IntriCon
The Body-Worn Device Company

Audion™16

Product Features

Fourth-Generation Reliant™ Adaptive Feedback Cancelling

- Fast adapting speed means less whistling, even when things move around the ear
- New aggressive setting to minimize feedback in the most challenging situations

Wind Noise Suppression

- Detection system quickly recognizes when wind is present
- Automatically suppresses wind noise while preserving speech

Sixteen-channel Wide Dynamic Range Compression with Dynamic Contrast Detection™

- Three-mode adaptive time constants to optimize Wide Dynamic Range Compression performance in critical environments
- Compression ratio and threshold are independently adjustable in each channel
- Maximum Power Output compression limiting is independently adjustable in each channel

ACOUS-TAP™ Acoustic Push Switch

- IntriCon's patented acoustic switch changes programs when a user taps their ear and not the hearing instrument
- Eliminates the need for physical push button, saving size and cost

Adaptive Directional Microphone Processing

- Automatically switches from Omni to Directional when the environment changes
- Eliminates the need for a dedicated 'directional' user program needing manual activation

Voice Prompts

- Available for Start-up Program, Active Program, Minimum/Maximum Volume Control Position and Low Battery warning
- Choose from the IntriCon standard prompts or create and load your own custom prompts

Layered Noise Reduction™

- A state-of-the-art solution to environmental noise reduction

Data Logging

- Records average time per program and displays it in percentage of total hours and actual hours
- Records number of battery changes and estimates average battery life in hours
- Additional data logged: Average volume control setting per program, user environment levels per program, usage log, and total hours used

Digital Random Noise Generator

- Digital generation of random noise gives a clean noise sound for masking use
- Can be used in mixed-mode applications: one program for masking and another program for hearing instrument use

Digital Volume Control Compatible

- Two-pin digital volume control port
- Start-up volume control position is programmable
- Use push-button switches or a digital rotary control
- Analog volume control mode also available

Autosave for Program and Volume Control Position

- Active program and current volume control position are saved to the Electrically Erasable Programmable Read-Only Memory (EEPROM) after program or volume control change

OA	VBAT	SDA	I2C	Vdbl	M-	M+	MIC1	MIC2
RBAT						CLK	DAT	
OB	GND	SW	VC2	TSW	VC	TC+	TC-	DAI
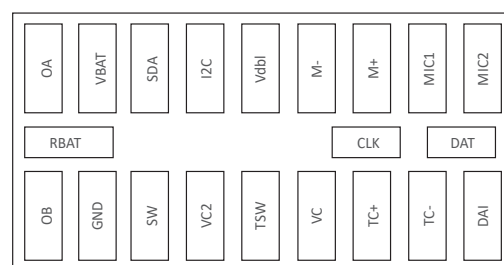
Reflowable PCB Package

FEATURE DESCRIPTIONS

ACOUS-TAP Acoustic Push Button

The Audion 16 amplifier has the Acous-Tap acoustic push button option for program selection, designed for in the ear applications. In these applications, the hearing instrument wearer taps their ear with their hand to change programs. The tap generates a pressure wave which is detected by the amplifier and changes the programs. The switch functions in the same manner as a physical push button with regards to how it changes programs and the switch tones that are generated.

There are two mode settings for the Acous-Tap:
1) Single Tap — This is the simplest mode, requiring only one tap to activate the switch.
2) Double Tap — This mode requires the user to tap their ear twice to activate the switch. This mode is more resistant to false switches than the single tap.

There is also a sensitivity setting for the acoustic switch that compensates for the low frequency response of the microphone. The normal setting is for flat response mics and the high setting is for mics with low frequency roll-off.

Adaptive Directional

The adaptive directional feature eliminates the need for a dedicated 'directional' user program needing manual activation. There are three adaptive directional input options available; adaptive cardioid, adaptive supercardioid or adaptive hypercardioid. The directional inputs can be selected in each program based on the polar pattern desired. The adaptive directional modes can be selected to allow the hearing instrument to automatically adapt from an omni mode to the selected polar pattern when the environment noise level rises above a configurable threshold. The available thresholds settings are low (50 dB), mid (55 dB), high (60 dB) and highest (65 dB).

Automatic Telecoil and M-T-O Switching

A dedicated switching pad is available for applications of automatic telecoil switching or M-T-O switching. This mode is used by attaching a magnetic switch or mechanical switch from the telecoil switch (TSW) pad to GND. When the TSW pad is pulled to GND, the amplifier switches to program 6 and stays there until the TSW pad is open. The amplifier then reverts to the user program that was active just before the TSW was grounded. The 'Auto Telecoil' mode is enabled through software programming.

Autosave

The Autosave option enables the writing of Current Program and volume control (VC) position to EEPROM. If the program switch is activated or the VC position changes, a flag is set telling the processor to save the value(s) to EEPROM. These values are then used as the default program and VC position the next time the device is powered on.

Band Gain Equalizers

Sixteen band gain adjusters — equalizers — are available to precisely match fitting targets. Band 1 covers the frequency 250 Hz and below. Bands 2-15 are 500 Hz wide and go from 500 Hz to 7 kHz. Band 16 covers 7250 Hz to 8000 Hz. Each band has adjustable gain in 2 dB steps from 0 dB to -40 dB.

Data Logging

The data logging feature on Audion 16 stores information associated with the device usage: time per program, total usage time, daily usage, and average battery life. It will also track environmental levels and the amount of time spent in each level.

In-situ Tone Generator

The Audion 16 amplifier comes with a programmable tone generator that can be used for in-situ validation of the hearing instrument fitting. The programmable parameters are frequency, level, and duration of the generated tone signal. The eight frequency options available are: 250 Hz, 500 Hz, 1 kHz, 1.5 kHz, 2 kHz, 3 kHz, 4 kHz, 6 kHz. The input referred level of the generated tone can be adjusted between 20 dB SPL and 100 dB SPL, in 5 dB increments. The duration of the tone being generated is set by providing a count which sets the signal duration as follows: Count = Duration (sec) / .0005 sec. Count is an integer between 1 and 32767.

Example: Count needed to get 500ms beep is: 0.5s/0.0005s = 1000

Indicator Adjustments

Voice prompts or tones can be used as indicators for program switching and low battery warning. The voice prompts and tones are output referred. Available frequency settings for the tone options are 500 Hz, 1 kHz, 1.5 kHz, and 2 kHz. Seven loudness levels are available (70 to 100 db).

Input Low Cut Filter

The Input Low Cut Filter provides a 12 dB/octave smooth linear roll off below the corner frequency. Programmable corner frequency values are 250 Hz, 500 Hz, 750 Hz, 1 kHz, 1.25 kHz, 1.5 kHz, 2 kHz, 2.5 kHz, 3 kHz.

Input Modes

There are 14 selectable input modes. The first four modes are single input modes: Microphone 1, Microphone 2, Telecoil, and Direct Audio Input (DAI). When one of these modes is activated, the input pad by that name is active and all other inputs are turned off. All 4 inputs are capacitive coupled, so there is no need for external coupling capacitors.

There are three fixed directional pattern modes and three adaptive directional pattern modes that use the signals from microphones connected to inputs Microphone 1 and Microphone 2.
- Fixed modes are: Fixed Cardioid, Fixed Supercardioid, Fixed Directional–Hypercardioid
- Adaptive modes are: Adaptive Cardioid, Adaptive Supercardioid, Adaptive Hypercardioid.

There is one input mode that enables the Digital Noise Generator source. The Digital Noise Generator may be used for tinnitus treatment.

Three summing input modes are available: (Microphone 1 + DAI), (Microphone 1 + TC), and (Microphone 1 + Noise Generator).

FEATURE DESCRIPTIONS

Layered Noise Reduction™ (LNR)

Our Layered Noise Reduction technology acts to remove noise between speech syllables, as well as lowering general background noise from the environment. The LNR function can be set to the following settings: Off, Low (7 dB), Medium (10 dB), High (13 dB), and Max (17 dB).

Low Battery Warning

When the battery voltage nears the end of life, the amplifier will detect this condition and provide a low battery warning signal. The first warnings begin when the average battery voltage falls below 1.1V. At this time, the amplifier will emit either a voiced warning or three sets of double beeps every ten minutes. When the average battery voltage falls lower than 1.05V, the amplifier will emit six sets of double beeps and shuts down the hearing instrument. The frequency and loudness of the beep tones, as well as the level of the voice prompt, are programmed as set forth in the section 'Indicator Adjustments.' Low battery warning can be disabled via software.

Low-Level Expansion

Our new Low-Level Expansion feature works in conjunction with our LNR function to further reduce unwanted noise at lower levels. The low-level expansion threshold is fixed at 45 dB SPL.

Manufacturer's Data Area (Scratch-Pad Memory)

Approximately 224 bytes of scratch pad space is available for storing manufacturer specific data. Typical stored items are model code, serial number, calibration constants, version numbers, etc.

Manufacturer's ID

An 8-bit memory location is reserved to store a code called Manf_ID. This code is assigned by IntriCon to each manufacturer that requests a unique code. This can be used to identify each individual manufacturer's hearing instruments. IntriCon's Motif engineering software will not read and program amplifiers with the Manf_ID set to values other than zero, unless the code has been unlocked using the proper security key provided by IntriCon. This prevents undesired changes to hearing instrument parameters.

Overall Gain

The overall gain parameter is adjustable in 1 dB steps, from 0 dB to -47 dB. Use this parameter to set the overall gain and then use the band gain adjusters to handle frequency shaping. The user volume control adjustment will reduce the gain downward starting at the setting of matrix gain. It is important to remember that some matrix gain values will be too high for certain applications and the fitting system should ensure that these high values are not available at fitting time.

Output Filter

The two output filters provides the flexibility to adjust the overall frequency response for all programs. There are 12 preset filters (6 High Pass filters and 6 Low Pass filters) and the option to create custom filters. The preset High Pass filter cutoff frequencies are 500 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz and 5 kHz. The preset Low Pass filter cutoff frequencies are 1 kHz, 2 kHz, 3 kHz, 4 kHz, 5 kHz and 6 kHz. Custom filter types available are: High Pass, Low Pass, Peak, Notch, Low Shelf and High Shelf with adjustable frequency, Q and gain. The Q and gain adjustments are operational based on filter type selected.

Output Limiting

The maximum power output (MPO) of the amplifier can be limited using the compression limiter. This method of output control does not create harmonic distortion like peak clipping. In each of the sixteen compression channels, the MPO can be programmed to the settings of: Off, 0 dB, -2 dB, -4 dB, -6 dB, -8 dB, -10 dB, -12 dB, -14 dB, -16 dB, -18 dB, -20 dB, -22 dB, -24 dB, -26 dB, and -28 dB (relative to maximum output). The output limiter threshold will not be affected by the VC setting, since the limiter is placed right before the output stage and after the VC block.

Preamp Digital Gain

Each input also has an additional digital preamp gain control parameter that can be used to get more low noise front end gain. This can be used in applications using low sensitivity inputs, such as a passive telecoil (T-Coil) input. The digital gain can be adjusted from 0 dB to 18 dB, in 6 dB increments.

Power-on Options

Two parameters are available to control how the amplifier behaves during power-up. The Delay Until Normal Volume sets the length of time before the amplifier reaches full volume after the power is applied. It is programmable to values of None, 5, 10 and 15 seconds. The Initial Volume Level controls how loud the amplifier is after power is applied until the preset volume setting is reached. Parameter values are: Mute (-60 dB), -30 dB, -20 dB, -10 dB.

Program Switch Indicator

When the Program Switch Indicator feature is enabled, the amplifier will either emit a voice prompt or beeps every time the switch pad is connected to ground. If programmed for Tones, the number of beeps indicates the program number being switched into, i.e. when moving into Program 2, two beeps will be heard. If programmed for Voice, the voice prompt indicates the program being switched into, i.e. when moving into Program 2, the "Program 2" voice prompt will be heard. The frequency and level of the beep ones or voice prompts are programmed as set forth in the section 'Indicator Adjustments.'

Random Noise Generator

The Audion 16 amplifier has an internal random noise generator that creates a flat spectrum, pseudo-random digital noise sequence. The Noise Generator can be set up as Input referred or Output referred. When set to Input referred, the noise signal is injected at the front end of the amplifier before any of the signal processing. The amplitude of the noise is programmable to values of 30 dB SPL to 65 dB SPL (input referred) in 5 dB increments. When set to output referred, the noise signal is injected at the output of the amplifier and is shaped using the noise filters. The two noise filters provide 12 preset filters (6 High Pass filters and 6 Low Pass filters) and the ability to create custom filters to shape the Noise Generator frequency response independently from the microphone frequency response. The preset High Pass filter cutoff frequencies are 500 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz, and 5 kHz. The preset Low Pass filter cutoff frequencies are 1 kHz, 2 kHz, 3 kHz, 4 kHz, 5 kHz, and 6 kHz. Custom filter types available are: High Pass, Low Pass, Peak, Notch, Low Shelf, and High Shelf with adjustable frequency, Q and gain. The Q and gain adjustments are operational based on filter type selected. Using the Input Selector parameter, the Noise Generator can be set up to operate in any of the user programs. For example, Program 1 could be set up with microphone 1 active as a hearing instrument program and Program 2 could be set up to activate the noise generator as a masking program.

FEATURE DESCRIPTIONS

Reliant™ Adaptive Feedback Canceller (AFC)

Our fourth-generation Reliant Adaptive Feedback Canceller takes the technology to a new level. By making the adaptation time faster, this unique adaptive filtering technology cancels feedback before it becomes bothersome, even in the most extreme situations. Advancements in feedback detection have also allowed better resistance to entrainment. Entrainment is the tendency of a feedback canceller to become confused by tonal sounds. This can cause false whistling and squeaks. The AFC is effective for feedback occurring in the frequency range of 750 Hz to 6750 Hz. The AFC can be programmed as enabled or disabled separately in each user program. There is also an additional setting to allow for a more aggressive Feedback management.

SDA Programming Port

Communication to and from the amplifier is by means of the SDA port. This port implements a proprietary bidirectional communication protocol with data and clock on the same line. Low-level PC-to-amplifier communication is handled using IntriCon's generic dynamic-linked library. This driver supports the Hi-Pro interface unit, as well as the eMiniTec and NOAHLink.

Contact IntriCon for the latest support information or check our website at www.intricon.com.

User Program

Up to six programs are available by setting the value of the configuration parameter "number_of_programs." Each of the user programs has a unique set of audio parameters. All of these parameters change when the user changes programs. The program change is accomplished by grounding the switch pad of the amplifier. There are three modes for this switch function: static mode, momentary mode and multifunction push button. The static mode only allows changes from Program 1 to Program 2 using a toggle switch. When the switch pad is grounded, Program 1 is active and when the switch pad is open, Program 2 is active. In the momentary mode, every time the switch pad is grounded, the user program is incremented until the top available program is active. The next time the switch is grounded causes the user program to return to Program 1. The Multifunction Push Button mode functions the same as the Momentary mode, but the required time the switch pad needs to be grounded is longer, therefore the user push button control input required is a push and hold instead of just a press. The Multifunction Rocker is a shared user control (see section 'Volume Control Function' for additional functionality). Program voice prompts or switch tones will sound if enabled (see section 'Program Switch Indicator').

Note: Program 6 will adjust the ATC program when the Auto-Telecoil feature is activated.

Voice Prompts

Unique voice prompts can be recorded for each of the nine available prompts. These voice prompts can be language specific and can be loaded at the device level, so there is no need to stock a unique device. Desired voice prompts must be uploaded before shipping to dispensing professional.

Volume Control (VC) Function

A user VC can be connected to this amplifier and the function can be configured to match the application. The VC can be programmed to one of three digital modes (digital control, multifunction rocker and single push button VC), analog control or disabled.

The Digital Control has two control options available: a digital VC (rotary or scroller) or momentary push button switches. The rotary or scroller digital control end connections determines the direction of rotation for volume increase and decrease. When using two push button controls (Digital Control or Multifunction Rocker), pressing one button will increase the volume and pressing the other button will decrease the volume. The Multifunction Rocker is a shared user control. (See section 'User Programs' for additional functionality). The single push button VC will loop through the available volume control steps, increasing the volume to the maximum available level and then return to the lowest volume level and then restart the cycle. The Digital Control, Multifunction Rocker and Single push button VC have variable ranges based on selectable step size and number of steps. The range is programmable up to 60 dB.

To create an analog VC, the center terminal of a 100K ohm linear-taper VC (such as IntriCon models 11, 12, 14, 25, 26, and 35) is wired with the center wiper to the VC pad and the ends of the VC are wired to M+ and GND. The analog VC range is programmable to the following settings; 50 dB, 40 dB, 30 dB, 20 dB, or 10 dB.

Wide-Dynamic-Range Compression (WDRC) with Dynamic Contrast Detection™

The Audion 16 amplifier uses unique IntriCon technology called Dynamic Contrast Detection in a 16-channel WDRC configuration. The technology is described in detail in the technology white paper titled *Two-Channel WDRC with Dynamic Contrast Detection™* (available on the IntriCon website or from your IntriCon sales representative).
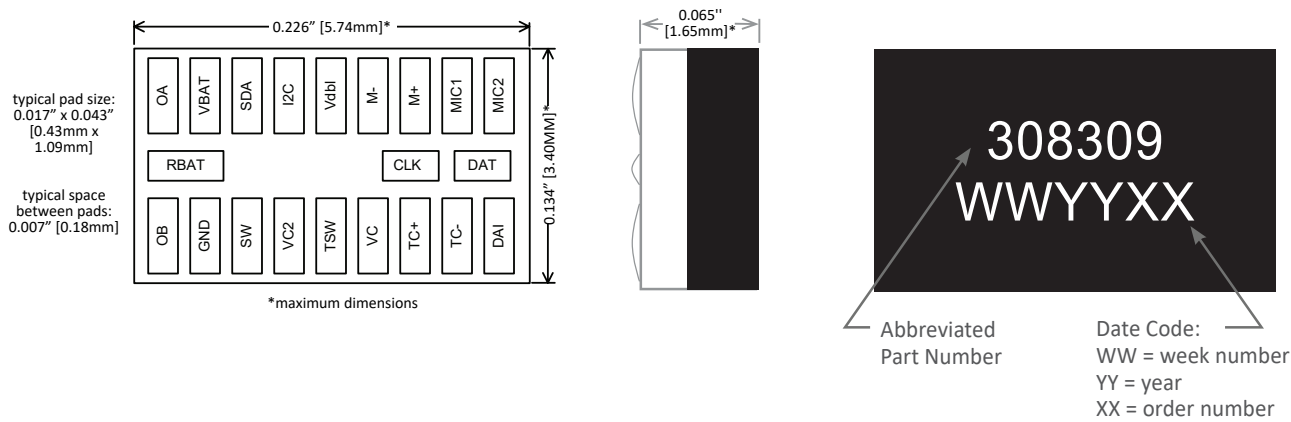
Compression thresholds settings for each channel can be set from 20 dB SPL to 82 dB SPL, in 2 dB steps. Compression ratio settings in each channel are adjustable from 1:1 to 8:1 (35 steps). Time constants settings are described in the technology white paper mentioned above. Channel crossover frequencies are at 500 Hz intervals from 250 Hz to 7250 Hz.

Wind Noise Suppression

The dedicated wind detection system quickly recognizes when wind is present by adjusting gain levels and modifying the IntriCon multi-layered noise reduction algorithm. By making these adjustments, there is a large reduction in induced wind noise, while preserving the amplification of voice signals.
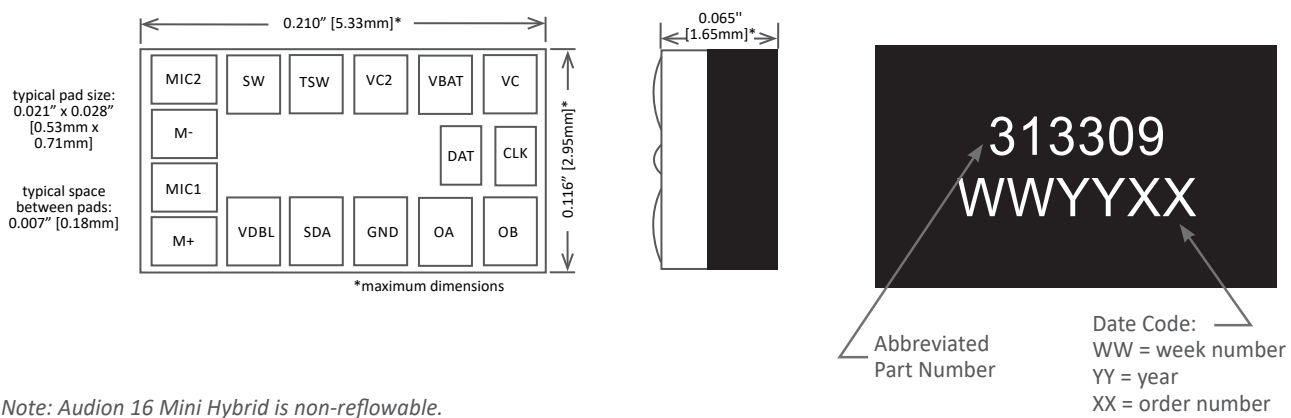
Audion™ 16 Standard Hybrid Package
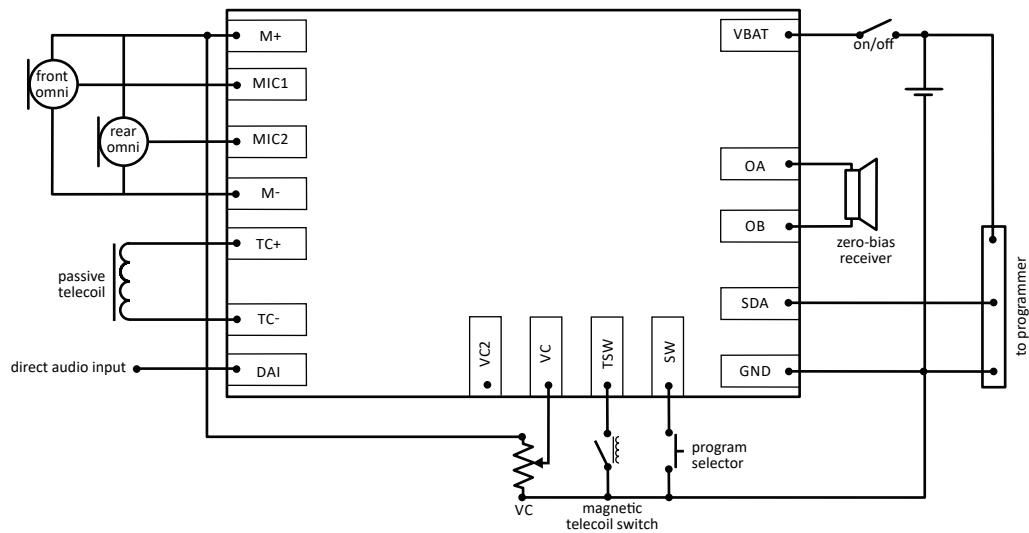Part Number 93083-0009 — RoHS Compliant

0.226" [5.74mm]*

0.065''
[1.65mm]*

0.134" [3.40MM]*

typical pad size:
0.017" x 0.043"
[0.43mm x
1.09mm]

typical space
between pads:
0.007" [0.18mm]

| OA | VBAT | SDA | I2C | Vdbl | M- | M+ | MIC1 | MIC2 |

| RBAT | | | | | CLK | DAT |

| OB | GND | SW | VC2 | TSW | VC | TC+ | TC- | DAI |

*maximum dimensions

308309
WWYYXX

Abbreviated
Part Number

Date Code:
WW = week number
YY = year
XX = order number

Audion™ 16 Mini Hybrid Package
Part Number 93133-0009 — RoHS Compliant

0.210" [5.33mm]*

0.065''
[1.65mm]*

0.116" [2.95mm]*

typical pad size:
0.021" x 0.028"
[0.53mm x
0.71mm]

typical space
between pads:
0.007" [0.18mm]

MIC2	SW	TSW	VC2	VBAT	VC
M-				DAT	CLK
MIC1					
M+	VDBL	SDA	GND	OA	OB

*maximum dimensions

313309
WWYYXX

Abbreviated
Part Number

Date Code:
WW = week number
YY = year
XX = order number

Note: Audion 16 Mini Hybrid is non-reflowable.

Wiring Schematic Showing Full Features

front omni
rear omni
passive telecoil
direct audio input

M+
MIC1
MIC2
M-
TC+
TC-
DAI
VC2
VC
TSW
SW
VBAT
on/off
OA
OB
zero-bias receiver
SDA
GND
to programmer

VC
magnetic telecoil switch
program selector

Wiring Schematic Simple Programmable Application

omni mic

M+
MIC1
MIC2
M-
TC+
TC-
DAI
VC2
VC
TSW
SW
VBAT
OA
OB
zero-bias receiver
SDA
GND
to programmer

VC wiring in gray is optional
program selector
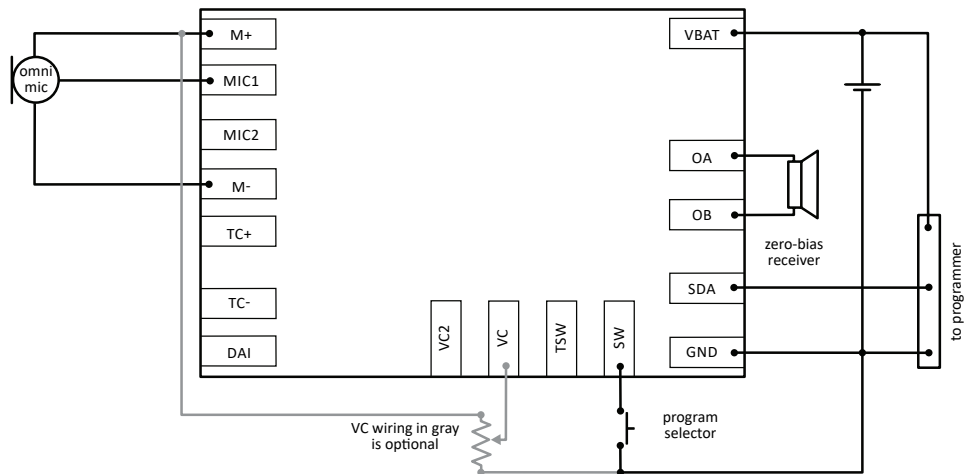
Wiring Schematic with Active Tcoil, VC, DAI, and MTO Switch

omni mic
amplified telecoil
direct audio input

M+
MIC1
MIC2
M-
TC+
TC-
DAI
VC2
VC
TSW
SW
VBAT
M
T
O
OA
OB
zero-bias receiver
SDA
GND
to programmer

T
O
M
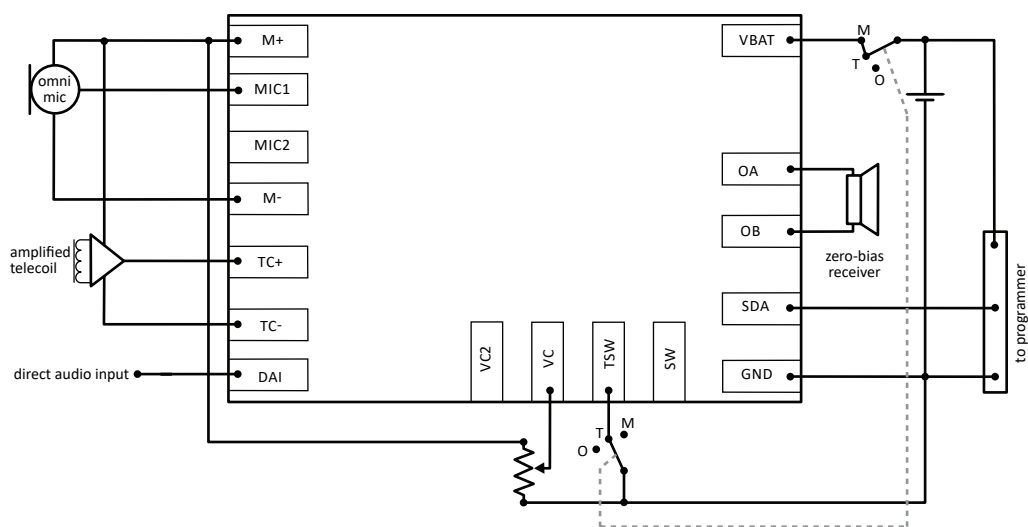
Wiring Schematic Showing Digital VC with Program Switch
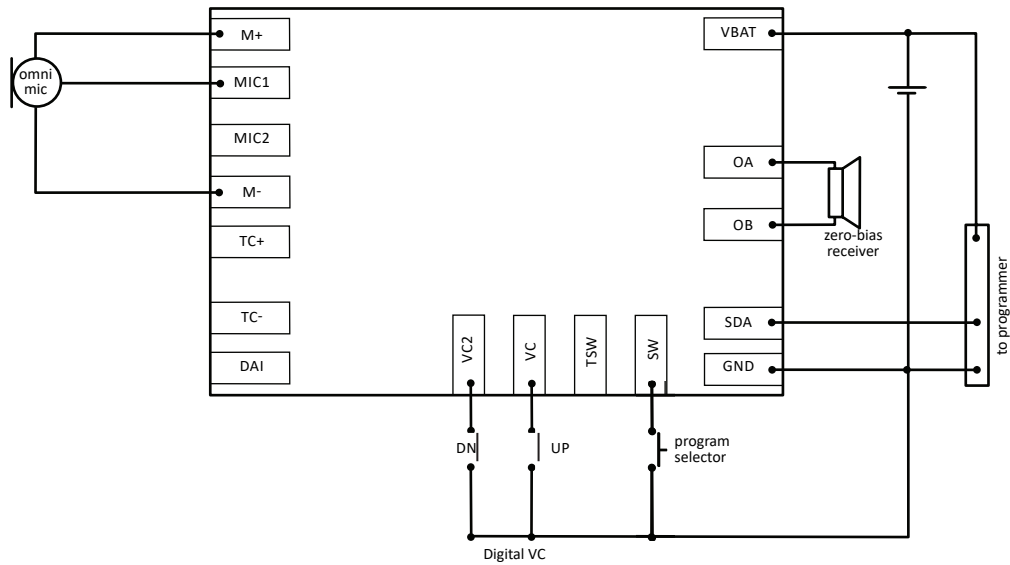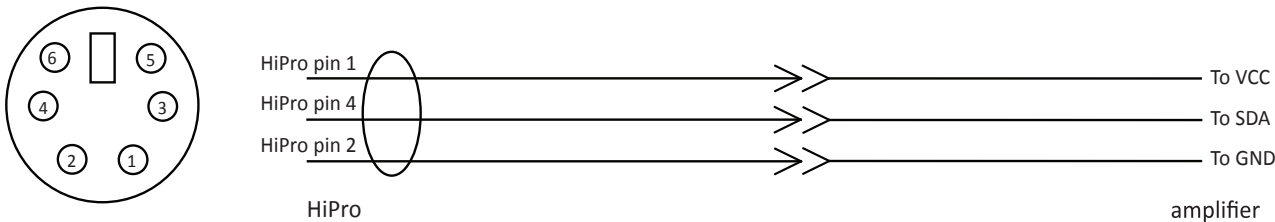

Wiring Schematic Showing Digital Scroller VC

22949_A
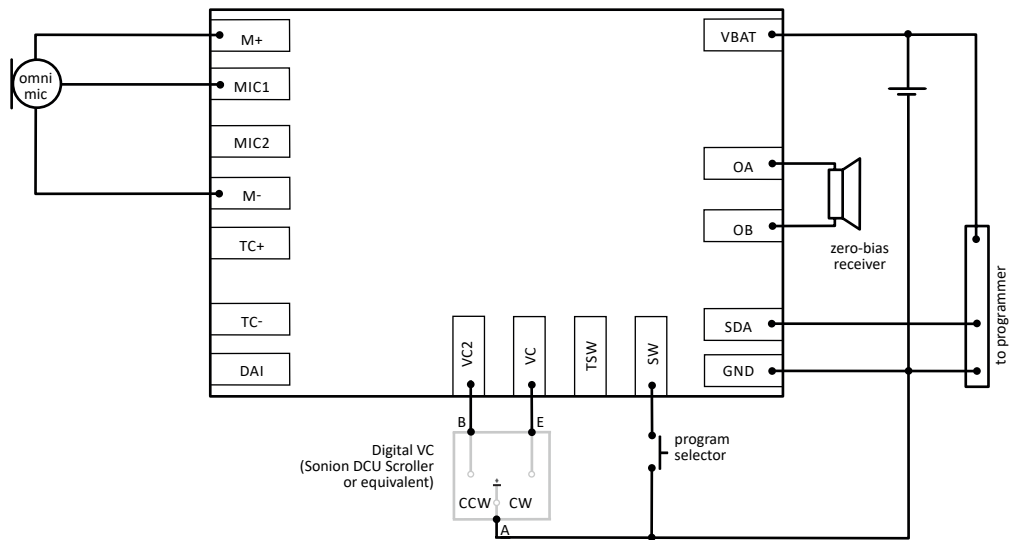
Programmer Wiring

Pin numbering of the DIN connector on the front of the HiPro, as seen facing the HiPro box

HiPro pin 1 — To VCC
HiPro pin 4 — To SDA
HiPro pin 2 — To GND

HiPro

amplifier

Technical Specifications

Parameter	Minimum	Typical	Maximum	Units	Condition
Minimum Operating Supply Voltage	1.05	1.25	2.0	V	
Supply Current	--	1.0	--	mA	AFC enabled at idle
Clock Frequency	--	6.4	--	MHz	
Sampling Frequency	--	16	--	kHz	
Bandwidth	--	8	--	kHz	
Input Noise	--	--	4	uVrms	bandwidth 200-8000 Hz
Dynamic Range	90	--	--	dB	max input signal with THD < 2%
Output Impedance, Standard Mode	--	--	8	ohms	
Output Impedance, High Power Mode	--	--	4	ohms	

SOLDERING INFORMATION

Customer Attach Process	Process Parameters	Max Hybrid Temp	Recommended materials to attach hybrid
Hand Solder Wire	Set iron tip temp to 650°–715° F. Max dwell time of 2 seconds. Allow 10 seconds between solder operations.	250° C	Use SAC 305 solder wire
Flip Chip	Reflow in convection oven—see profile below for recommended reflow temperature.	250° C	Print SAC 305 paste onto pads. Flip hybrid onto wet paste and reflow. Alternate method is to apply flux to the pads then flip hybrid onto fluxed pads and reflow. Recommended flux is indalloy tac flux 025 (this is a water soluble flux).

Solder Reflow Temperature Profile
(Lead-free SAC Alloy)
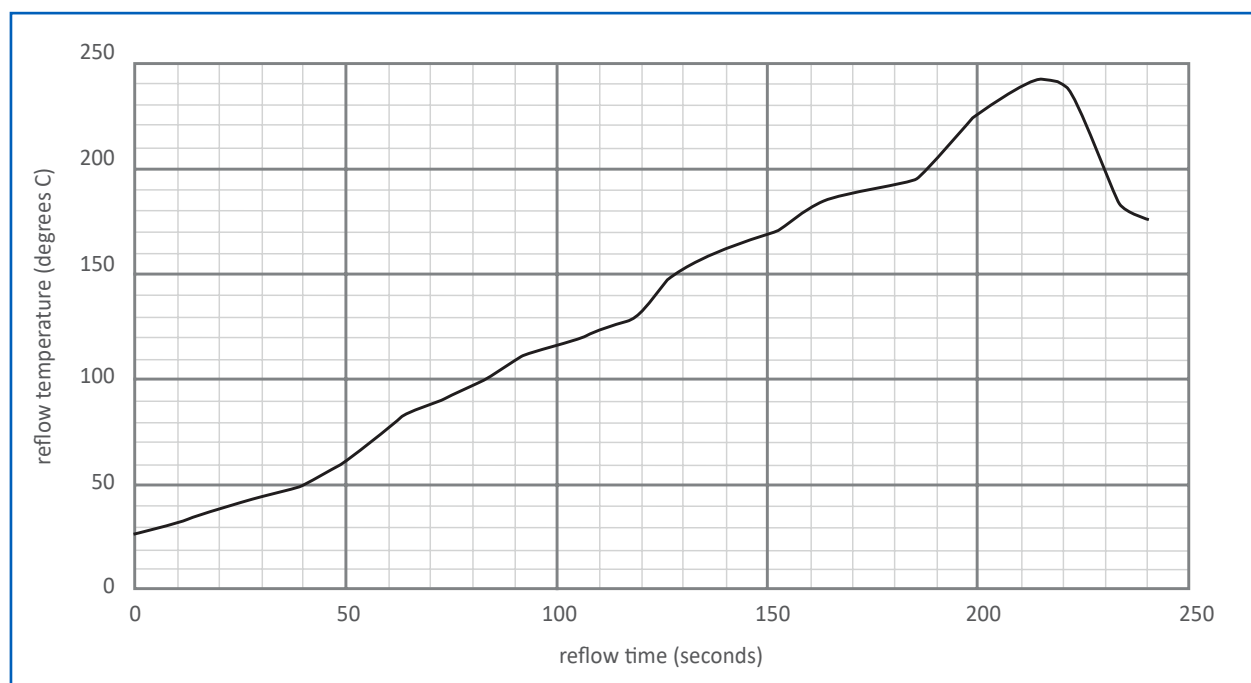
For more information on IntriCon products, visit www.intricon.com
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This product may be covered by one or more of the following patents, as well as patents pending: 8,355,517; 8,605,927; 8,767,987; D671,218; 9,571,939; 9,832,578; 6,678,386; D525,617; D527,377; D567,232; D588,110; 7,519,193; 8,358,797.

IntriCon
The Body-Worn Device Company