

Conversion Manual for Philips FM1200 / 1300 VHF/UHF PMR with 12-button numeric keypad console

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Summary

This conversion developed by Dennis Koller PA4DEN is a follow-up of a simpler and less invasive conversion for 100 fixed channels developed by Gerrit Speelman PA1MT and described by Jan Buiting PE1CSI in *Radio Today*, September 2000. The conversion developed by Dennis PA4DEN is based on completely rewritten software for (1) main CPU, (2) tone CPU and (3) display CPU. It overcomes all restrictions of the original Philips firmware for FM1000 radios.

Essentially, the conversion consist of the following steps:

- 1) replacement of the EPROM in de display console
- 2) removal of the trunking PROM, clearing PCB area
- 3) mounting a new SMD PROM
- 4) construction of two small auxiliary circuits for CTCSS / 5-tone generation and detection
- 5) replacement of the 24C16 EEPROM by a larger type
- 6) fitting the new radio firmware (moulded 28-pin module)

Although it should be possible to carry out the conversion by referring to the schematics only, the conversion is described below in a step by step manner.

How it works

The following discussion makes reference to the schematic of the conversion circuit. Essentially, two small add-on audio circuits within the dashed area are connected to processor lines formerly used by the internal FFSK modem IC type FX419 (which is no longer used).

CTCSS tones are generated by the tone CPU using PWM (pulsewidth modulation) and look-up tables stored in the tone PROM. The software-generated PWM signals are taken from processor port line P1.3 and applied to an R-C low-pass filter to recover the sinusoidal envelope waveform. The 5tone, 1750 Hz and

DTMF tones generated using CPU port lines P1.1 and P1.2 are summed using R560 and R561. All tone signal lines are brought together and then injected into the modulation amplifier via opamp IC543B.

The 80C31 CPU 'reads' received tones via a level shifter stage built around the BC547 transistor. By removing feedback resistor R550, opamp IC541 supplies infinite gain thus converting analogue input signals at its input into quasi-digital pulses. However, because the pulses swing between 2V and 6V, further digitising is required to ensure a clean TTL swing of 0-5V, hence the addition of the BC547. The internal pull-up at the INT\ input of the 80C31 CPU acts as the collector resistor for the BC547. The fact that the input of the FX419 modem IC still receives speech and tone signals via C550 is of no consequence.

Contents of Conversion Kit

Resistor 47 k Ω
Resistor 4.7 k Ω
Resistor 82 k Ω
Resistor 10 k Ω
Resistor 1.8 k Ω
Transistor BC549 or BC547
Capacitor 0.22 μ F MKT
EEPROM 24C65 or 24(L)C64, programmed with basic radio settings
EPROM 27C256 or 27C128 (DIL28), programmed with Display Software
PROM 27C256R (PLCC32), programmed with Tone Software
Flash EEPROM module, moulded, programmed with Firmware
Transparent film for display
Marked-up circuit diagram of FM1200 control board
Marked-up component overlay of FM1200 control board
Schematic of conversion circuit
User Manual FM1200 / 1100 / 1300 VHF/UHF Personal Mobile Radio
Conversion Manual (this document)

Price of the Conversion Kit:

UK: £25 incl. P&P

Other countries: Euro 38 incl. P&P

Step-by-step conversion description

The version number of the control board inside your FM1200 or FM1300 radio is either **1**, **2**, **3** or **4** as shown by the number printed in yellow in the top right hand corner of the board. On Version-1 control boards, pin 32 of the firmware EPROM socket has to be connected to pin 28, and the moulded module has to be mounted 'bottom-down', i.e., with module pins 14 and 15 inserted in socket pins 16 and 17 respectively. Only version-1 boards have a 32-way PLCC socket for the trunking PROM (position IC549). This socket obviates PROM removal and all soldering work as described under 4) and 5) below since the old PROM is simply pulled from the socket and the new one inserted.

Warning. When handling integrated circuits, take precautions against static discharges.

1. Disassemble the display console and fit the new EPROM (marked 'display') from the Conversion Kit. For 27C128/256 only: relocate track jumper LK4 to left-hand position. Fit the new transparent film. Re-assemble the display console.
2. Remove the control board from the radio.
3. Check the position of the wire link near the trunking PROM IC549. The centre pad should be (re)connected to ground.
4. Remove the existing 27C256R PROM in position IC549. On control boards types 2, 3 and 4 a plastic anti-tamper cap has to be removed first. The IC itself is best removed using a small circular cutter (mini Flex), which is applied such that the pins are severed from all four sides of the IC body. In this process the PROM body may be destroyed without problems. The PROM pins left behind on the PCB are removed one by one using the solder iron tip. Next, smoothen the surface of the underlying PCB pads with the solder iron only. Do not use desoldering braid, as it will totally absorb the small amount of solder flux residue needed to solder in the new IC.
5. Mount the 27C256R PROM marked 'T' from the Conversion Kit. Position the PROM so that the hole (pin 1) is at the side of the nearby 80C31 processor. An SMD solder iron (max. power 15 watts) will be required. Carefully align the PROM on the underlying solder pads. Start by soldering one (corner) pin to get the device provisionally fixed in place, then re-check alignment and re-position if necessary. Use a continuity

tester and the PROM check-up diagram and table to verify proper connections of all PROM pins with the circuit. Also check for short circuits between PROM pins.

6. Remove the 24C16 EEPROM (IC311) and replace it with the 24C64, 24LC64 or 24C65 from the Conversion Kit. (not on control board type 1).
7. Remove the three SMD resistors marked in red on the component overlay drawing.
8. Cut the two tracks at the indicated locations on the component overlay drawing. These are very short tracks! Use your continuity tester or ohmmeter to make sure the tracks are effectively broken!
9. Now construct the two small circuits that appear within the dashed outline on the conversion schematic. The 7 components from the Conversion Kit are mounted on the control board using a flying lead construction. Be sure to keep the construction lower than the tops of the electrolytic capacitors on the board. Find suitable grounding points for the 0.22 μ F capacitor, the emitter of the BC547 and the 1.8k Ω resistor. Sufficient grounding points are available at the component side of the board. The blue squares on the component overlay drawing show the points where the auxiliary circuits are effectively connected. The number labels correspond with those shown in the conversion circuit schematic and the conversion board schematic. Use thin wire (wire-wrap) for the wire connections.
10. Use an ohmmeter and the circuit diagrams to check all wire connections and component connections within the added circuits.
11. Mount the converted control board into the radio chassis.
12. Remove the firmware EPROM 27C512 and mount the moulded Flash EEPROM module. Pin 1 of the module is marked with a white dot and a hole. Control board type 1 only: align the module 'bottom-down' in the 32-way socket. All other versions: the pin-1 marker on the module goes near the edge of the board.

Testing

1. Hold any key pressed while switching on the radio. The radio should enter a special display test mode. Check LCD contrast,

Component overlay for FM1200 control board type 2.
 Type 1, 3 and 4 may have minor differences.

— = out track
 ■ = connection pad for add-on circuit
 ■ = remove resistor

