups, or as an output.

Note:

If an application is stand-alone (once you download the program via asynchronous serial I/O), the two serial I/O pins, **P0.0** and **P0.1**, and the serial port enable, **P1.7**, may be used for other purposes.

Since I/O pins **P0.5** and **P0.6** are connected to the address bus of the Flash memory, they can be used only for the matrix keypad; they should not be used under any other circumstances since they are allocated as Flash address lines.

Power

The typical operating current is 10 mA operating at 14.32 MHz and 3V. Lowering clock frequency reduces power consumption, although speech recognition requires a 14.32 MHz clock. Standby current is <5μA in power down mode.

Oscillators

Two independent oscillators in the VE-IC provide a high-frequency clock and a 32kHz time-keeping clock. Both oscillators work with an external crystal, a ceramic resonator or LC.

The oscillator characteristics are:

	Oscillator #1	Oscillator #2
Pins	XI1 and XO1	XI2 and XO2
Frequency	14.32 MHz	32768 Hz
Notes		Available only with DIE package

Clock

The VE-IC uses a fully static core – the processor can be stopped (by removing the clock source) and restarted without causing a reset or losing contents of internal registers. Static operation is guaranteed from DC to 14.32 MHz.

Preamplifier

The on-chip preamplifier circuit consists of three stages with a maximum overall gain of about 500. The amplifier includes a Vref input that is used to set the amplifier center voltages and must be driven by a low impedance voltage supplied by an external source. The signal inputs of all stages have an 80 KΩ input impedance to the Vref pad. In a typical design, AOFE1 would be directly coupled to AIFE2, and AOFE2 would be capacitively

coupled to AIN0 through an RC lowpass filter to remove DC offset and digital noise. AOFE3 would be bypassed to Vref with a small (220pF) capacitor for additional noise suppression.

Analog output

The VE-IC offers two separate options for analog output. The DAC (Digital to Analog Converter) output provides a general-purpose 10-bit analog output that may be used for speech output (with the inclusion of an audio amplifier), or other purposes requiring an analog waveform.

For speech applications that require driving a small speaker, the PWM (Pulse-Width Modulator) output can be used instead of the DAC output. The PWM output can directly drive a 32 ohm speaker.

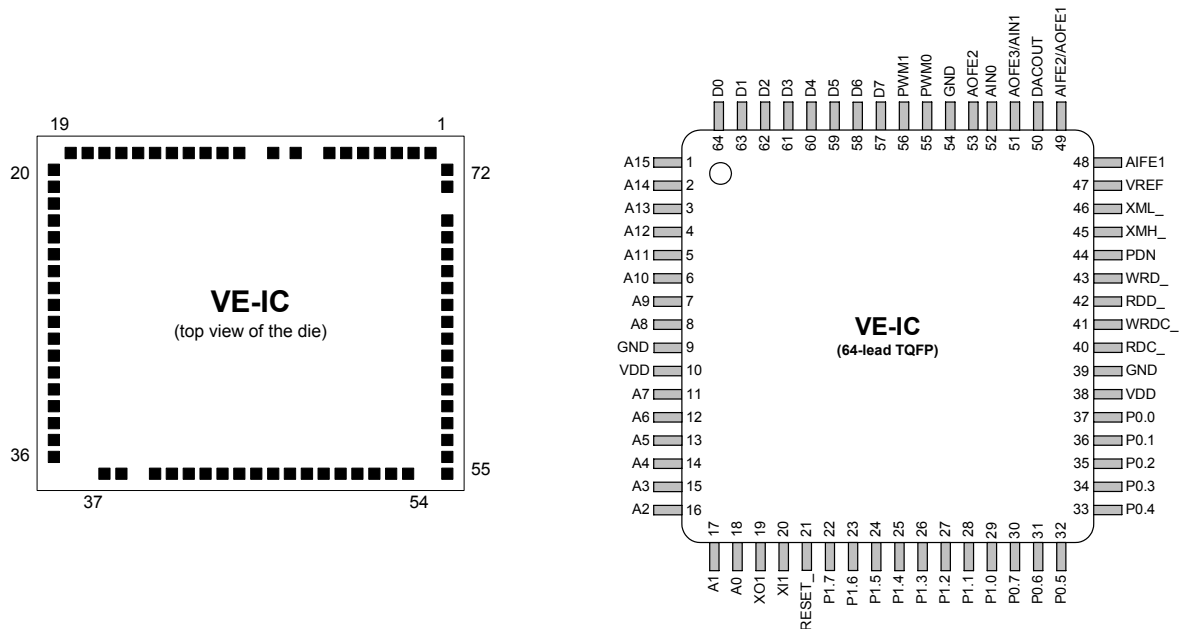
Serial (RS-232) Communication

Serial communication at the *application* level in Voice Extreme™ are always performed at **9600** baud, **8** data bits, **no** parity, **1** stop bit (the download operation runs at 115Kbaud).

If an application is stand-alone (once you download the program via asynchronous serial I/O), the two serial I/O pins, **P0.0** and **P0.1**, and the serial port enable, **P1.7**, may be used for other purposes.

Packaging

The RSC-300/364 can be purchased as unpackaged die or a 64-pin TQFP package.



DIE Pad	Name	QFP Pin	Description	I/O
1	AIFE2	49	Input of 2 nd stage of preamplifier	I
2	DACOUT	50	Analog Output (unbuffered).	O
3	AOFE3	51	Output of 3 rd stage of preamplifier	O
4	AIN1	51	Analog In, hi gain (8X input amplitude of AIN0, same range)	I
5	AIN0	52	Analog In, low gain (range AGND to AVDD/2.)	I
6	AOFE2	53	Output of 2 nd stage of preamplifier	O
7	GND	9	Ground	-
8	PWM0	55	Pulse Width Modulator Output 0	O
9	TE1_ or PWM1	56	Test Mode or Pulse Width Modulator Output1 (multiplexed)	I or O
10	NC	-	Not Connected	-
11	NC	-	Not Connected	-
12	D7	57	External Data Bus D7	I/O
13	D6	58	External Data Bus D6	I/O
14	D5	59	External Data Bus D5	I/O
15	D4	60	External Data Bus D4	I/O
16	D3	61	External Data Bus D3	I/O
17	D2	62	External Data Bus D2	I/O
18	D1	63	External Data Bus D1	I/O
19	D0	64	External Data Bus D0	I/O
20	A15	1	External Memory Address Bus A15	O
21	A14	2	External Memory Address Bus A14	O
22	A13	3	External Memory Address Bus A13	O
23	A12	4	External Memory Address Bus A12	O
24	A11	5	External Memory Address Bus A11	O
25	A10	6	External Memory Address Bus A10	O
26	A9	7	External Memory Address Bus A9	O
27	A8	8	External Memory Address Bus A8	O
28	GND	39	Ground	-
29	V _{DD}	10	Supply Voltage	-
30	A7	11	External Memory Address Bus A7	O
31	A6	12	External Memory Address Bus A6	O
32	A5	13	External Memory Address Bus A5	O

DIE Pad	Name	QFP Pin	Description	I/O
33	A4	14	External Memory Address Bus A4	O
34	A3	15	External Memory Address Bus A3	O
35	A2	16	External Memory Address Bus A2	O
36	A1	17	External Memory Address Bus A1	O
37	A0	18	External Memory Address Bus A0	O
38	XO2	-	Oscillator 2 output (32768 Hz)	O
39	XI2	-	Oscillator 2 input	I
40	XO1	19	Oscillator 1 output (high frequency)	O
41	XI1	20	Oscillator 1 input	I
42	RESET_	21	Reset	I
43	NC	-	Not Connected	-
44	NC	-	Not Connected	-
45	P1.7	22	RS232 enable or General Purpose I/O	I/O
46	P1.6	23	General Purpose I/O	I/O
47	P1.5	24	General Purpose I/O	I/O
48	P1.4	25	General Purpose I/O	I/O
49	P1.3	26	General Purpose I/O	I/O
50	P1.2	27	General Purpose I/O	I/O
51	P1.1	28	General Purpose I/O	I/O
52	P1.0	29	General Purpose I/O	I/O
53	P0.7	30	General Purpose I/O	I/O
54	P0.6	31	External Memory Address Bus A17 (see note 3)	O
55	P0.5	32	External Memory Address Bus A16 (see note 3)	O
56	P0.4	33	General Purpose I/O	I/O
57	P0.3	34	General Purpose I/O	I/O
58	P0.2	35	General Purpose I/O	I/O
59	P0.1	36	RS232 output (XMT) or General Purpose I/O	I/O
60	P0.0	37	RS232 input (RCV) or General Purpose I/O	I/O
61	V _{DD}	38	Supply Voltage	-
62	GND	54	Ground	-
63	RDC_	40	External Code Read Strobe	O
64	WRC_	41	External Code Write Strobe	O
65	RDD_	42	External Data Read Strobe	O
66	WRD_	43	External Data Write Strobe	O
67	PDN	44	Power Down. Active high when powered down.	O
68	XMH_	45	External Hi-memory enable (low active)	O
69	XML_	46	External Low-memory enable (low active)	O
70	VREF	47	Reference Voltage = V _{dd} /2 or V _{dd} /4. Depends on software	-
71	AIFE1	48	Input of 1 st stage of preamplifier	
72	AOFE1	49	Output of 1 st stage of preamplifier	O

Notes:

1. Substrate should be connected to VSS
2. If an application is stand-alone (once you download the program via asynchronous serial I/O), the two serial I/O pins, **P0.0** and **P0.1**, and the serial port enable, **P1.7**, may be used for other purposes.
3. Note that since I/O pins **P0.5** and **P0.6** are connected to the address bus of the Flash memory, they can be used only for the matrix keypad; they should not be used under any other circumstances since they are allocated as Flash address lines.

DC Characteristics

($T_O = 0^\circ\text{C}$ to $+70^\circ\text{C}$, $V_{DD} = 2.85\text{V} - 5.25\text{V}$)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IL}	Input Low Voltage	-0.1		0.75	V	
$V_{IH}(V_{CC}<3.6)$	Input High Voltage	$0.8 \cdot V_{DD}$		$V_{DD}+0.3$	V	
$V_{IH}(V_{CC}>3.6)$	Input High Voltage	3.0		$V_{DD}+0.3$	V	
V_{OL}	Output Low Voltage		0.3	$0.1 \cdot V_{DD}$	V	$I_{OL} = 2\text{ mA}$
V_{OH}	Output High Voltage (I/O Pins)	$0.8 \cdot V_{DD}$	$0.9 \cdot V_{DD}$		V	$I_{OL} = -2\text{ mA}$
I_{IL}	Logical 0 Input Current		<1	10	μA	$V_{SS} < V_{pin} < V_{DD}$
I_{DD1}	Supply Current, Active		10	20	mA	Hi-Z Outputs
I_{DD3}	Supply Current, Powerdown		1	10	μA	Hi-Z Outputs
Rpu	Pull-up resistance P0.0-P1.7 I/O Pins	5,80, Hi-Z	4.5,200, Hi-Z		$\text{k}\Omega$	Selected with software

Absolute Maximum Ratings

Any pin to GND:	-0.1V to +6.5V
Operating temperature (T_O):	0°C to $+70^\circ\text{C}$
Soldering temperature:	260°C for 10 sec
Power dissipation:	1 W
Operating Conditions:	0°C to $+70^\circ\text{C}$; $V_{DD}=2.85 - 5.25\text{V}$ $V_{SS}=0\text{V}$

WARNING:
Stressing the VE-IC beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

Ordering Information

Part	Shipping P/N	Marketing P/N	Description
VE-IC Die	65-0087	C300XS1P	Tested, Singulated RSC-300 die in waffle pack
VE-IC QFP	65-0111	C300XV1T	RSC-300 64 pin 10 x 10 x 1.0 mm TQFP



Voice Extreme™ Toolkit

The Voice Extreme™ Toolkit enables quick development of applications using Sensory Speech™ technologies.

The Voice Extreme™ Toolkit contains:

- ▶ Voice Extreme™ Development Board
- ▶ Voice Extreme™ Module
- ▶ Power supply
- ▶ Serial cable for PC RS-232 connection
- ▶ Quick Start Guide
- ▶ Software CD containing the Voice Extreme™ IDE, Quick Synthesis™, sample projects, sample data files and documentation

The Interactive Speech™ Product Line

The Interactive Speech line of ICs and software was developed to "bring life to products" through advanced speech recognition and audio technology. The Interactive Speech Product Line was designed for consumer telephony products and cost-sensitive consumer electronic applications such as home electronics, personal security, and personal communication. The product line includes award-winning RSC series general-purpose microcontrollers and tools, SC series of speech microcontrollers, plus a line of easy-to-implement chips that can be pin-configured or controlled by an external host microcontroller. Sensory's software technologies run on a variety of microcontrollers and DSPs.

RSC Microcontrollers and Tools

The RSC product line contains low-cost 8-bit speech-optimized microcontrollers designed for use in consumer electronics. All members of the RSC family are fully integrated and include A/D, pre-amplifier, D/A, ROM, and RAM circuitry. The RSC family can perform a full range of speech/audio functions including speech recognition, speaker verification, speech and music synthesis, and voice record/playback. The family is supported by a complete suite of evaluation tools and development kits.



SC Microcontrollers and Tools

The SC-6x product line feature the highest quality speech synthesis ICs at the lowest data rate in the industry. The line includes a 12.32 MIPS processor for high-quality low data-rate speech compression and MIDI music synthesis, with plenty of power left over for other processor and control functions. Members of the SC-6x line can store as much as 37 minutes of speech on chip and include as much as 64 I/O pins for external interfacing. Integrating this broad range of features onto a single chip enables developers to create products with high quality, long duration speech at very competitive price points.

Application Specific Standard Products (ASSPs)

Voice Direct™ 364 provides inexpensive speaker-dependent speech recognition and speech synthesis. This easy-to-use, pin-configurable chip requires no custom programming and can recognize up to 60 trained words in slave mode, and 15 words in stand-alone mode. Ideal for speaker-dependent command and control of household consumer products, Voice Direct™ 364 is part of a complete product line that includes the IC, module, and Voice Direct 364 Speech Recognition Kit.

Voice Extreme™ simplifies the creation of fully custom speech-enabled products by offering developers the capability of programming the chip in a high-level C-like language. Program code, speech data, and even record and playback information can be stored on a single off-chip Flash memory. Based on Sensory's RSC-364 speech processor, Voice Extreme includes a highly efficient on-chip code interpreter, and is supported by a comprehensive suite of low-cost development tools.



Software and Technology

Voice Activation™ micro footprint software provides advanced speech technology on a variety of microcontroller and DSP platforms. A flexible design with a broad range of technologies allows manufacturers to easily integrate speech functionality into consumer electronic products.



Fluent Speech™ small footprint software recognizes up to 50,000 words; offers Animated Speech with the ability to automate enunciation and articulation; performs text-to-speech synthesis in either male or female voices; provides noise and echo cancellation, performs word spotting for natural language usage; offers telephone barge-in; and provides continuous digit recognition.

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