PrecisionWave AG
Swiss RF Solutions

FM Voice Break-In Solution

The Voice Break-In (VBI) solution is a highly integrated, hardware based repeater and content replacement system for FM broadcast. VBI's are in-tunnel/in-building broadcast systems that in case of emergency play out real-time voice or pre-recorded audio via the FM radio by replacing the regular program. Our system generates an FM broadcast signal with RDS. The program IDs of the original signal are automatically adopted.

Repeat Radio or Talk: The Voice Break-In

For proper in-car coverage and audio reception in both standard operation and the case of emergency, on air FM programs received from outside the tunnel are constantly analyzed and forwarded. The audio payload is replaced with customer specific content (i.e. emergency messages via microphone or phone, pre-recorded content, VoIP, etc.) whenever needed by a simple push of a button or fully digital via Ethernet.

The generated FM broadcast signal is fed into the tunnel or specific sections of it by the repeater system.

Tunnel operators can switch from original broadcast source to the modified signal without loss of signal reception or receive interruption for the customer. The system continuously monitors the input and other important system parameters and generates alarms if something in- or outside the system is not properly working.

Functional Diagram
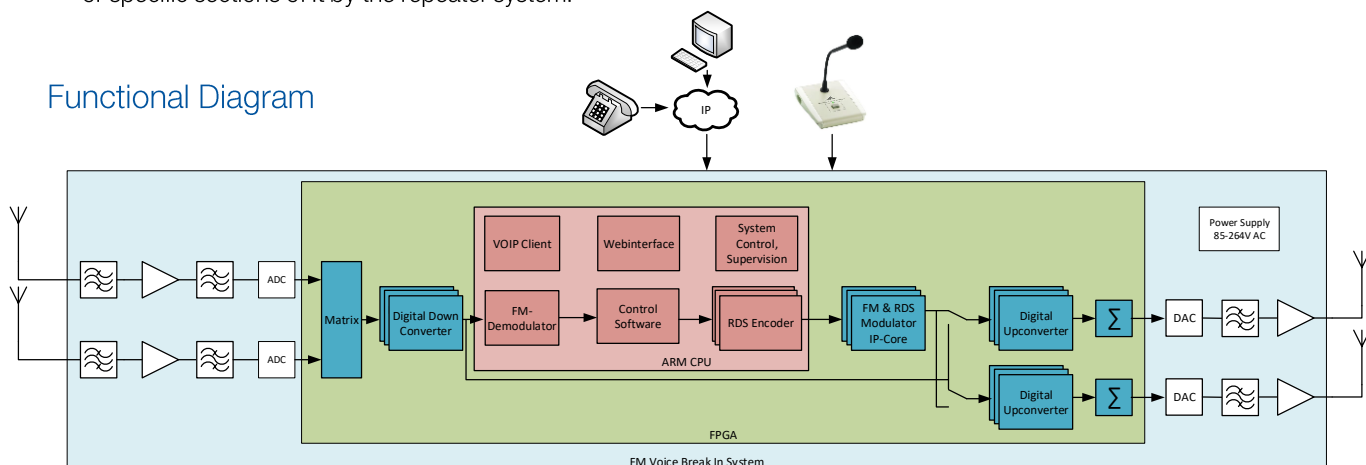
Benefits & Highlights of our Solution

- Repeater and Voice Break-In mode
- Scalable, up to **32 programs** on a **single unit**
- **Dual RF** output and individual selection of the mode (voice break-in/repeater) for two tunnel tubes / zones
- **Two audio inputs** for two zones or languages
- Integrated **playout system**: analog, files, VoIP
- Automatic gain control and attenuation and precise RF input level measurement
- **Automatic** setup of RDS parameters from the original signal
- **Low power** consumption (only 20W typ.)

- **Web management** for control and monitoring
- **Second RF receiver** available for monitoring of RF signals on a fully redundant setup
- Two audio inputs for **individual voice break-in** on RF **output 1 & 2**
- Future ready: modulator fully embedded in hardware, yet programmable (FPGA) Various interfaces, alarm outputs for signal loss or customizable inputs/outputs, SNMP
- Compact module or 19" device available
- High reliability, MTBF
- All-in-one hardware solution

All-in one hardware: improved reliability and low power

To guarantee high reliability, long term operation, compact size and low power consumption, our system follows a simple yet powerful approach where the complete hardware is downsized to just few, but of highest quality components. We're not ready to make compromises when it comes to quality.

All electronic parts are contained on a single board, from RF input, digital signal and audio processor, to the RF output.

Innovative: FM-modulators are completely hardware based IP-cores, running on an FPGA and without the need of an embedded computer.

Our dedicated RF frontends in conjunction with the high speed analog to digital converters, allows to cover the whole FM broadcast band at the full bandwidth of 20.5 MHz with processing capabilities of **up to 32 programs on a single hardware unit**.

Our compact, fully integrated FM Voice Break-In module. Multi-ensemble processing, IP connection, low power consumption and a robust, RF safe casing are just some of the features we offer.

General Hardware Information

Frequency range (FM)	87.5-108 MHz
Typical power consumption (1 ensemble)	20W
Supply voltage (module)	8-15V DC
Supply voltage (rack version)	85-264V AC
Operating temperature	0-50 °C
MTBF	260908 h
Long-term availability	At least until 2030

Mechanical: robust housing

For optimal heat transfer and RF shielding, everything is enclosed in a compact, fully milled aluminum case. For custom system integration, the VBI solution can either be delivered as a module (figure above) or, if preferred, completely assembled in a 19" rack mountable chassis including an AC power supply and cooling fan.

Chassis

Size (module, no power supply)	210x155x40 mm
Size (rack version)	483x88.1x280 mm (19", 2HU)

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Operation Mode: Voice Break-In

Per default, all configured ensembles are repeated with low latency to enable best reception quality and no interference of the user experience. During Voice Break-In mode, all or a selectable number of ensembles are replaced by custom voice (via microphone input), pre-recorded messages or audio via IP. Also, radio display messages are replaced and fully customizable, by default showing "Police info".

FM Voice Break-In	
Number of FM modulators	32
Max deviation	±75kHz
Max modulation power MPX	3.0dBr
Modulation type	Mono
RF Frequency Error	<100Hz
Automatic audio gain control range	20dB

RF Interface at the module: dual RF-input, clocking and dual RF-output. E.g. our hardware also allows the independent operation of two tunnel tubes.

Operation Mode: Repeater

Thanks to the hardware embedded modulators, the group delay in the repeater mode can be reduced to under 10µs.

The output has automatic gain control and high channel suppression, low noise figure and high linearity.

Repeater	
Number of repeater channels	32
Adjacent channel suppression	>70dB
Out of band suppression	>55dB
Group delay	8.2µs
Noise figure	<10dB
Max. gain	75dB

RF Specifications

The RF inputs and outputs both offer two channels and are connected via SMA (module version) or customized according to your needs (19" rack version).

Apart from a clock reference input, we offer a high-precision, lowest phase-noise clock reference output to synchronize other devices. **GPS is not needed** to operate the device in Voice Break-In or Repeater mode. However, for specific applications an optional GPS module can readily be mounted for improved long-term clock output stability.

RF Input (2x)

Impedance	50Ω
Connector type	SMA
Max. input level sum	-10dBm
IIP3 (0dB)	-7dBm
IIP3 (15dB)	7dBm
Input ESD protection	
S11	<-10dB
Input attenuator	0..31.5dB (0.5dB steps)
Max. level meas. error	±0.2dBm

Ref. Clk In

Impedance	50Ω
Max. input power	10dBm (2Vpp)

RF Output (2x)

Impedance	50Ω
Connector type	SMA
Max. output level sum	6dBm
S22	<-9dB
OIP3	>30dBm
Max level set error	±0.2dBm

Clock Output

Impedance	50Ω
Output frequency	Programmable (0.22 - 2370MHz)
Total Jitter [rms]	120fs typ.

Modular, broadband RF Interfaces (up to 150MHz RX- and 600MHz TX-bandwidth) make our system ready for you customized frequency needs. Contact us with your specifications.

Whatever your interface needs are – we've got your back!

The system per default is set to indicate and output signal alarms in case reception of one, multiple or all channels is below a defined threshold or too weak. The audio input is stereo fully differential and the stereo differential output allows you to listen to any audio stream in real-time.

Besides the Gigabit Ethernet connection, we offer both isolated RS485 with CAN support as well as isolated I2C and customizable GPIOs. You decide: Voice Break-In mode can be entered by buttons, switches, relays or even via Ethernet interface.

Audio Input	
Impedance	10 kΩ
Max input voltage	10 Vpp
Format	analog, differential, stereo

Audio Output	
Audio Output	5 Vpp, Stereo, differential

Other Interfaces	
Ethernet	RJ45, 1 GBit/s
GPIO	8 channel open collector or digital IO
RS485	CAN support
Fan connectors	2x at Vcc, 300mA max.
USB	1x Host, 1x UART

Configuration and control

Full control over the hardware configuration as well as the mode control and Voice Break-In functionality is provided via a Web-Interface. For secure systems where no Ethernet access is desired, the hardware can easily be set up via USB-UART and new firmware is simply loaded by replacing an SD card or by a USB-stick and the push of a button. SNMP is available.

System control and operation	
Web-interface	configuration and control
Firmware Update	SD-card, USB, Ethernet
SNMP	status and alarms

Flexible playout sources

Beside the standard 2-channel analog line inputs, audio can be routed from SIP (VoIP) sources or uploaded via Web UI and stored on the device (max 2h).

Fully redundant setup possible

Thanks to the optional second RF receiver a full redundant setup with two independent FM-VBIs is possible. In normal condition the RF signal from the master device output will be selected with a relay. The slave device monitors that signal and in case of fault switches over the relay.

Industrial 19" enclosure

We have a 19" 2HU enclosure (depth 343mm) with integrated power supply and fully isolated I/Os available from stock. Ask us for more.

What else?

In case you need different frequency ranges, intrusion detection, localized operation restriction, precise clock generation, reflected power sniffing or even a GSM connection in the device, please talk to us!

We're there to enable your desired features and discuss any needs you might have.

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Hardware Products & Options

Product Code	Description
FM-VBI	**FM-VBI Hardware-Module** FM-VBI channel selective repeater and voice break-in system for FM Broadcast, base hardware module with ethernet, SNMP, webinterface, stereo analog audio IO, 7xGPIO
VBI-RACK	**Enclosure 19inch 2U** Enclosure 19inch 2U with integrated 90-264VAC power supply for one DAB-VBI or FM-VBI module and IO board with isolated stereo audio XLR I/O, 4 isolated switching inputs and 4 relays
VBI-2PS	**Option Redundant Power Supply** Option second power supply with supervision
VBI-FM-PA	**FM band power amplifier** Frequency range=87-108MHz, OIP3=58dBm, max composite power=30dBm, harmonic filter, forward, backward power & temperature measurement
VBI-FAN	**FAN Kit** 2pcs fans 80x80x25mm with tacho signal, connector and 280mm cable length

Software Options

Software options can be unlocked by entering a keycode in the webinterface.

Product Code	Description
FM-VBI-REP	**Option FM repeater channel** maximum 32
FM-VBI-BI	**Option Voice Break-in per Ensemble** maximum 32 Option Voice Break-in per channel including RDS encoder with individual Programm ID (requires Option Repeater per channel)
FM-VBI-2TX	**Option Dual RF Output** Option Dual RF Output (simultaneous Repeater/VBI)
FM-VBI-2RX	**Option Second RF Input** Option Second RF Input
FM-VBI-SIP	**Option Audio from SIP VoIP** Break-in audio signal can be picked up from analog audio output for external usage
FM-VBI-PLAYOUT	**Option Audio Playout from Files** Break-in playout from audio files stored on the FM-VBI. Break-in messages can be uploaded over the web user interface and triggered there, by isolated inputs or by SNMP. Break-in audio signal can be picked up from analog audio output for external usage

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