

SMT Soldering.

It's Not Just a Lot of "Hot Air"

Steve Smith WB6TNL
Mike Schettler WA6MER

October 20, 2007

Outline

- Why Surface Mount?
- Some Recent SMT QRP Kits
- SMT Assembly Methods for Hams
- Which SMT Method is Best for You?
- Tools for Any Method of SMT
- Additional Tools for the Hot Air Method
- Step-by-Step Photos of SMT Assembly Using the Hot Air Method
- Web Links

Why Surface Mount?

For Commercial Manufacturers:

- **Cost.** SMT components are less costly to manufacture than conventional leaded parts. Also streamlines automated manufacturing processes.
- **Size.** Along with trying to cram more functionality into each box, everything is shrinking, especially mobile electronics. Less 'real estate' (ie, smaller circuit boards) means less copper.
- **Weight.** SMT components weigh much less than equivalent leaded components. Also, much less solder is used during assembly, compared to leaded parts.
- **Environmental.** RoHS (Restriction of Hazardous Substances) Directive has nearly eliminated lead bearing solders in industry.
- **Availability.** Many new parts, especially ICs, are simply not available in conventional packaging.

For low-volume QRP amateur radio kit manufacturers, many of the same:

- **Cost**
- **Size**
- **Availability**

Some Recent SMT QRP Kits

| Kit | Description | Active / Retired |
|---------------------------------|--|------------------|
| NorCal SMK-1 | 40m CW Transceiver, with Tx & Rx VXO's | Retired |
| NorCal 2030 | 30 or 20m High Performance CW Transceiver, using Tayloe mixers, more than 400 SMT parts | Retired |
| KD1JV ATS, ATS-2, ATS-3, ATS-3A | Multi-band CW Transceiver, fits inside Altoids tin. Popular with ARS Spartan Sprint contesters | Retired |
| KD1JV ATS-3B | 6-band (80-15m) CW Transceiver, 5W, DDS based, fits inside Altoids tin | Active |
| NorCal Tuner Upper | Single band (40/30/20m) antenna tuning aid | Active |
| NorCal FCC-2 | 0-20 MHz DDS VFO / signal generator, used with NorCal FCC-1 | Active |
| NorCal Dummy Load | 5W dummy load. Great SMT starter kit! | Active |
| QRPKits Firefly | Single band (30 or 20m) CW transceiver, using SDR receiver | Active |
| NJ QRP Micro908 Controller | Multipurpose Digital Platform, heart of Micro908 system | Active |

SMT Assembly Methods for Hams

- Conventional solder & soldering iron
- Solder paste, applied with a syringe, heated by:
 - Toaster oven
 - Electric skillet
 - Hot air embossing tool

Today we will review and demonstrate the embossing tool method

Which SMT Method is Best for You?

| Method | Tools Needed | Pro | Con |
|------------------------|--|---|--|
| Soldering iron | Small diam tip, small diam solder, fine-point tweezers, visual aid | Minimal new tools | Slow, solder bridging on fine pitch leads |
| Toaster oven | Solder paste, dedicated toaster oven, oven thermometer | Fast. Paste applied in one step, then place all parts | Slow reaction to temperature control, observability |
| Electric skillet | Solder paste, oven thermometer | Fast. Paste applied in one step, then place all parts | Skillet is single-sided boards only, temp. control |
| Hot air embossing tool | Solder paste, hot air embossing tool | Fast. Better control of heat. Can do 2-sided boards (FCC-2, NorCal DL). | High profile parts can move off pads due to hot air velocity |

Tools for Any Method of SMT

- Solder wick
- Tweezers
- Toothpicks
- Something to hold your board, or tray / pan
- Audible continuity tester
- Magnifying lens or other optical aid
- Good lighting

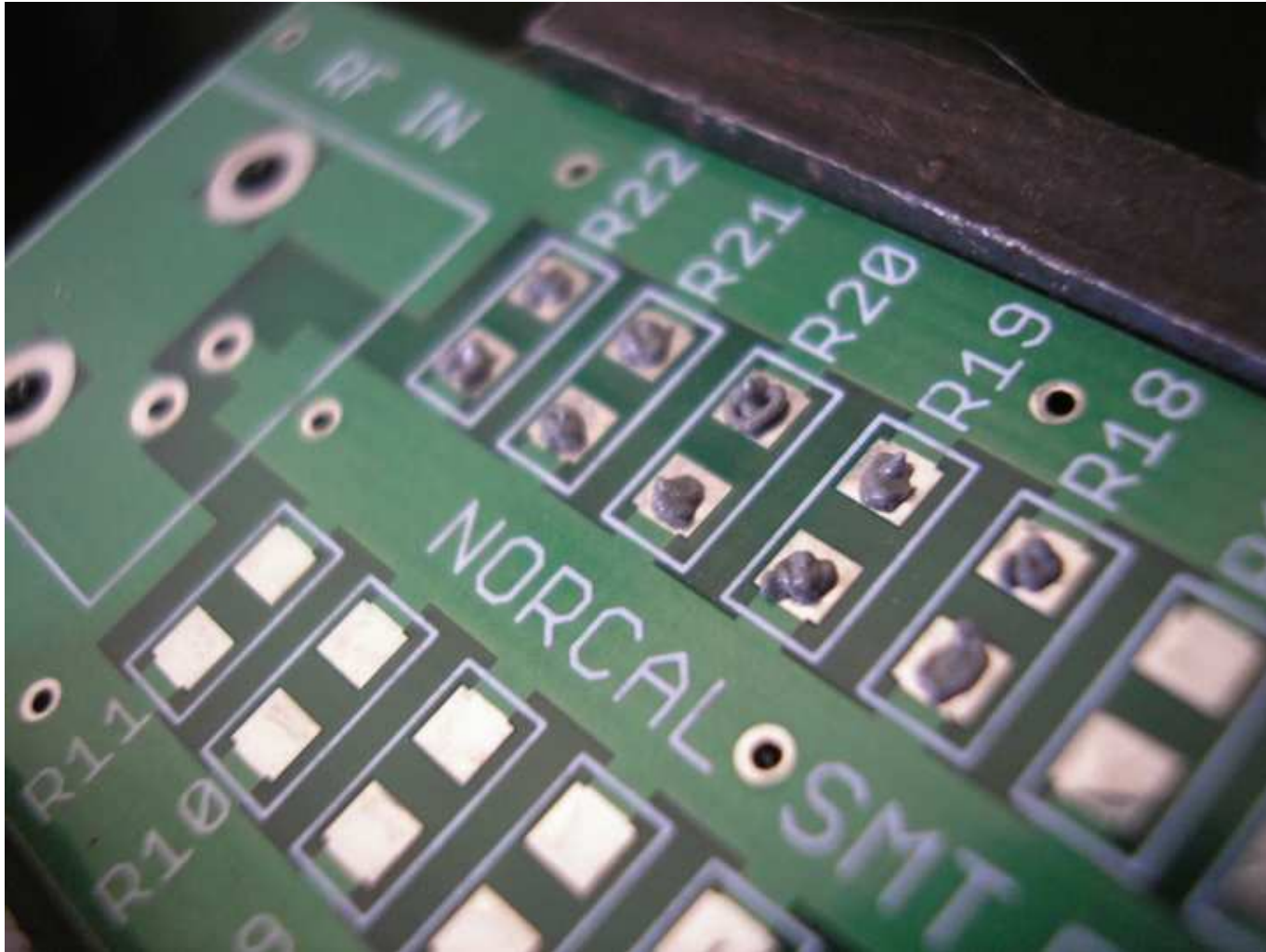


Additional Tools for Hot Air Method

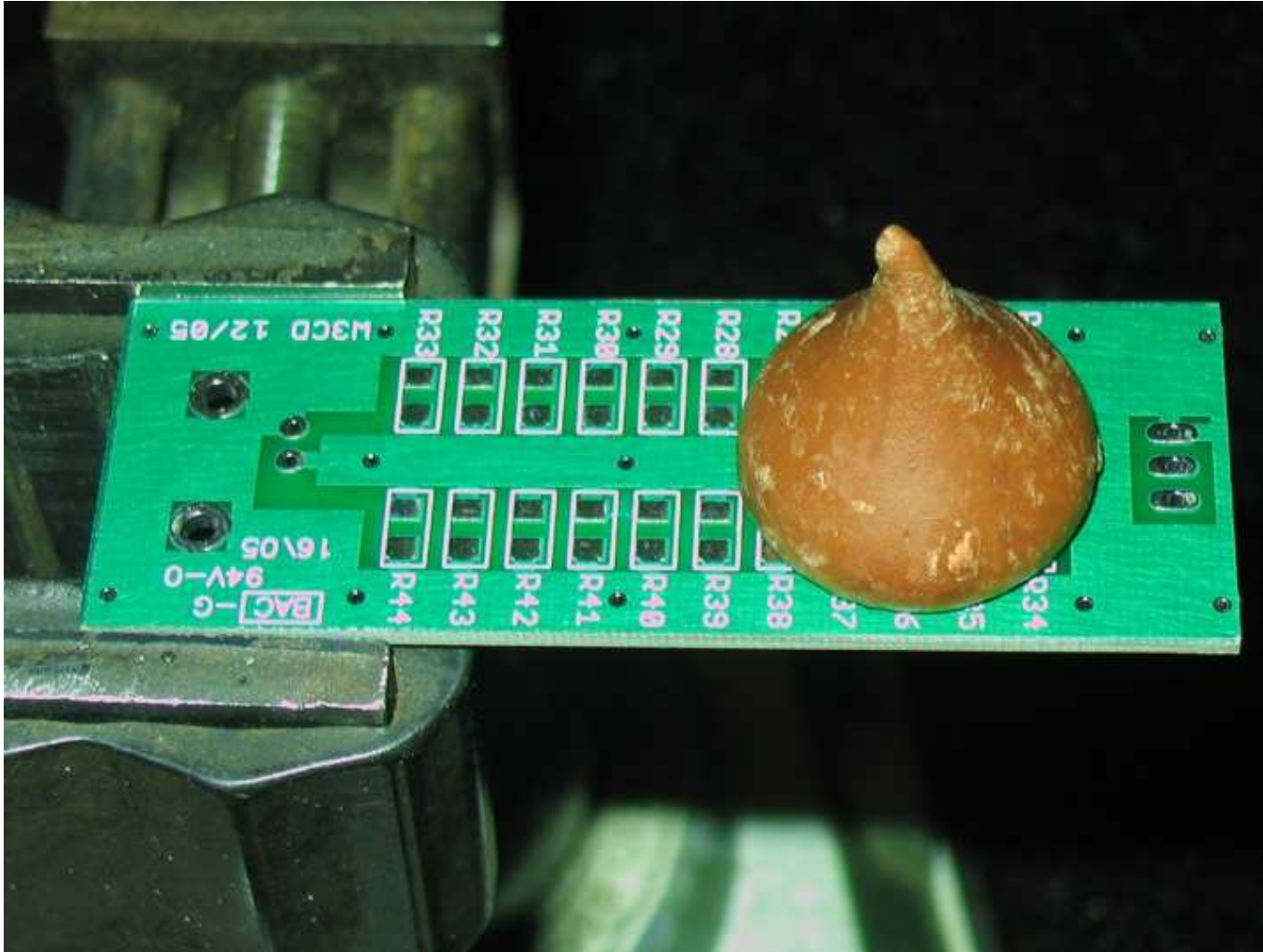
- Hot air embossing tool
- Solder paste
- Beverage warmer



Apply Solder Paste in Small Amounts



An Early Attempt



Pacificon 2007

QRPacificon

Place Parts on Circuit Board

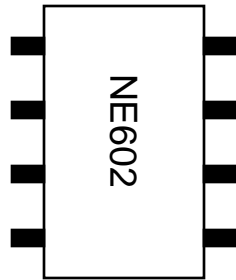
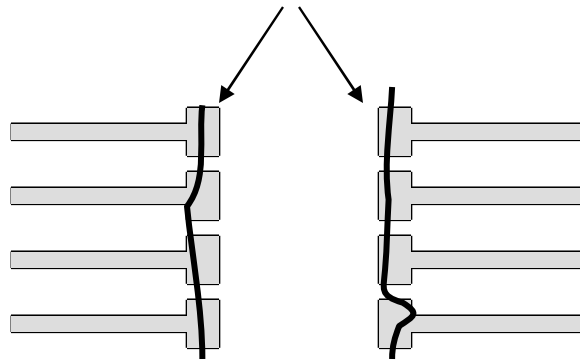


Pacificon 2007

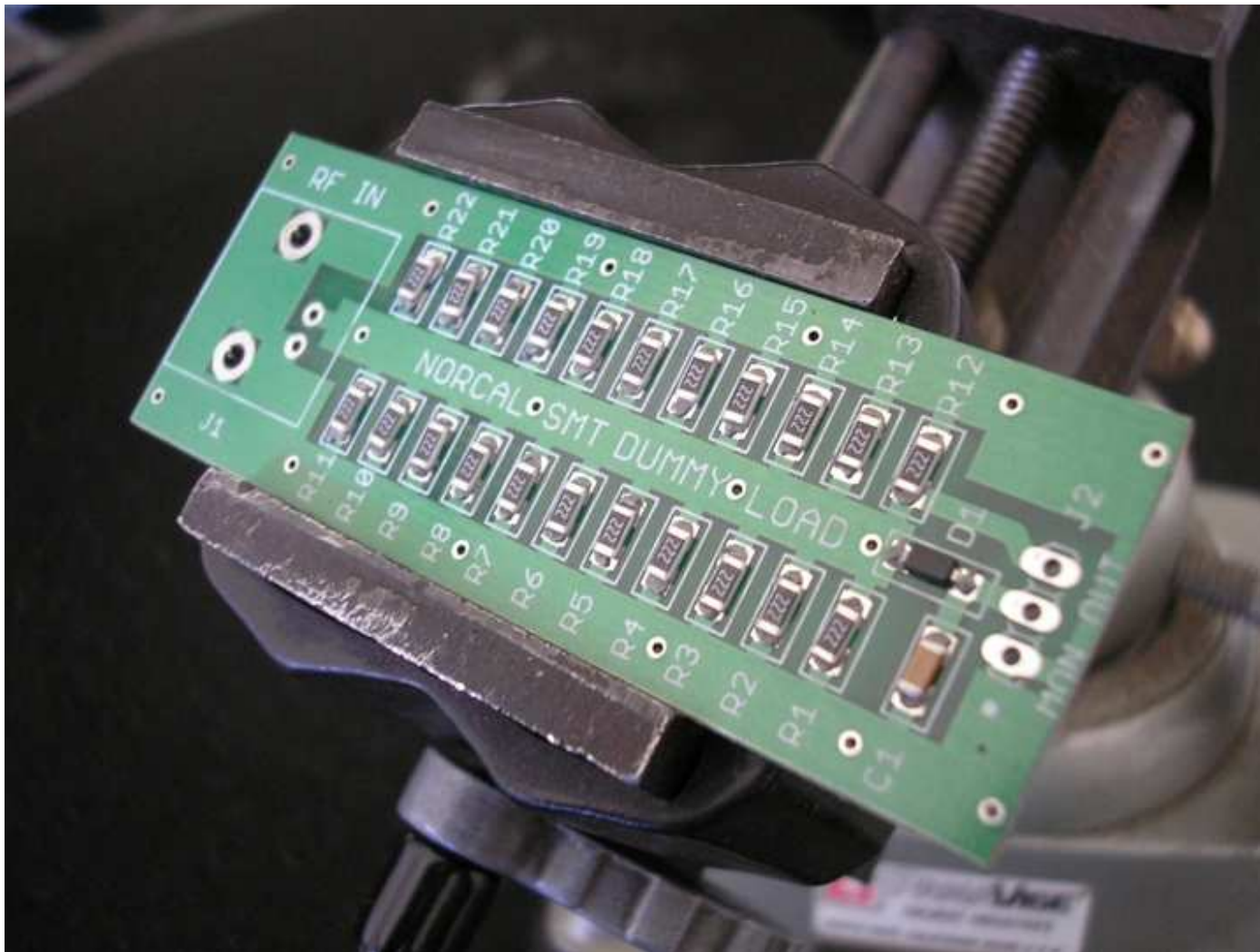
QRPacificon

Fine Pitch IC's are Easy

Just apply a "line" of solder paste across all the pads on a side



Ready for Hot Air



[Show finished board](#)

Pre-Heat



Pacificon 2007

QRPacificon

Apply Hot Air



Pacificon 2007

QRPacificon

Allow to Cool



[Show ready for heat](#)

Pacificon 2007

QRPacificon

Conclusions

- Consumer electronics have embraced SMT in a big way
- SMT offers hams a means to build smaller, lighter, more state-of-the-art hardware
- Assembly using the hot air method is fast and easy, using a few easily obtainable and inexpensive tools

Questions?

Web Links

- Cash Olsen's KD5SSJ site to purchase solder paste. Also, a good general tutorial on the hot air method
<http://www.zianet.com/erg/ShopSolderPaste.html>
- Cecil Bayona's K5NWA site on using the hot air method
<http://www.hpsdr.com/Public/Projects/SMT/SMT.html>
- Web site on using the skillet method
<http://wb9ipa.qrpradio.com/smt/smt.htm>
- Spark Fun soldering tutorial on surface mount
<http://www.sparkfun.com/commerce/hdr.php?p=tutorials>
- NorCal kits (FCC-2, Tuner Upper, Dummy Load)
<http://www.norcalqrp.org>
- Hendrick's QRPKits (Firefly)
<http://www.qrpkits.com>
- KD1JV Designs (Steve Weber kits, ATS-3B)
<http://kd1jv.qrpradio.com>
- Kester Solder Paste data sheet
<http://tinyurl.com/3xzxsx>