

Midnight Design Solutions



SDR Cube Transceiver Online Assembly Guide

Select links below for detailed construction notes for building & testing the SDR Cube kit modules

[Home](#) [Bill of Materials](#) [I/O Board](#) [Controls Board](#) [DSP Board](#) [Softrock SR-Base](#) [Softrock TX/PA](#)
[RXAMP](#) [X-LPF](#) [Internal Cable Set](#) [External Cable Set](#) [Main Enclosure](#) [Accessory Enclosure](#)
[Digital Subassembly Test](#) [Final Assembly](#) [RF Functional Test](#)

Welcome to the SDR Cube Kit "Online Assembly Guide"!

[Revisions Log](#)

What's New?

A "Service Pack" was shipped in January to Cube Kit owners to supply parts missing from initial "Early Bird" orders ...
ENC (sub-chassis bracket); *X-LPF* (2-pin header); *RXAMP* (0.1uF 0805 SMT cap C3); *DSP* (two 1/4" nylon threaded spacers and #4-40 screws); *CABLE-INT* (6" 2-wire ribbon cable, extra 2- and 3-pin receptacles); and *SR-Base* (U5, two 1K resistors, six 10K resistors, one 22.1K resistor, one 4.99K resistor, four 0.01uF SMT caps, two 4.7uF caps); *I/O* (tie-wrap).



Thank you ... for purchasing the SDR Cube Transceiver Kit! This is the official online resource for guidance in

Assembling the SDR Cube Transceiver

building, setting up and using the SDR Cube, and we'll be keeping these web pages very current with the latest information, tips & techniques, and guidance for getting the most from your investment in this very fun and leading-edge amateur radio product.

This website provides detailed instructions for assembling each of the 11 sub-modules comprising the SDR Cube, as listed along the top of this page in the banner. Because the Cube is such a modular product, you might have opted to only get a few of the modules for now ... but that's okay, as we'll take you through the construction of "the whole enchilada" and you can just pay attention to the modules that you purchased.

What you are reading now here is our "home page" for the Online Assembly Guide. We will cover some of the basics in order to set the stage for you understanding the high-level organization of the Cube, the skills and tools that are going to be required of you in order to assemble its modules, and present a set of files for convenient downloading of concise documentation so you might take the build process offline. We'll also provide some "tech support" contacts that might be helpful if the going gets rough.

If you instead wish to work offline, or work from a printed copy of the Assembly Guide, we have provided a [PDF file](#) for each section that you can download to your computer and print.

So browse through the information on this page to familiarize yourself with the framework of the kit building project sitting in front of you, and keep in mind that you can zip around pretty easily on this website using the links in the page banner above (also present on every other page). We designed this website in a very flat and hot-linked manner to serve you well no matter what you are focusing on building or troubleshooting.

"Okay, so where do I start?!"

The recommended order for building the SDR Cube modules is ... **(1)** I/O board, **(2)** Controls board, **(3)** DSP board, **(4)** Cable #1 in the Internal Cables package, **(5)** Install in Enclosure, **(6)** Digital Subassembly Test ... and celebrate! Then continuing onward with ... **(7)** SR-Base, **(8)** TXPA, **(9)** RXAMP, **(10)** X-LPF, **(11)** the rest of the Internal Cables and/or the External Cables, and **(12)** RF Functional Test ... and rejoice!

We hope you enjoy building and using your SDR Cube!

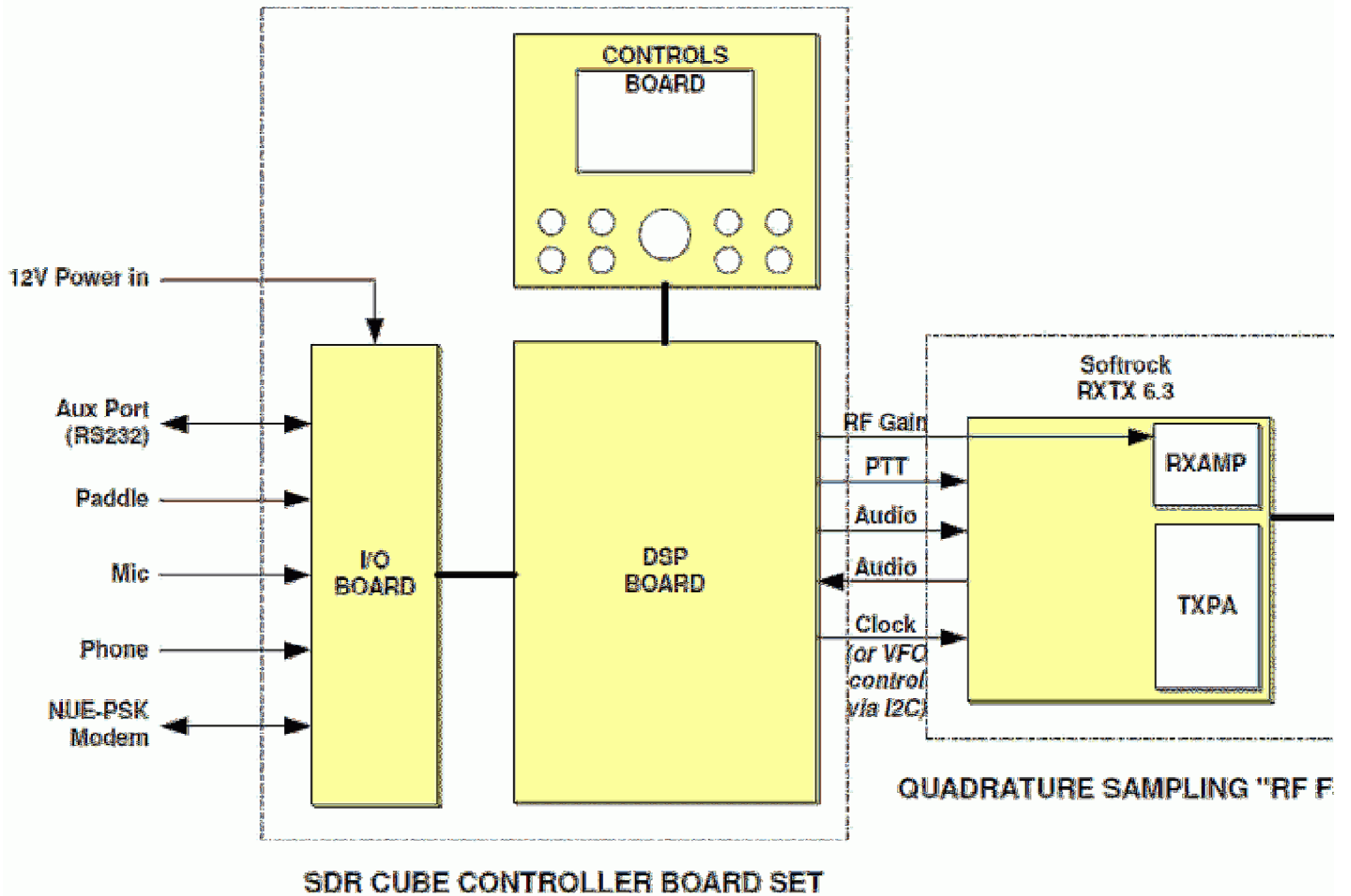
73, George N2APB and Juha OH2NLT

[Home Page Contents ...](#) [Overview](#) [Module Descriptions](#) [Skillsets & Tools](#)
[Documents](#) [Tech Support](#) [Assy Guide PDFs](#)

SDR Cube Overview

The SDR Cube is a QRP transceiver consisting of an embedded DSP controller coupled with a Softrock as the RF deck. A PC is not needed with this SDR because all the signal processing is accomplished "in the box". Sized at 4" x 4" x 4", the Cube contains a full complement of built-in user interface: graphic LCD for spectrum display, typical controls for frequency, mode and signal management, and I/O connectors for connection to the outside world. The Cube design is optimized to internally accommodate the popular Softrock RXTX 6.3 electronics. Alternatively, a connector on the rear panel allows the SDR Cube to connect with virtually any other quadrature sampling RF front end that uses the standard I/Q baseband audio signals. Different from other experimenter single board solutions, the Cube was designed from the start to serve as a complete and standalone transceiver – the power and flexibility that software defined radio brings, with the convenience of a full user interface with standard (physical) radio controls that most operators prefer, and the small size to allow easy portability.

Assembling the SDR Cube Transceiver



The SDR Cube controller consists of three interconnecting pc boards that serve to interface with the user and provide the signal processing necessary for processing the in-phase and quadrature (I and Q) audio signals to/from the RF front end. The I/O board provides for the connection of the usual radio peripherals – mic, paddle headphones – and an RS-232 port for enabling the Cube’s software to be easily updated by the user when needed.

The SDR Cube is designed to interface to any quadrature-based RF front end that provides I/Q baseband audio signals. We use the terms “RF front end” and “RF deck” to mean the electronics that perform the mixing, amplification and filtering of RF signals for an HF radio. The most popular and prolific RF deck around is the Softrock family of small and inexpensive kits. Some 11,000 of these boards in different flavors have been sold around the world already, and each depends on a PC for signal processing and user interface. So by designing the SDR Cube to easily interface with this huge installed base of Softrocks, and especially for the RXTX 6.3 model that we include as an optional rf deck in the kit, we provide a way for every Softrock owner to decouple from the complexities of using the PC as a radio.

SDR Cube Module Descriptions

PCB-Bare – A set of the three PC Boards, without any parts.

PCB-Kit – Three separate bags containing the pc board and parts for the DSP, I/O and Controls boards comprising the Cube

Cable-Kit (Int) – The connectors and wire to be used to create cables needed to connect the Cube electronics to an internal RF front end (e.g., Softrock)

Assembling the SDR Cube Transceiver

- Cable-Kit (Ext)** -- A bag containing the connectors and wire to be used to create cables needed to connect the Cube electronics to a connector on the rear panel, thus enabling you to control an external RF front end (e.g., Softrock)
- Cable-Modem** – The special cable that interconnects the SDR Cube with the NUE-PSK Digital Modem. Enables optimized support of digital modes.
- SR-Base-Kit** – The base board for the Softrock RXTX 6.3 rf front end. Nearly identical to the original RXTX 6.3 sold by Tony Parks KB9YIG, except for: pinheaders added, two capacitor substitutions for improved performance, removed unneeded parts (DIP switch, DB9 connector), and different mounting hardware.
- X-LPF-Kit** – The small pc board and components kit that serves as an external low pass filter board. (Included with every SR-Base-Kit order.)
- TXPA-Kit** – The Transmit/PA module kit that plugs into the SR-Base. May be built for either 30/20/17 or 80/40 band groups.
- RXAMP-Kit** – The Receive Amp/Filter/Attenuator board kit that plugs into the SR-Base. May be built for any of the four frequency groups covering the HF spectrum.
- Clock-Si570** – The Si570 chip for optional use on the Controls board of the Cube, providing the programmable LO clock to RF decks that might not have an onboard clock generator.
- Clock-DDS** – The handful of components (and DDS chip) for optional use on the Controls board of the Cube, providing the programmable LO clock to RF decks that might not have an onboard clock generator.
- ENC-Cube** – The black powder-coated aluminum clamshell enclosure, pre-milled and labeled for use with the Cube.
- ENC-Accy** – The black powder-coated aluminum clamshell enclosure, no holes. Useful for containing various homebrew station accessories.

Skillssets & Tools needed for Building the SDR Cube

Homebrewers with at least some amount of experience with surface mount devices (SMD) should have no problems successfully assembling the SDR Cube. For the most part, we used the larger sized "1206" devices for the resistors and capacitors, and the relatively larger SOIC integrated circuits with the wider-spaced leads. There are many excellent online references and videos for soldering SMD devices - just do an online search with those keywords and you'll enjoy the long list of other people's suggestions. For general guidance in this area, we particularly like the [PDF document](#) at the Sparkfun site. Also there at Sparkfun, you can see a number of [tutorial videos](#) actually showing someone attaching ICs just like you'll be doing here in the SDR Cube kit.

In several cases, and only when it was unavoidable, we used some ICs with closely-spaced leads that will need slow and careful attention when soldering to the pc board. One of these ICs is the dsPIC33F controller for the Cube, IC3, which is a 100-pin TQFP package on the DSP board. Four other ICs will need some special attention, but are not nearly as formidable: the codec (IC4) on the DSP board and the level shifters (IC13 and IC14) on the Controls board. We gave our "flood soldering" guidance at the IC3 point in the DSP assembly instructions, so you can see what works for us. What works for you is actually up to you ... the end goal is a properly attached IC, no matter how you get there.

The references mentioned at the Sparkfun site highlight the tools you'll need for attaching the SMDs to the board ... good magnifying headset and/or a good lighted magnifying lamp, fine-tipped soldering iron (a temperature-controlled station is preferable), thin solder (0.015") and thicker/normal solder. Then of course

Assembling the SDR Cube Transceiver

the standard homebrewer's bench tools will be used along the way ... screwdrivers, volt-ohmmeter, pliers, side cutters, etc. Additionally, a "[PCB vise](#)" or some other method of holding a board-in-progress from moving around can be of great help.

Overall, we think it will take a confident homebrewer about **seven hours** to assemble the three Cube pc boards (DSP, Controls, I/O) and get them working. Of course it is best to break this time up into many stages, take many breaks to clear the mind, eyes and muscles, and be sure to double-check your work at every opportunity. Quite honestly, between us two designers, we've probably built up 10-to-15 Cube board sets, and other than some solder shorts and other minor errors, each Cube became operational in a very short amount of time. It is actually a straightforward design and it is troubleshooting is straightforward if problems are encountered.

Essential Documents

- [Cube Schematics](#) -- Single file containing DSP, Controls, I/O, RXAMP and X-LPF
- [Softrock RXTX 6.3 Schematics](#) -- Single file containing the three RXTX schematics as used in the SDR Cube
- [Parts Lists \(BOMs\)](#) -- Full set of Bill of Materials in single file
- [Board Interconnection](#) -- A convenient 1-page diagram showing how the boards and cables connect.
- [Internal Cable Construction](#) -- A 1-page diagram showing how to construct the "internal cables" that connect the Cube boards to the internal Softrock.
- [External Cable Construction](#) -- A 1-page diagram showing how to construct the "external cables" connecting the Cube boards to the External Softrock connector on the rear panel.
- [Mechanical Assembly](#) -- A 1-page diagram of board assembly in the enclosure
- [Features List](#) -- Quick summary of Cube features
- [Operator's Manual](#) -- Describes how to use the SDR Cube
- [Read Me First Sheet](#) -- Introduction to the SDR Cube Kit, included in all packages shipped

Downloadable Assembly Guide

One PDF file for each section is provided below for downloading, printing or storing on your computer, if desired. Each section has a "version number" listed in the title bar at the top of the page to help you keep track of things when updates have occurred, and a brief description of the latest change is listed below for each section.

- [Home ...](#) Version 1a
- [Bill of Materials ...](#) Version 1a
- [I/O Board ...](#) Version 1a
- [Controls Board ...](#) Version 1a
- [DSP Board ...](#) Version 1a
- [Softrock SR-Base ...](#) Version 1b
- [Softrock TX/PA ...](#) Version 1a
- [RXAMP Board ...](#) Version 1a
- [X-LPF Board ...](#) Version 1b
- [Internal Cable Set ...](#) Version 1b
- [External Cable Set ...](#) Version 1ab
- [Main Enclosure ...](#) Version 1a
- [Accessory Enclosure ...](#) Version 1a
- [Digital Subassembly Test ...](#) Version 1a
- [Final Assembly ...](#) Version 1a
- [RF Functional Test ...](#) Version 1a
- [Revisions Log ...](#) January 31, 2011

Technical Support

1. **This website (<http://www.sdr-cube.com/construction>)** -- The first line of support that is provided is actually the best ... and you're in it right now! if you have a problem, chances are that someone else had a problem too and we are very fast in incorporating new/corrected information to help all builders get their kits working. Just go to the module you are having trouble with and look for possible ideas to help you through.
2. **The SDR Cube's Home page (<http://www.sdr-cube.com>)** -- Similarly, we provide a link with Builder's Notes, or "special things to watch out for" when building the Cube.
3. **The SDR Cube email site on Yahoo Groups (<http://groups.yahoo.com/group/sdr-cube/>)**-- Again, if you are having a problem, chances are good that someone already posted a question to the group ... and maybe there is an answer there already! If not yet answered, any number of Cube owners may hop in to help right away, even before us two designers have a chance! We have a very sharp technical group.
4. **Email to the designers: George N2APB (n2apb@midnightdesignsolutions.com) or Juha OH2NLT (juha.niinikoski@sitecno.fi)** -- We really don't mind answering questions that you are not able to resolve on your own by the above methods.

Copyright 2010 Midnight Design Solutions, LLC. All Rights Reserved.

Pagemaster: n2apb@midnightdesignsolutions.com

Page last updated: Jan 22, 2010