*digi*PCM 0.3

Transmit and receive PCM audio on FM-ATV with the 7020, without a PC · operated in a web browser · FPGA and software PE1PzN · manual for digiPCM 0.3, test version (3 November 2026)

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1. What is digiPCM

With digiPCM the 7020 works as a **PCM transmitter and receiver**. The digital audio goes into a video picture as black and white blocks, like with the Sony PCM-F1 and the EIAJ processors. That picture goes on air as **FM-ATV**. The receiver is in there too. Everything happens in the FPGA of the 7020; you operate it in a **web browser**, on a PC, a tablet or a phone.

Format	EIAJ 14-bit or Sony PCM-F1 16-bit, PAL or NTSC, stereo
Sample rate	44.1 kHz (NTSC 44.056 kHz)
Video	No colour burst. FM-ATV with CCIR 405-1 video pre-emphasis, channel 18 or 27 MHz, deviation 1 to 16 MHz (default 4 MHz)
Sound in	Test tone or I2S ADC. Audio emphasis 50/15 µs on or off
Sound out	DAC on the 7020. The de-emphasis follows the emphasis bit in the signal

2. What you need

- An **SDR7020** (Zynq 7020 + AD9363) with a micro SD card. Only the board with a Zynq 7020 (XC7Z020 on the chip) and four SMA connectors.
- An **I2S ADC board** on the 7020 for sound in. Without one is fine too: then you transmit the test tone.
- An **I2S DAC board** (PCM5102A) on the 7020 for the received sound.
- A network cable and a web browser.
- To receive: an antenna on RX1 or RX2. If you transmit and receive with the same 7020, put an attenuator between TX and RX.

3. Making the SD card and starting up

1. Take an empty micro SD card, formatted as FAT32.
2. Put **everything** from the folder *SD-kaartje digiPCM 0.3* straight onto the card, so not in a folder. At the top of the card you then find BOOT.bin, uImage and the folders *bootbin* and *pcm*, among others.
3. Eject the card properly and insert it into the 7020 (power off).
4. Network cable in, switch the 7020 on and wait about a minute.

5. In the browser: **http://IP-address/**. The IP address is in your router. You end up on the right page (port 8080) by itself.

From now on everything starts **by itself** when the 7020 is switched on, with the last settings.

> **Everything is on the card, including your settings** (in *pcm/instellingen.txt*). Nothing is written to or removed from the 7020's memory (the flash). The IP address does not change.

Updating

Put a new version onto the card in the same way, over the old files. *pcm/instellingen.txt* stays, so your settings are kept.

Removing

Take the card out and switch the 7020 on again. Nothing of digiPCM is left in the 7020: it is as it was.

Does it not work?

What you see	What to do
The page does not open	Wait another half minute. Are you on the same network as the 7020? Is everything straight on the card (not in a folder)?
Old page after a new version	Press F5 once.
Two 7020s, only one gets a network connection	They have the same MAC address. Use *MAC-adres.bat* (free download on the website) to give each 7020 its own address.
Something else	Start *Hulp\Controle.bat*. It makes a report of the 7020 (read only, nothing changes). Send the folder to PE1PzN.

4. The rack

At the top is the rack. It is the same on every tab.

Part	What it does
Lamps	**CONNECTED**: the browser hears the 7020. **PCM SYNC**: the receiver has a PCM signal. **7020 SDR**: the 7020 can be operated. **ON AIR**: the transmitter is on. **I2S**: green = I2S locked, yellow = measuring. **ALARM**: with the reason below it. Below that the temperature of the FPGA and the AD9363.
`FREQ`	Type the transmit frequency (70 to 6000 MHz).
`PRESET`	Presets: tune, add, delete, order. Double click a name or frequency to change it. The step of ▲▼ is also set here.
`POWER`	The transmit power (TX ATT, 0 to -89.75 dB). The 7020 remembers it per frequency.
`SETUP`	To the Setup tab, and back again.
Display	Frequency, ON AIR / OFF AIR, the format and the main settings. At the bottom the signal bar with the C/N and the S-meter. Turn the mouse wheel on a digit of the frequency to tune that digit.
`DISP`	The display switches between transmitter (TX) and receiver (RX).
`▲` `▼`	Transmit frequency one step up or down. Right click: the step size.
TRANSMITTER	The switch turns the transmitter on (I) or off (O).

5. Transmitter



Transmitter tab: PCM-F1 16-bit PAL, sound from the I2S ADC, emphasis 50/15 µs, CCIR 405-1, channel 18 MHz.

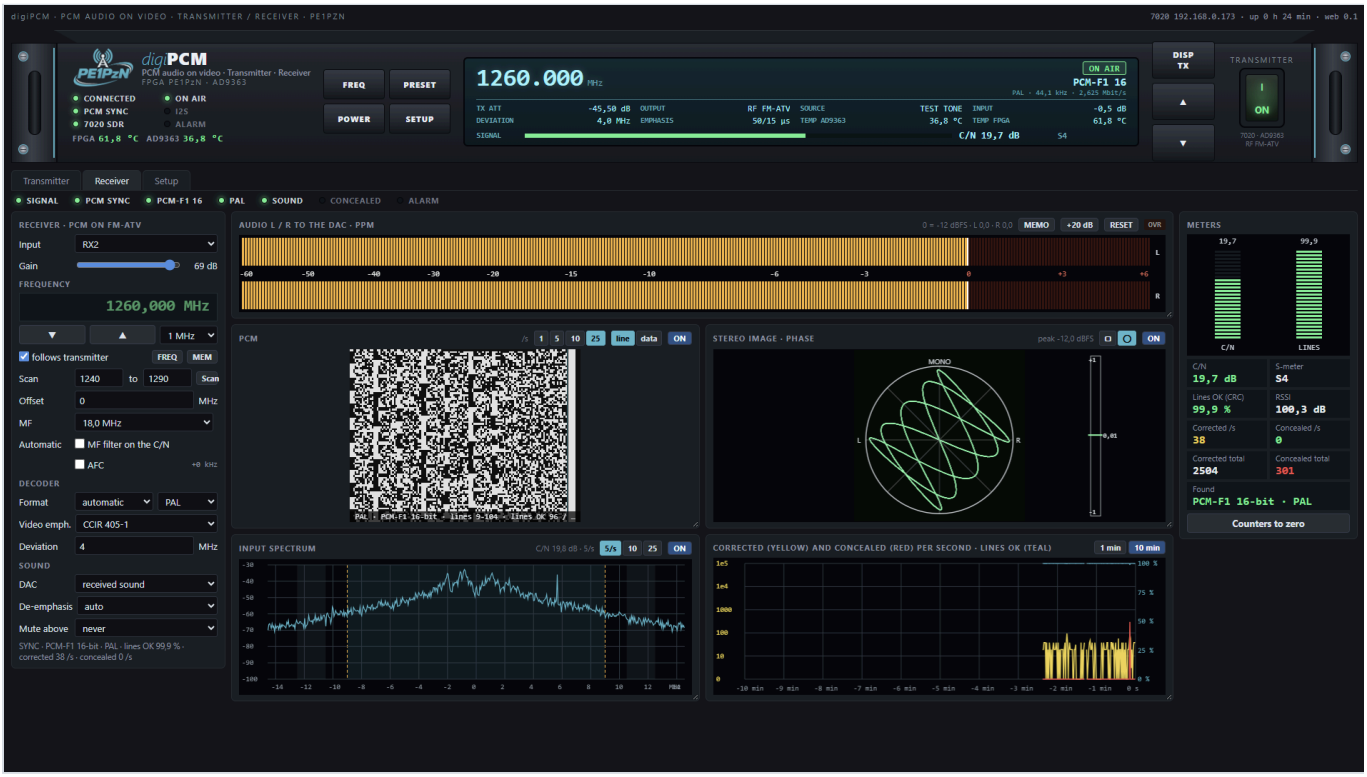
Controls on the left

Setting	What it does
Format	EIAJ 14-bit or PCM-F1 16-bit.
System	PAL or NTSC.
Source	Test tone (1 kHz), I2S (ADC).
Input gain	Gain of the ADC input, -20 to +12 dB.
Test tone	Level of the test tone, -60 to 0 dBFS (default -12).
Emphasis	Audio emphasis 50/15 µs on or off. The emphasis bit goes along in the signal.
Output	RF (FM-ATV). Composite will come later.
Video emph.	CCIR 405-1 (the standard), or as digiATV.
Channel	18 or 27 MHz wide.
Deviation	FM deviation from sync to white, 1 to 16 MHz (default 4).

On the right

- **Status bar**: EMPHASIS, CLIP (the sound is too loud) and ADC OVERLOAD. On the right the state of the source.
- **PPM** of the sound to the encoder: 0 = -12 dBFS. `MEMO` holds the peak, `+20 dB` for quiet signals, `RESET` clears the peak and OVR.
- **Output** and **PCM format**: what goes out now.
- **Spectrum** of the transmitted sound: FFT or 1/3 octave.
- **Stereo image**: `▢` square with phase bar, or `◯` round, like a vectorscope, with the correlation on the right.

6. Receiver



Receiver tab: PCM-F1 16-bit PAL on 1260 MHz, C/N 19.7 dB, 100 % good lines.

Controls on the left

Setting	What it does
Input, Gain	RX1 or RX2, and the gain (0 to 73 dB).
Frequency	Receive frequency, with ▼▲ and a step size. **follows transmitter**: the receiver is on the transmit frequency. `FREQ` to type, `MEM` memories.
Scan	Searches between two frequencies in steps of 1 MHz until there is PCM.
Offset	For a converter or LNB: the difference in MHz.
MF	Channel (IF) filter from 27 to 6 MHz. **Automatic**: narrower when the C/N gets worse, and only wider again after a minute.
AFC	Keeps the signal in the middle. Off at start-up.
Format	Automatic: the decoder finds the format itself. Or fixed EIAJ 14-bit or PCM-F1 16-bit, and PAL or NTSC.
Video emph., Deviation	As the transmitter at the other end.
DAC	What the DAC plays: nothing, test tone, the transmitted sound or the received sound.
De-emphasis	Off, auto (follows the emphasis bit in the signal) or always 50/15 µs.
Mute above	The DAC goes silent while there are more concealed samples per second than this. Never = never silent.

The PCM picture

The bits as the decoder sees them: 96 lines. `line` shows all cells of the line, with a teal mark where the data cells end; to the right of it the white reference. `data` shows only the data cells, stretched. A red tint = a line with an error. Choose 1, 5, 10 or 25 pictures per second.

Input spectrum

The RF spectrum around the tuning. Teal = the channel, orange = the edges of the IF filter. The C/N is measured against the noise floor next to the channel.

Errors

Per second: **corrected** (yellow) and **concealed** (red), and the good lines (teal), over 1 or 10 minutes. Corrected you do not hear. Concealed: there the decoder has estimated a sample.

Meters

The bars C/N and LINES, and the tiles: C/N, S-meter, good lines (CRC), RSSI, corrected and concealed per second and in total, and the format found. `Counters to zero` resets the totals.

> **Double click** on a box makes it large (Esc = back). Drag the bottom right corner of a box to make it taller or shorter; the browser remembers that.

7. Setup

On the left what this browser remembers: the PCM picture on or off, the number of pictures per second, the step of ▲▼ and the length of the error graph. Below that how much data the page uses. On the right the details of the 7020. Presets, memories and the power per frequency are on the card.

8. Known limitations

- This is a test version.
- Composite in and out will come later.
- PCM-F1 16-bit only has the P correction (that is the format). EIAJ 14-bit has P and Q, and is therefore stronger against errors.

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