

## Crystal Sets to Sideband

*Dear friends, I have read the book with great interest. The book really captivates and I cannot tear myself away the book. The book contains 16 very interesting chapters, and every chapter says us a separately story about radio. I can strongly recommend to you have read this book. Below you can see the Contents of the book and path to load this one.*

**73! I.G.**

### CRYSTAL SETS TO SIDEBAND

#### A Guide to Building an Amateur Radio Station

By Frank W. Harris, KØIYE

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### Contents

#### Chapter 1

##### THE FASCINATION OF RADIO

- Exploring the shortwave bands
- Growing up in the Morse code era
- The joy of building it yourself
- A brief history of radio communication
- Henry, Maxwell, Hertz, Tesla and Marconi.
- Fessenden, Edison, Flemming, DeForest and Armstrong
- The sinking of the RMS Republic and the birth of ham radio
- Ham radio in the last 80 years
- Becoming a radio amateur

#### Chapter 2

##### HOMEBUILDING AMATEUR RADIO EQUIPMENT

- What qualifies as homebuilding?
- When homebrewing is not appropriate
- Barriers to modern homebuilding –
- Time, frequency stability and lead inductance
- Basic electrical knowledge
- Magnets & static electricity
- Voltage, current, resistance, energy and power (Illustrated with drawings of water & mechanical analogies)
- Conductors, Insulators and semiconductors
- Capacitors, inductors, transformers & alternators
- Home power distribution, transformers at low and high frequencies

#### Chapter 3

##### SETTING UP AN ELECTRONICS WORKSHOP

- R&D as recreation
- How to build radios (or anything else) in your basement
- Persistence, read books, keep a notebook, & work in small increments
- Minimum tools needed
- The ARRL Amateur Radio Handbook
- Soldering irons and small tools
- Drills & thread taps
- Wood carving gouges for making PC boards
- >50 MHz Oscilloscope
- Frequency counter
- Quality multimeter
- Lab power supply
- Calculator
- Lab notebook
- Collection of electronic junk
- Parts catalogs
- Capacitance meter
- Test leads & socket boards
- Nice-to-have tools
- RF & audio generators, spice software & spectrum analyzer

#### Chapter 4

##### HERTZIAN WAVES IN THE BASEMENT

- The nature of radio waves
- Mechanical and LC electrical oscillators
- Antenna and transmission line theory

- Crystal set components
- LC tuner
- PN junction diode detectors
- P-type and N-type semiconductors
- Detection of AM signals
- Homebuilding the parts for a crystal set
- The Jamestown diode
- The Caribou headphone
- Recreating Hertz's radio equipment
- Transmitting and receiving as simply as possible
- The 1880 ten-meter communicator
- Proving that radio waves exist and aren't just capacitive or magnetic coupling
- Demonstrating standing waves to measure frequency
- Building homebrew transistors
- Bipolar transistors, PNP and NPN
- Demonstrating voltage gain
- The Boulder Rock Radio

## Chapter 5

### **GETTING ON THE AIR - DECIDING WHAT TO DO FIRST**

- How to earn a license
- The rules of the homebuilding game – Whatever makes you happy!
- Picking an HF band
- Getting acquainted with the HF ham bands, 160 – 10 meters
- Instant high quality HF communications
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- Building an antenna
- Dipoles, regular and folded
- Multi-band dipoles
- 80 meters when you don't have room for a dipole
- The curtain rod vertical
- A multi-band vertical antenna
- Lightning protection

## Chapter 6

### **BUILDING A QRP HOMEBREW**

- A single-band, crystal-controlled, QRP module
- The transmitter mainframe
- HF construction methods
- Making your own PC boards
- "Dead Bug" and "Gouged Board" construction
- Superglue "Island Boards"
- Coax jumpers
- Shielded boxes
- The complete QRP crystal-controlled transmitter
- Transistor amplifiers and oscillators

## Crystal Sets to Sideband

- How an amplifier becomes an oscillator
- Class A and Class C amplifiers
- Stabilizing the operating point, bypass caps and emitter resistors
- Quartz crystals – the key to frequency stability
- The 40 meter QRP circuit
- Oscillator and buffer
- Inductors, RF transformers and impedance matching
- Tapped toroid inductors
- How to wind them (and mistakes you might make)
- The final amplifier stages for the QRP
- Tuned versus broadband - Use both for best results
- Bifilar wound, broadband transformers
- How to wind them (and how you might screw up)
- Ferrite bead RF chokes, expensive RF power transistors, heat sinks & output connectors
- Conquering inductors
- Calculating resonance
- Calibrating trimmer capacitors
- Calculating turns on powdered iron and ferrite toroids
- Chebyshev output low pass filters
- Keying your QRP
- MOSFET power transistors
- A "spot switch" for the QRP

## Chapter 7

### **BUILDING A CODE PRACTICE RECEIVER**

- A simple, direct-conversion receiver
- A great first project for a new ham
- Excellent sensitivity and good stability
- Poor selectivity
- Adding 700 Hz audio filtering
- High pass and low pass filters
- Cascaded bandpass filters increase selectivity
- Operational amplifiers
- Building with integrated circuits
- AM broadcast filter
- Getting rid of the image

## Chapter 8

### **POWER SUPPLIES**

- Line powered power supplies
- Power supply safety features
- Isolation, 3-conductor cords, fuses, switches, ratings
- Supply performance and regulation
- Rectification, ripple, chokes, capacitors, & bleeders
- Zeners, linear regulators, switching regulators

- A QRP regulated power supply
- A battery power supply for the radio shack
- Solar cell charging, low drop-out regulators
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### Chapter 9

#### ACCESSORIES FOR THE TRANSMITTER

- A straight key
- An electronic bug
- Building dummy loads
- "T" type antenna coupler
- A low pass filter
- How to stay legal with a homebrew transmitter
- Antenna and power relays
- Homebrew QSL cards

### Chapter 10

#### VARIABLE FREQUENCY OSCILLATORS

- Drift is a big deal today
- Low frequency VFOs drift less than high frequency VFOs
- JFET transistors
- The oscillator circuit
- The buffer, final amplifier and output filter
- The 50 secrets of avoiding drift
- JFETs, single-side PC boards, cast metal box, multiple NPO caps, small variable caps, precision voltage regulation and more
- Vernier tuning
- Varactor tuning elements – advantages and disadvantages
- A precision power supply
- A voltage doubler power supply for battery use
- Square wave generator with a multivibrator
- Squaring up the square wave
- Charge pump, diode/ capacitor voltage doubler
- Schottky diodes for efficiency
- Temperature compensation methods
- Positive coefficient capacitive trimmer compensation
- How to adjust the compensator
- Thermistor/ varactor temperature compensation

### Chapter 11

#### Building a VFO for the higher bands (PMOs)

- Old approaches that no longer work
- Frequency multiplication
- High frequency oscillators
- PreMix Oscillator method of frequency translation
- A VFO-controlled QRP module

### Crystal Sets to Sideband

- Crystal oscillators are stable, aren't they?
- Crystal oscillator circuits
- Butler oscillators and big crystals
- Mixers, bipolar transistor and dual-gate MOSFET
- Optimum drive requirements
- Direction of tuning, drift error cancellation
- Multistage filters and filter/amplifiers
- The QRP final amplifier stages

### Chapter 12

#### FINAL AMPLIFIERS

- The basic features of a modern linear power amplifier
- It looked easier in the Handbook
- Linear "noise mode" operation
- A tuned 50 watt class B amplifier
- Ferrite balun transformers
- An untuned, sort-of-linear, class B, amplifier
- Keying the 50 watt transmitter
- A linear Class AB amplifier, this time for sure
- Single Sideband (SSB) needs a linear
- Biasing without thermal runaway
- Clamp diodes prevent runaway
- Mechanical construction

### Chapter 13

#### BUILDING A HOMEBREW HF RECEIVER

- Building a receiver - an unusual adventure
- What's a reasonable goal?
- An "adequate performance" HF communication receiver
- Does it have to be so complicated?
- Planning your receiver
- Direct conversion versus superhetrodyne
- Why not single conversion?
- Start with a single-band, single-conversion superhetrodyne
- How do modern digital receivers do it?
- Receiver construction – build with shielded modules connected by thin coax.
- The 80 meter preselector
- Reception on 80 meter and 160 meters is aided by a tuned transmatch
- The Variable Frequency Oscillator
- Mixer magic
- Mixers will give you lots of static – and howls and squeals
- A practical homebrew mixer made from discrete parts – it's harder than it looks
- Dual gate MOSFET mixers
- Not all MOSFETS work equally well
- Crystal ladder filters – essential for CW
- All 9.000 MHz crystals aren't equal

- Using the BFO oscillator to match crystals
- Switch in filters with a rotary switch
- The IF amplifier
- The cascode amplifier strip - variable gain with constant Q
- Automatic Gain Control (AGC) - not a luxury
- The product detector
- Nearly anything works at least a little
- The AF amplifier – a vital part of the signal dynamic range
- Protecting your ears from strong signals
- How Hi-Fi should it be?
- Driving a speaker
- HF converters for the other ham bands
- Crystal oscillators
- Bandswitching
- Receiver power supplies
- Use a linear regulator, not a switching regulator

### Chapter 14

#### OLD-TECH VACUUM TUBE RADIO

- How old can radio technology be and still be used on the air today?
- Why bother with vacuum tubes?
- Glowing filaments, colored plasmas & Jules Verne glass envelopes
- Power supplies for tubes
- High voltage power supply safety
- The old-tech QRP transmitter
- Vacuum tube amplifiers
- The three roles of the triode filament
- RF sinewave oscillator
- Quartz crystals
- Triode and pentode oscillators
- Old-tech voltage regulation – big, crude, expensive, but beautiful
- The travails of triode tubes
- The oscillator and buffer
- The final amplifier – triodes chirp
- The transmitter power supply
- An inadequate supply from a 1935 radio
- A good power supply made from cheap, modern, boring parts
- How to check out junk power transformers
- A complex but adequate supply made from ancient parts
- It works! No one suspects it's old and it's a success on today's 40 meter band
- An old-tech receiver
- A super regenerative receiver made from ancient tubes
- The power supply
- Super-regen on the modern hambands
- Lots of fun, but not up to modern QRM & QRPs - back to the drawing board!

### Chapter 15

#### THE NOBEL PRIZE FOR SIDEBAND

- It can't be that hard! Want to bet?
- The sideband generator – how it works
- The 9 MHz oscillator / amplifier
- The audio amplifier
- The balanced modulator
- Building your own crystal ladder filter
- Decoupling the power supply leads
- Getting rid of RF feedback - RF filtering for all inputs
- Tuning and testing
- Using the generator for AM modulation and CW
- Moving the 9 MHz SSB signal to a hamband
- Move the SSB only once!
- No wonder most ham rigs are transceivers
- Moving the 9 MHz signal to the difficult HF hambands
- Move the VFO first, then mix it with the SSB 9 MHz.
- Pick your oscillator and VFO frequencies carefully
- Hearing your own VFO in the receiver
- The hardest band – 17 meters
- Covering the widest band – 10 meters
- A linear sideband QRP, VFO-tuned module
- All stages must be linear and low distortion
- All gain stages should be broadband to prevent oscillation
- Sometimes high pass filter output is needed & not the usual low pass
- Checking out the generator
- Driving a 50 watt linear amplifier

### Chapter 16

#### ANCIENT MODULATION

- Defining amplitude modulation
- Modulating vacuum tube final amplifiers
- Plate, screen & cathode modulation
- A "collector modulator"
- Converting a MOSFET keyer into a modulator
- Generating AM with an SSB balanced modulator
- Compensating for non-linearity
- Compression by accident
- You probably don't need to build a compressor

#### In conclusion:

*Homebrew ham radio is never complete - when it works perfectly and does all the latest stuff, the hobby is over. Not likely. Long live homebuilding!  
Thanks for reading my book.*

**73's Frank W. Harris, KØIYE**