DIGITAL ACOUSTICS

IP7™-FX

IP Intercom/Amplifier

Reference Manual

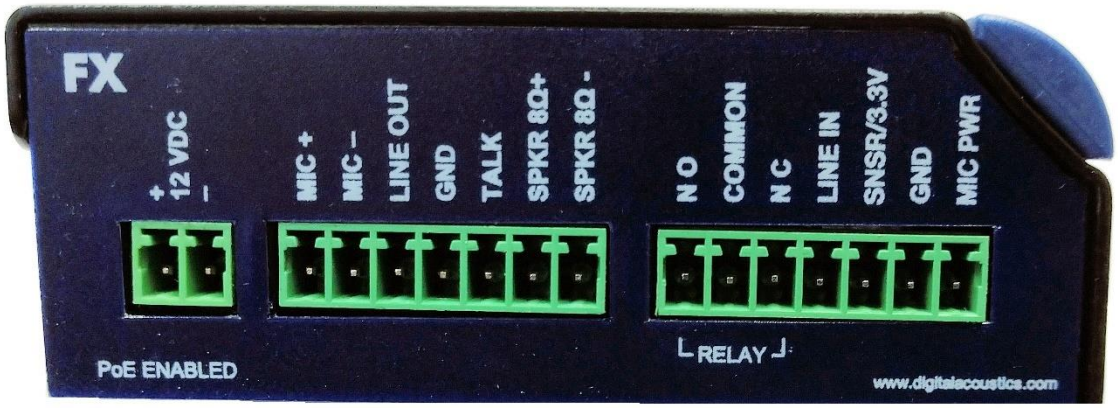

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Table of Contents

Overview

The Digital Acoustics IP7-FX is a versatile IP (Internet Protocol) 2-way audio module with an integrated 8-watt amplifier, call button, relay, sensor and 2-port network switch. It is designed to replace the older IP7-ST/STx[1], IP7-SS8, IP7-SE8 and the IP7-FD model IP audio modules and can support:

- Full duplex audio with echo cancellation
- Half duplex audio using a separate mic and speaker
- Half duplex audio using the speaker as both a speaker and microphone
- Paging only audio using one or more 8 Ohm speakers
- Paging only audio using an analog amplifier which is connected to multiple speakers

With this flexible design the IP7-FX can be used in a variety of applications where network-based audio is required.

Standard features of the IP7-FX include:

- Pluggable DIN connectors to facilitate wiring connections
- Flexible analog audio device options
- Highly scalable, seamless expansion
- Mounting via rail or surface mount
- Fixed or DHCP compliant IP assignment
- Powered via external 12VDC or PoE (802.3af)
- Integrated 2-port switch
- Field upgradeable firmware

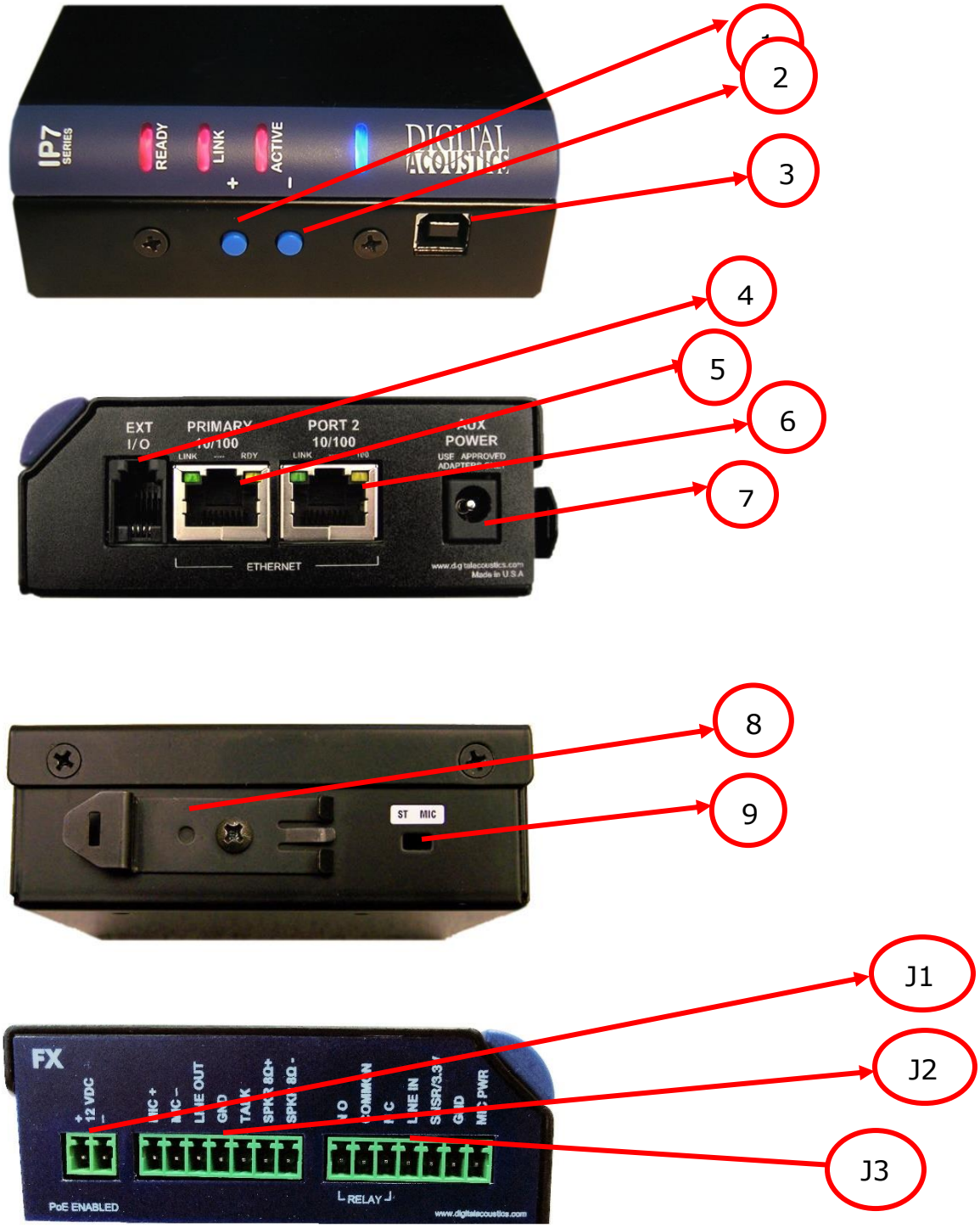
*The IP7-FX must be configured using the **TalkMaster** software or **eSIP** software before being used. Please consult the configuration section of the software manual for details.*

[1] The IP7-FX does not support the Aiphone IE/IF Series two wire Door Station. The IP7-STx is the only Digital Acoustics IP audio module that supports the IE/IF Series

Specifications

Items	Specification
Network Protocols	TCP, UDP, SIP, RTP, ICMP, IGMP Multicast
Network Interface	10/100 Ethernet (Auto detection, Auto MDIX)
Command protocols	Proprietary and Standards Based
Audio Resolution	G.711 (8-bit PCM and 16-bit uLaw)
Audio Sample Rate	8K (Voice band), 22K (Background Music)
Audio Frequency	90-4kHz (Voice band), 90-11khz (Background Music)
Internal Amplifier	8 watt @ 8 Ohms 1% THD
Humidity	10~90%
Power	External Power 12VDC @ 1.2 amps or 24VDC @ 2.5 amps.
	PoE (802.3af) compliant (requires 15.4 watts from PSE). External Power overrides PoE power
Size	3.85. x 3.59 x 1.37 in 98 mm x 91mm x 35mm

IP7-FX Layout



Connections and Controls

Refer to the preceding pictures.

Connector	Connector / Control	Notes
1	Volume Up	Volume up button +
2	Volume Down	Volume down button -
3	USB-B	Provides for low level firmware flashing as well as viewing technical support information. Will also power the unit for diagnostic purposes.
4	Ext I/O	I2C expansion bus interface that can be used for custom applications. Requires custom firmware from Digital Acoustics
5	Ethernet 10/100	10/100 Ethernet network interface. Supports auto negotiation and auto-MDIX. PoE enabled
6	Port 2 10/100	Provides a 10/100 Ethernet network connection for another device. Supports auto negotiation and auto-MDIX
7	Aux Power	2.1mm power connector with center tip positive. 12VDC @ 1.2 amps or 24VDC at 2.5 amps. Overrides PoE power. **Warning**: Connecting power to both the 2.1mm Power jack and the J1-1 and J1-2 power connectors at the same time will damage the unit
8	DIN Rail Mounting Clip	Allows unit to be snapped on to standard 35mm DIN Rail stock
9	ST MIC switch	The ST MIC switch is in the **MIC** position by default. If using single transducer mode (speaker used as both a speaker and microphone) use a small screwdriver to move the recessed switch to the **ST** position (towards the DIN clip).

J1 Connector

Connector	Signal	Notes
J1-1	Power +	12VDC at 15 watts or 24VDC at 2.5 watts. Overrides PoE power. **Warning:** *Connecting power to both the 2.1mm power jack and the J1-1 and J1-2 power connectors at the same time will damage the unit*
J1-2	Power -	

J2 Connector

Connector	Signal	Notes
J2-1	MIC +	Microphone Inputs. Pseudo differential (Actively Balanced differential). Also capable of accepting Line In signal
J2-2	MIC -	
J2-3	Line Out	2VPP
J2-4	GND	System Ground. Same as J3-6
J2-5	TALK	Talk or Call button. Initiates a call to the configured Server. Reference to J2-4
J2-6	SPKR 8Ω+	Floated differential output. Able to drive an 8 Ohm load @ 8 watts or a 600 Ohm load
J2-7	SPKR 8Ω-	

J3 Connector

Connector	Signal	Notes
J3-1	NO	Isolated Dry Contact Relay output. Connect J3-2 and either J3-1 for NO (Normally Open) or J3-3 for NC (Normally Closed)
J3-2	COMMON	
J3-3	NC	
J3-4	LINE IN	**Line In** - Unbalanced. Reference to J3-6. Use J3-7 to supply 12V to if needed to power a Line Level Microphone. ** NOTE: When configuring the device, make sure to configure the **Input Source** from **Microphone** to **Line In**
J3-5	SNSR/3.3V	**Sensor** – **Active when closed to ground** (default) or **Active when open to ground** based on software configuration. Reference to J3-6. Optionally provides 3.3V (current limited) to power an LED. If powering an LED, make sure to configure **SNSR/3.3V** from **Activate when grounded** to **Activate when open** in the software configuration
J3-6	GND	System Ground. Same as J2-4
J3-7	MIC PWR	Provides 12VDC to power a Line Level Microphone

LED Indicators

Intercom LEDs

There are four LEDs present on the curved bezel on the front of the product.

- The blue LED indicates that the IP7-FX has powered up.
- The three red LEDs indicate status of the unit.

LED	Description
Ready	Indicates whether the unit has connected to a Server
Link	Indicates whether the unit has a valid network Connection
Active	Indicates whether audio is being transmitted or received

LED Status Table

Description	Ready	Link	Activity
Normal operational mode. Intercom can communicate with its Server	On	On	Off
Playing Audio	On	On	Flashing
Playing Broadcast Audio	Fast Flash 20x per second	On	Flashing
Sending Audio	On	On	On
Attempting to connect to make a connection to a Server or unit has not been configured	Flashing 4x per second	On	
LAN connection is inactive. The RJ45 may be unplugged	Flashing 4x per second	Off	
Device has reported its configuration on a discovery request or connection. Fast flash will stop after 20 seconds	Fast Flash 20x per second	On	

LAN Connector LEDs

On the **Ethernet 10/100** RJ-45 connector:

- The Green LED tracks to the Ready LED
- The Yellow LED tracks to the Link LED

On the **Port 2 10/100** RJ-45 connector

- The Green LED tracks to network transmit activity
- The Yellow LED tracks to network receive activity

Replacing an older Model IP7

If the IP7-FX is being used to replace an existing an existing IP7-ST/STX, IP7-SS8/SE8 or an IP7-FD, please note the following:

- The J3-7 (Case) connector on older models was an extra ground. If replacing an older model with an IP7-FX, any wire connected to J3-7 should be moved to J3-6.
- If replacing an IP7-ST/STx, make sure the internal **ST-MIC** switch (located on the DIN clip side) is set in the same position on the IP7-FX
- If the older IP7's J2-6 (SPKR 8Ω+) and J2-7 (SPKR 8Ω-) is connected to an amplifier or amplified speaker, use the IP7-FX's J2-3 (Line Out) and J2-4 (GND) instead
- If replacing an IP7-SE8 / IP7-MSR-BRD with an IP7-FX, the IP7-MSR-BRD can be eliminated by changing the IP7-FX's **ST-MIC** internal switch to the **ST** position
- The IP7-FX does not support the Aiphone IE/ IF series call station. An IP7-ST/STx must be used
- Other than the exceptions noted above, the J1, J2, J3, and network can be moved over to the IP7-FX

Connecting to an Ethernet Network

The **Ethernet 10/100** connects to a 10/100 network switch port. **Port 2 10/100** allows an additional IP device to be connected to the network without the need for an additional network drop. The second port is not PoE capable.

- Plug a Cat5 cable into the RJ-45 connector labeled **Ethernet 10/100** and connect the other end to a 10/100 switch.
- To optionally connect a second IP device to the network, plug a Cat5 cable in the RJ-45 connector labeled **Port 2 10/100**
- The **Ethernet 10/100** connector supports auto "MDIX" and can be plugged directly into a PC for diagnostic purposes.

Connecting Power

The IP7-FX auto senses the power source and voltage. An external power source will always override PoE power.

PoE

Plug a Cat5 cable from an 802.3af compatible switch or injector into the RJ-45 connector labeled **Ethernet 10/100**. 15.4 watts will be requested from PoE (802.3af compatible) Power Source Equipment (PSE).

External Power

- The 2.1mm Power Jack (center tip positive) and the J1-1(+) / J1-2(-) connectors both accept 12VDC at 1.2 amps or 24VDC at 2.5 amps (With 12VDC, the IP7-FX can supply up to 8 watts to the speaker. With 24VDC, the IP7-FX can supply up to 25 watts to the speaker)
- **DO NOT** supply power to both the 2.1mm Power Jack and the J1-1 and J1-2 connectors

USB Power

The USB connector can be used to power up the unit for diagnostics or low-level firmware flashing. Plug a USB cable from a PC into the USB-B connector. The unit will power up but will not be able to be used for audio operations.

Audio - Mic and Speaker

Understanding Full Duplex Audio

The IP7-FX Full Duplex Operation is often referred to as Speakerphone or Hands-Free mode. The technology to enable 2-way conversation without acoustic feedback involves a process called Acoustics Echo Cancellation (AEC). For AEC to be effective, the total system design needs to be considered. This includes incorporating sophisticated DSP electronics and optimizing the Speaker Frequencies and placement of the speaker and microphone based on the maximum volume to be played on the speaker.

The Digital Acoustics IP7-FX series has highly advanced DSP electronics with software that can optimize the endpoint based on the physical environment.

In full duplex echo cancellation mode, when the distance between the microphone and speaker is small (under 24”), the speaker volume and microphone sensitivity are limited to help prevent feedback. As the distance between the two increases, the microphone sensitivity and speaker volume can increase as there is less chance of feedback.

Understanding Half Duplex Audio

In half duplex audio mode, only the speaker or microphone is active at any one time. In this mode, the speaker volume and microphone sensitivity can both be maximized since there will not be any feedback.

Understanding Paging Audio

In paging mode, only the speaker will be active. The speaker volume can be maximized since there will not be any feedback.

Simple ‘dialog’ choices in the configuration software offer several **Audio Profiles** for different environments. Please refer to the Admin Console Reference Guide for more information on selecting Audio Profiles.

Microphones

The IP7-FX can receive audio through a microphone and transmit it across the network to be played or stored. There are several types of microphones with different pickup patterns (omni directional, unidirectional, etc.). The IP7-FX supports Electret and Line Level Mics as well as TalkBack Speakers.

Electret Microphone

An electret microphone (sometimes referred to as un-pre-amplified mic) transmits "mic level" audio to the IP7-FX. To use an electret microphone:

- For best results and to minimize interference connect to the microphone to the IP7-FX with 18-20 AWG **shielded** wire
- The Microphone wire must NOT be in the same jacket as the Speaker wire!
- Connect the plus and minus leads to the IP7-FX's J2-1 (Mic+) and J2-2 (Mic-) terminals
- Connect the shield to the IP7-FX J2-4 (GND), but do not connect the shield on the microphone end

Some examples of electret microphones are the ETS ML1-x series and the Louroe x-ML series.

Line Level Microphone

A line level mic (sometimes referred to as a powered or pre-amplified mic) transmits "line level" audio to the IP8-FX. To use a line level mic:

- Connect the Black (or Audio) lead to the J3-4 (Line In) connector
- Connect the Shield (or Ground) to the J3-6 (GND) connector
- Connect the Red (or Power) lead to the J3-7 (MIC PWR) connector

Some examples of line level microphones are the ETS SM1 series and the Louroe Verifact series.

TalkBack Speaker

Some 8 Ohm speakers work well as a microphone. To use a speaker as a microphone:

- Connect the two speaker leads to the J2-1 (Mic+) and J2-2 (Mic-) connectors. The connections are polarity independent
- Set the recessed ST MIC switch (connector 9 – next to the DIN clip) to the ST position using a small screwdriver

Some call stations only have a single speaker that is used as both a speaker and a microphone (also known as single transducer mode). The IP7-FX can also support this configuration in half duplex operation.

- Connect the two speaker leads to the J2-6 (SPKR 8Ω+) and J2-72 (SPKR 8Ω-) connectors. The connections are polarity independent
- Set the recessed **ST MIC** switch (connector 9 – next to the DIN clip) to the **ST** position using a small screwdriver. The **ST MIC** switch must be in the MIC position for all other configurations!
- Make sure the IP7-FX software configuration is NOT configured for Full Duplex

An example of a TalkBack Speaker is the Visiton FRS8-8.

Speakers

The IP7-FX receives audio from the network and plays it on its speaker. It can drive one or more speakers, a self-amplified speaker or an analog amplifier connected to one or more speakers. For best results and to improve performance, connect the speaker or amplifier to the IP7-FX using 18 AWG wire.

Single 8 Ohm Speaker

To drive a single 8-Ohm speaker, connect the speaker leads to J2-6 (SPKR 8Ω+) and J2-7 (SPKR 8Ω-). The connections are polarity independent.

Amplified Speaker or Analog Amplifier

To drive an amplified speaker or analog amplifier connect the amplifier's Audio+ signal to J2-3 (Line Out) and the Ground to J2-4 (GND).

Do not connect the IP7-FX J2-6 and J2-7 connectors to an unbalanced audio signal. This will cause permanent damage and void the warranty!

Multiple Speakers

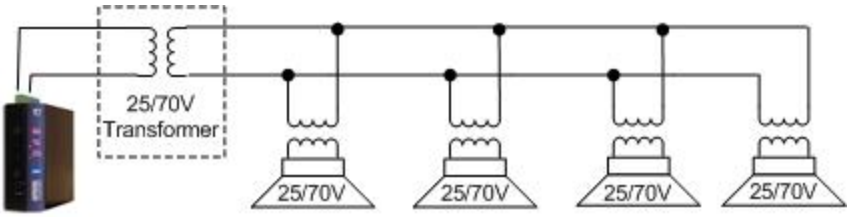
Multiple speakers are typically used if the IP7-FX will be used for overhead paging. If more than one speaker is connected to an IP7-FX, all speakers will sound when audio is sent to it.

When driving multiple speakers, it is recommended that a 25/70V distribution line be used. This requires the optional 25/70V transformer (part# COMTR25/70-324J) for the IP7 and speakers with 25/70V transformers.

Multiple Speakers using 25/70V transformers

Due to transformer loss, the IP7-FX will only:

- Supply about five watts to the speaker output when using PoE or 12VDC.
- Supply about 30 watts to the speaker output when using 24VDC



Please note the following guidelines:

- Each speaker must have its own 25/70V transformer
- Do not mix Speakers tapped for 25V with a 70V distribution line or speakers tapped for 70V with a 25V distribution line
- All speakers must be wired in parallel.
- Speakers should be installed within 500 feet (150 meters) of the IP7-FX using 18-gauge wire. For longer runs, increase the wire gauge
- Each speaker may be tapped differently
- The total wattage of the selected speaker taps cannot exceed the five watts (12VDC or PoE) or thirty watts (24VDC) available from the IP7
- Maintain the same wiring polarity between speakers

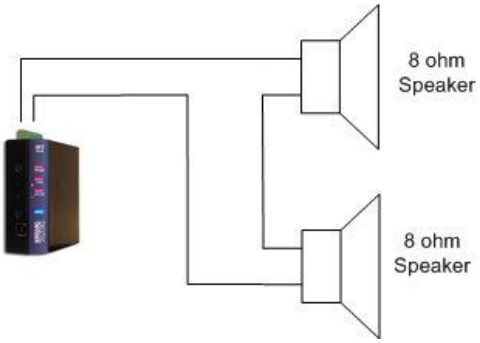
To use the optional transformer:

- Mount the transformer next to the IP Amplifier
- Connect the J2-6 (SPKR 8Ω+) and J2-7 (SPKR 8Ω-) (polarity independent) from the IP Amplifier to the 8 Ohm side of the transformer
- Connect the 10 watt tap and common from the other side of the transformer to the wires leading to the speaker(s)
- Refer to the instructions included with the transformer for additional information

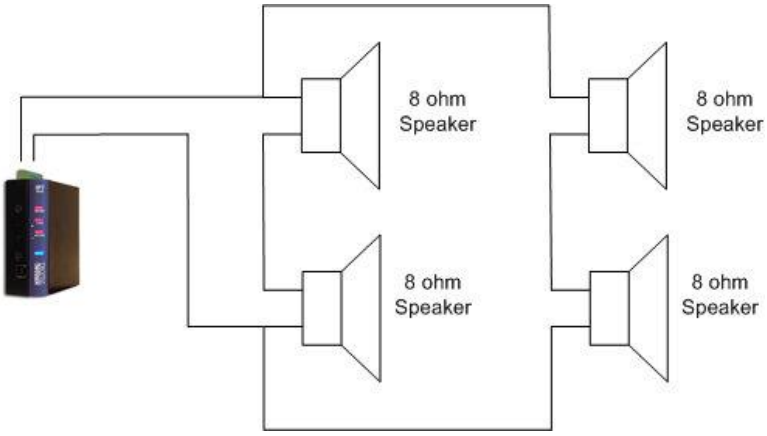
Multiple 8 Ohm Speakers

The IP7-FX is also capable of driving multiple 8 Ohm speakers without 25/70V transformers.

- Two 8 Ohm speakers must be wired in series



- Four 8 Ohm speakers must be wired in series-parallel



Please note the following guidelines:

- Connect the Speakers to the J2-6 (SPKR 8Ω+) and J2-7 (SPKR 8Ω-) (polarity independent)
- Speakers should be installed within 200 feet (60 meters) of the IP7-FX using 18-gauge wire
- The total watts available from the IP7-FX are distributed equally among the speakers so they will all have the same volume

Line Out

The Line Out generates a standard 2Vpp signal (two Volts peak to peak) to drive a Line In signal.

To connect Line Out to a standard Line In signal, amplifier or amplified speaker:

- Use 18-20 AWG shielded wire
- Connect J2-3 (Line Out) to the amplifier's "+" connector
- Connect J2-4 (GND) and the amplifier's "-" connector
- Follow amplifier manufacture's recommendations for balanced vs unbalanced audio signals.
- If any noise is heard in the output signal, connect the J2-4 (GND) to the negative terminal on the amplifier's power source

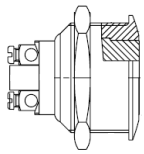
Line In

The **Line In** is an alternate audio input and must be selected as the **Input Source** instead of the **Microphone** in the IP7-FX software configuration. Some devices that require a Line In are Line Level Microphones, Microphone mixers, mobile phones or analog amplifiers.

To connect Line In:

- Use 18-20 AWG shielded wire
- Connect J3-4 (Line In) to the device's "+" connector
- Connect J3-6 (GND) to the device's "-" connector
- Connect J3-6 (GND) to the shield and leave it floated at the line in device
- Connect the shield to the device's ground connector

Talk (Call) Button



The optional Talk Button connector is used to initiate a call to the TalkMaster software or to a SIP Server.

To wire the Talk Button, connect J2-5 (Talk) to the Button, and then connect J2-4 (GND) to the Button's other contact. Optionally, the Button's other contact can be attached directly to one of the Speaker terminals. Use 18 AWG wire.

Dry Contact Relay

The **Relay** connector provides a dry contact output from the IP7-FX suitable for activating equipment such as electronic door strikes, strobe lights or CCTV cameras. Normally Open (N/O) or Normally Closed (N/C) can be chosen. Use 18 AWG wire.

The **Relay** is rated at 250 VAC / 30VDC @ 60W / 1500 VAC Isolation.

- Connect either J3-1 (NO) for a normally open relay or J3-3 (NC) for a normally closed relay to the device to be controlled
- Connect J3-2 (Common) to the other side
- Ensure **Relay** has been properly configured in the Intercom's Software Configuration program

SNSR/3.3V

The IP7-FX supports an input sensor that can be used for a variety of applications. The sensor can be defined as **Active when closed to ground** or A**ctive when open to ground** via software. Digital Acoustics' TalkMaster™ Software provides functionality for monitoring the status (open or closed) of a door via the sensor.

- Connect J3-5 (SNSR/3.3V) and J3-6 (GND) to a door sensor or device that can provide a contact closure
- Ensure **Sensor** has been configured to be **Activate when closed to ground** or **Activate when open to ground** in the IP7-FX's software configuration

Optionally, this connector can be used to power an LED at 3.3V (current limited).

- Connect J3-5 (SNSR/3.3V) to the positive side of the LED and J3-6 (GND) to the negative side
- Ensure **Sensor** has been configured to **Activate when open to ground** in the IP7-FX's software configuration to prevent the sensor alert from being generated

Mounting Instructions

The IP7-FX can be installed on a DIN Rail or surface mounted.

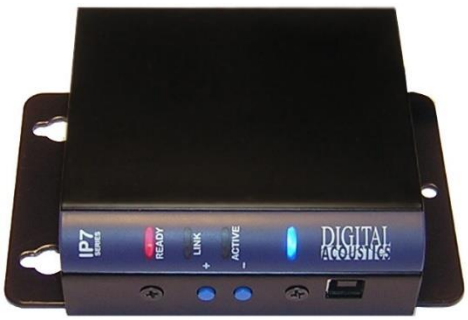
Din Rail Mounting

To DIN rail mount:

- Cut a piece of 35mm DIN rail (not supplied) to the desired length and secure it to the location
- Place the IP7-FX onto the DIN rail by tilting the top of the unit (J1, J2, J3 connectors facing up with Volume buttons and USB-B connector facing forward) back towards the DIN Rail until the IP7-FXs DIN clip catches the top of the rail
- Press in at the bottom of the IP7-FX to snap it in place

Surface Mounting

To attach the surface mount plate to the IP7-FX:



- Snap the plastic mounting plate in half at the score marks
- Line up the two pieces of the surface mount plate to the back of the unit. The two mounting holes of the surface mount plate should be above the J1, J2, and J3 connectors
- Attach the two halves of the plate using the four machine screws included in the package
- Attach two (2) #8 pan head screws 2” (52 mm) apart and screw in to within ¼”
- Place the mounting holes of the IP7-FX over the #8 screws

Setting Volume Levels

The IP7-FX supports seven volume levels for an attached speaker.

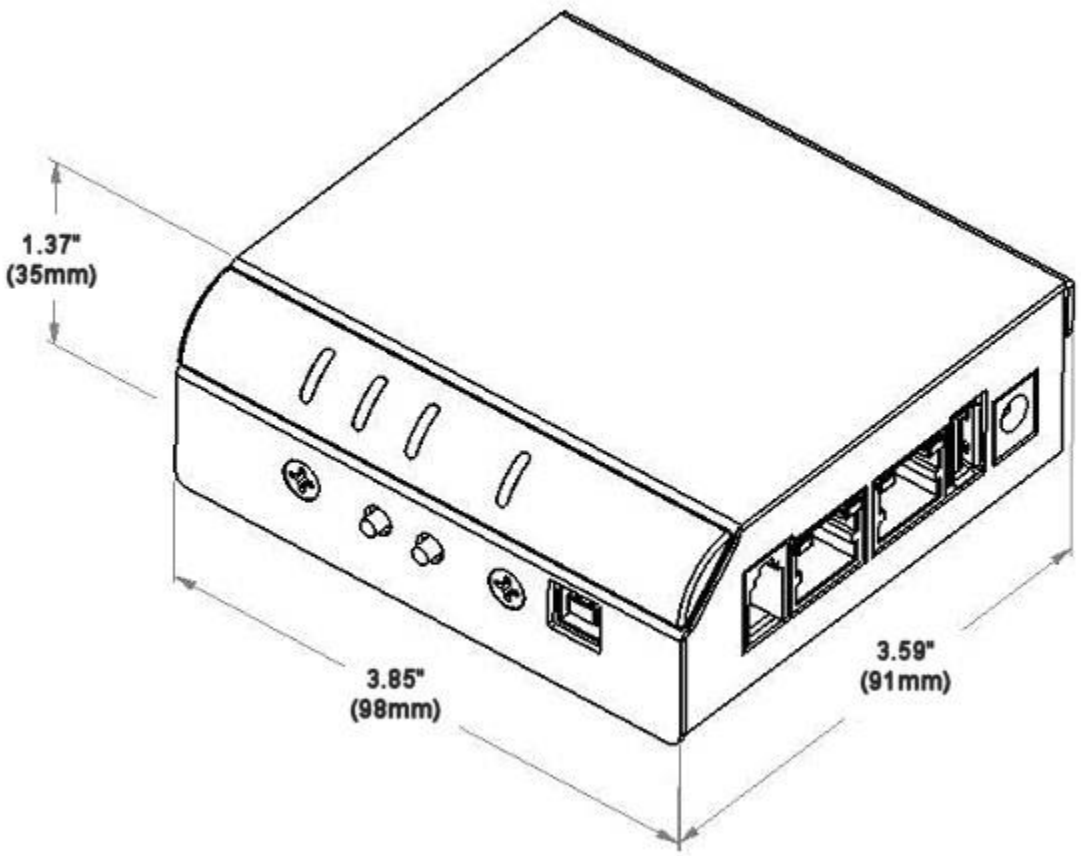
- Press the “+” or “- “ button one time to increase or decrease the speaker volume
- If the IP7-FX’s **Ready** and **Link** LEDs are on solid, a high frequency beep is heard when the volume “+” is pressed and a low frequency beep is heard when the volume “-” is pressed
- Pressing the “-” or “+“ button seven times sets the unit at its lowest or highest setting.
- Refer to the software manuals for setting the volume via software.

Configuration

Refer to the **TalkMaster Administrator Reference Manual** or the **eSIP Configuration** utility software manuals for instructions on setting the IP address information and optional settings for the IP7-FX.

Physical Dimensions

The IP7-FX dimensions are as follows:



Environmental

The IP7-FX is designed to operate indoors or in a weatherproof box that has a NEMA4 or IP66 rating.

Troubleshooting

Always refer the LED Indicator table when troubleshooting the IP7-FX.

Reset to Factory Defaults

The IP Address information and all Intercom options can be reset to factory defaults by the following procedure:

- Unplug the Power
- Press and hold the "Vol +" and "Vol -" buttons
- Power the unit
- Wait till the unit plays a 3-tone beep (about 5-8 seconds)
- Release the "Vol +" and "Vol -" buttons
- Refer to the software manuals for instructions on setting the IP address information

Connecting 1/8" (3.5mm) Audio Plug to the Pluggable connectors

To connect a Mic, Line In or Line Out to the pluggable connectors via a 1/8" audio plug, the audio plug should be wired as follows:

- The Tip should be wired to positive
- The Sleeve should be wired to minus or ground
- On stereo plugs, the Ring should be left unconnected

Reducing electrical noise in audio

Improper wiring can cause noisy audio when transmitting microphone audio from the IP7-FX. To minimize the possibility of this:

- Locate the unit at least one meter away from transformers, stepper motors or other noise producing equipment
- Use shielded twisted multi-conductor cable for microphone audio and follow the grounding recommendations
- Do not run audio cable in the same conduit with AC power
- Attached J3-6 to an earth ground

Viewing tech support info via the USB port

If requested by Digital Acoustics Support, a USB cable can be attached to the IP7-FX to capture additional information.

- Attach a USB cable to the USB-B connector on the unit.
- Attach the other end of the cable to a PC running Windows®.
- Open the Windows Device Manager to determine the virtual Serial port that has been assigned

- From the Windows **Start** menu, open a terminal emulation program such as Teraterm and set the properties to select the new Serial port with settings of 115kbs, 8,N,1, no flow control and ANSI Terminal
- Press the Enter key
- Provide the requested info to Digital Acoustics Tech support

Low Level Flashing Utility

If a power is removed from the unit while the firmware is being updated from the network, the unit may require a low-level flash.

- Install the SAFMA - Low Level Flashing Utility from the TalkMaster installation CD
- Perform the Phase 1 Reset procedure, followed by the Phase 2 Flashing procedure
- If the Phase 1 Reset Procedure fails:
  - Remove the four screws (two on the front and two on the back)
  - Open the case by pulling up on the side opposite the Volume buttons till the top pops off
  - Connect the USB cable (this will power the unit up)
  - Position the unit with the Vol "+" and Vol "-" buttons facing you
  - Bend a paper clip or piece of wire and insert into the two holes to the right of the Vol "+" and Vol "-" buttons
  - Power cycle the unit by removing and reinserting the USB cable
  - Run the SAFMA utility and perform the Phase 2 Flashing procedure
  - Verify by repowering the IP7

Technical Support

Technical support information is available online at www.digitalacoustics.com under the Support menu.

Email support:
esupport@digitalacoustics.com

Regulatory Notices

Federal Communication Commission Class A Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to **Part 15** of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

In compliance with FCC regulations, the following information is provided on the device or devices covered in this document.

- Product Name: IP7 Series
- Model number: FX
- Company name: Digital Acoustics LLC
  37 Sherwood Terrace
  Lake Bluff, IL 60044
  847-604-9246

IC Notice (Canada Only)

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme **NMB-003** du Canada.

NOTE: Industry Canada regulations provide that changes or modifications not expressly approved by Digital Acoustics, LLC could void your authority to operate this equipment

CE Notice

Marking by the symbol CE indicates compliance of this equipment to the EMC (Electromagnetic Compatibility) directive of the European Community. Such marking is indicative that this equipment meets or exceeds at least an **EN 55022:2006 Class A** device

VCCI Compliance

Class A

AS/NZS CISPR22:2006 Compliance

Class A

CNS 13438 Compliance

Class A

Index

Notes

www.digitalacoustics.com

Digital Acoustics' product designs are packaged by leading manufacturers around the world. Contact factory for technical specification before product design and/or use. Design and specification are subject to change without notice.

IP7-FX Reference Manual.docxu 2019-08-16-20