EMBEDDED · FPGA & CIRCUIT DESIGN

FPGA & Circuit Design (Artix-7 · Vivado · Altium)

Digital design on a Xilinx Artix-7 FPGA and custom printed-circuit-board (PCB) design/manufacture with Altium.

Artix-7 | Xilinx Vivado | Altium | PCB Design | Digital Design | HDL

Developer: Ömer Barış Berk

Scope: FPGA digital design flow + Altium PCB design/manufacture

Status: Concept document + real PCB design example (layer drawings)

Concept / Design Document

Embedded

Ömer Barış Berk

1. Project Summary

This work covers two connected engineering areas: complex digital circuit design on a Xilinx Artix-7 FPGA with the Vivado toolchain, and custom printed-circuit-board (PCB) design/manufacture with Altium. The FPGA side provides high-speed, parallel digital logic on reconfigurable hardware; the PCB side makes these systems physically realizable.

Technologies Used

- **FPGA:** Xilinx Artix-7 — reconfigurable digital hardware
- **Toolchain:** Xilinx Vivado (synthesis, place, bitstream)
- **Description:** HDL (VHDL / Verilog)
- **PCB:** Altium Designer — schematic, layout, routing, manufacturing (Gerber)

> *This document covers the design flow and a real PCB design example on hand; it will be extended when a specific FPGA project's HDL modules, resource usage and simulation waveforms are added.*

2. FPGA Digital Design Flow (Artix-7 / Vivado)

On the Artix-7, a design is realized through a standard flow from hardware description language to a physical bitstream:

Stage	Description
1. Design (HDL)	Defining the digital logic in VHDL/Verilog
2. Behavioural simulation	Verifying the logic with a test bench (waveforms)
3. Synthesis	Converting the HDL into a logic-gate/LUT network
4. Implementation	Place and route — mapping to Artix-7 resources
5. Bitstream	Generating the configuration file and loading it onto the FPGA
6. Timing analysis	Verifying that the timing constraints are met

3. PCB Design with Altium

On the circuit-design side, the process from schematic to physical board is carried out with Altium Designer: schematic capture → component/footprint assignment → board layout → copper-trace routing → manufacturing outputs (Gerber). Below are the top (component placement) and bottom (copper routing) layer drawings of a custom-designed board.

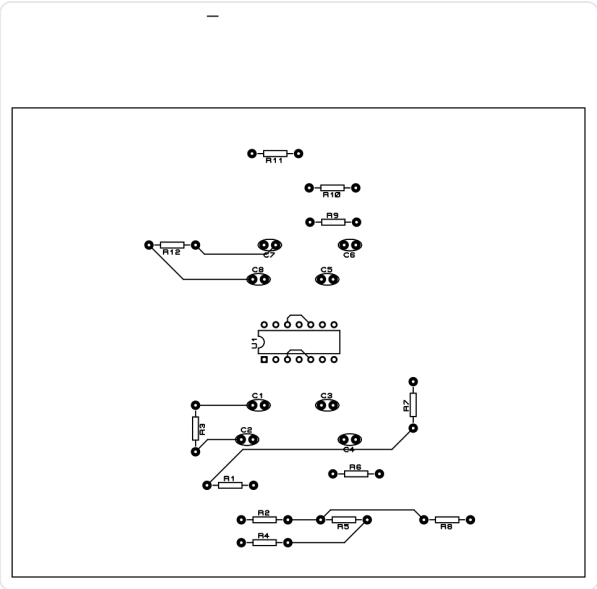

Figure 1. PCB top layer — component placement (silkscreen): one 16-pin integrated circuit (U1), 12 resistors (R1–R12) and 8 capacitors (C1–C8).

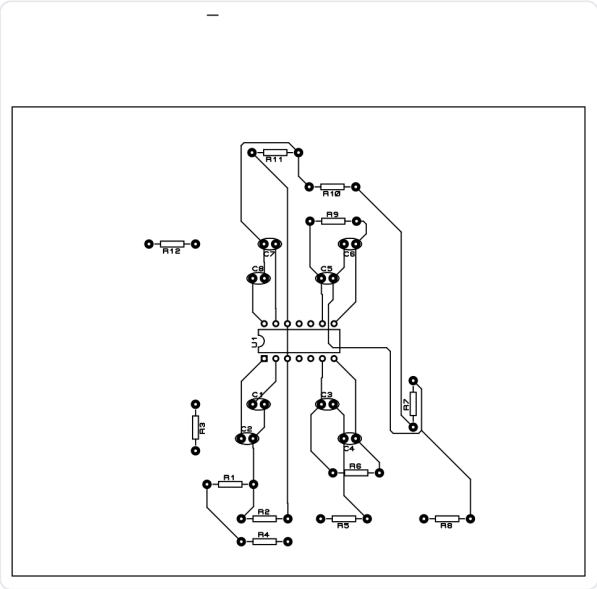

Figure 2. PCB bottom layer — copper routing. The connections between components are solved on a single copper side.

> *The same PCB design also appears in the hardware section of the Border Security Drone project (cross-reference).*