

# Integrated Microwave Assemblies (IMAs)



## Narda-MITEQ IMA Solutions

Narda-MITEQ is positioned as an industry leader that offers advanced integrated microwave assembly (IMA) products and subsystems to both the commercial and military markets. Every project we undertake benefits from our years of experience and world-class resources. Our strengths include:

- Custom solutions incorporating leading edge technology from DC to 40 GHz
- Advanced technology that produces cost savings, reductions in size and weight and improvement in efficiency and performance
- Highly experienced, senior engineering staff, working at the forefront of integrated microwave assembly and sub-assembly development for over 30 years
- Applications include electronic warfare, communications, radar and Satcom
- Designs which meet or exceed requirements for rugged military sea, air and land platforms
- An experienced, dedicated senior program management staff to minimize risk and ensure efficient, successful achievement of project requirements
- 200,000 square-foot, state-of-the-art headquarters and design center

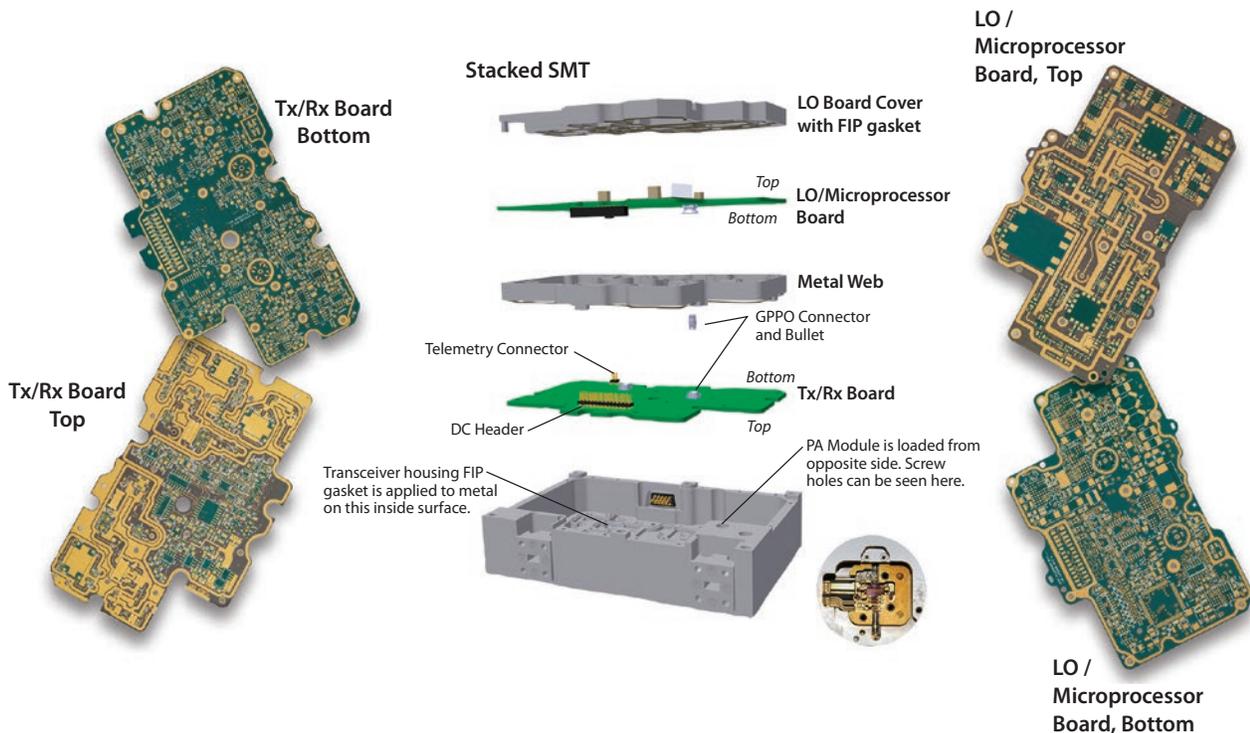
### *Facility*

Narda-MITEQ has a recently expanded state-of-the-art 200,000 square-foot plant in Hauppauge, NY for the (development, design, and production) of our products.



## From Classic MICs to State-of-the-Art MMC Technology

Narda-MITEQ has pioneered the design and manufacture of Integrated Microwave Assemblies (IMAs) for more than 30 years. The first IMAs manufactured by Narda-MITEQ, referred to as classic MICs, were realized by combining several alumina-on-carrier circuits within a single machined aluminum housing. These classic MIC multifunction assemblies provided high performance and longevity, yet the constraints of higher labor/materials costs and larger footprints often became prohibitive. While enhanced versions of this technology continue to remain viable for certain applications, Narda-MITEQ has evolved new technologies to effectively eliminate the constraints of traditional chip and wire manufacture. Our new and continually evolving proprietary MMC (Multi-layer Microwave Circuitry) technology leverages commercially available multi-layer board materials with unique interconnection techniques, along with DSP/FPGA – enabled monitor/control functions, to allow for densely packaged IMA's and Subsystems in footprints previously unachievable.



Compact Ka-Band Transceiver with Stacked SMT Board MMC Technology

### Narda-MITEQ's MMC Technology

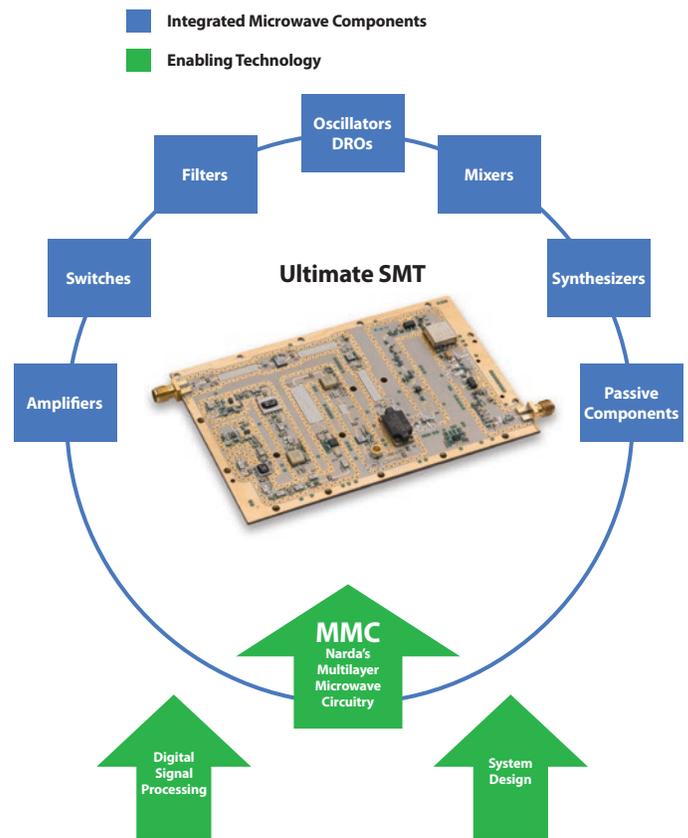
MMC uses multi-layered printed circuit boards to interconnect microwave devices (MIC, SMT, or MMIC configurations) with bias, control and digital signal processing components. These complex IMAs and Compact Subsystems are constructed using single or stacked multi-layer boards with the microwave circuitry on the top side, and the control circuitry, conditioning, microprocessor, FPGA and DSP circuits, on the bottom. Connections from top to bottom are made with specially developed vias, as appropriate.

Narda-MITEQ's MMC technology allows the creation of highly complex IMA modules with unprecedented performance, flexibility and unusually small form factors that facilitate integration into complex next level assemblies.

The MMC technology utilized on our module and sub-system solutions consists of two major types of approaches, the **Ultimate MIC** and **Ultimate SMT**. The Ultimate MIC approach is utilized when the majority of the electrical components are bare die and chip, while Ultimate SMT technology is employed when there is a prevalence of surface mount devices. Each type of technology promotes the ability to combine traditional MIC chip and wire hybrid technology with high volume, low cost, surface mount assembly techniques. As a result our modules or compact subsystems demonstrate unrivaled and previously unachievable integration levels. The results are smaller, reduced cost, higher performance solutions that combine microwave, bias/control circuits, and DSP functions interconnected with high isolation promoting multi-layer signal routing.

**Features of MMC enabled IMA modules and Subsystems:**

- A single multi-layer board construction integrates the RF/Microwave functions along with supporting bias, control and DSP needs, facilitating an unmatched level of integration
- “Stacked” multi-layer board topology allows for growth in height while preserving footprint
- Allows for the marriage of traditional MIC technology with SMT as may be required
- Dense packaging, reduced weight and lowered power consumption for SWaP considerations
- Custom solutions from DC to 40 GHz

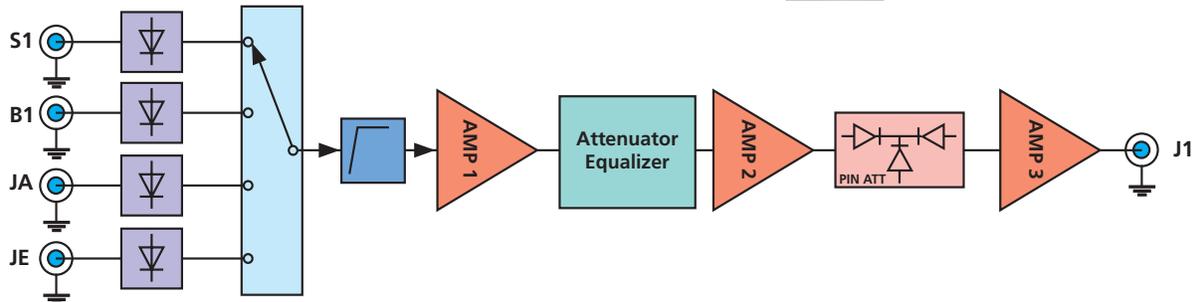


**Products**

- High Dynamic Range Front End Assemblies
- Up and Down Converter Modules
- Waveform Generators
- LNA's and SSPA's
- Transceivers
- Pin Diode Switch Solutions
- Switched Filter Banks
- Frequency Sources

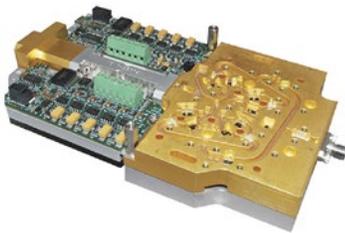
## Simple IMA Modules

Simple IMA Modules integrate two or more microwave components into a functional assembly using conventional MIC technology.



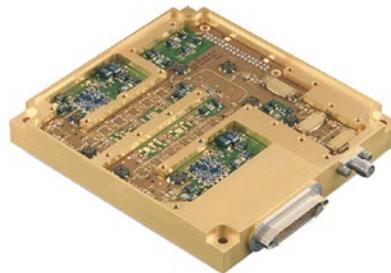
## Complex IMA Modules

Complex IMA Modules use MMC technology to create a much higher level of integration. These modules typically use the Ultimate MIC or Ultimate SMT topology.



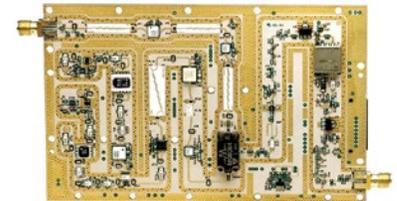
### Ka-Band SSPA

Smart IMA using a microcontroller to provide maximum power output with minimum DC drive over temperature and system variations.



### FPGA Programmable Source

This Ultimate MIC incorporates a Field Programmable Gate Array (FPGA) to provide DSP-based arbitrary waveform modulation of microwave signals.



### Ku-Band Block Upconverter

This IMA uses Ultimate SMT technology to provide a high performance, compact and efficient Ku-Band SATCOM block upconverter.



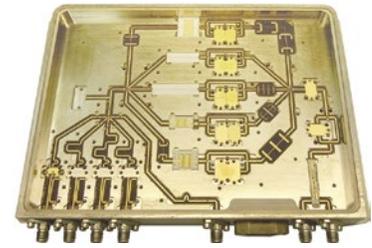
**Switched Filter Bank**

IMA utilizing high rejection PIN switches to select sharp cutoff channel filters.



**X-Band DDS Synthesizer**

Ultimate SMT X-Band synthesizer provides stable signals with precision resolution.



**EW Antenna Interface**

Complex IMA routing single input to multiple outputs with variable gain, preselection filtering and high power limiting in each path.

## Compact Microwave Subsystems (CMS)

Compact Microwave Subsystems (CMS) use IMA modules and support devices to build complete functional subsystems.



**EW Receiver**

Compact assembly of MMC (multilayer microwave circuitry) modules containing input and output switching networks, RF filters, and dual amplifier chains in a very small package.



**RF Distribution Network**

Complex distribution network integrating two multiplexers with input and output switching networks.

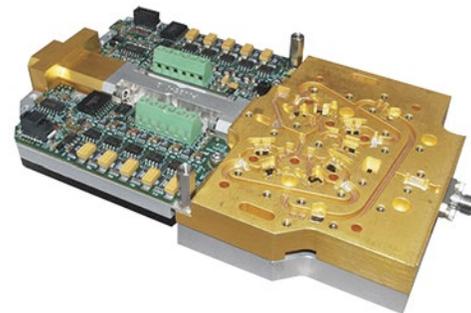
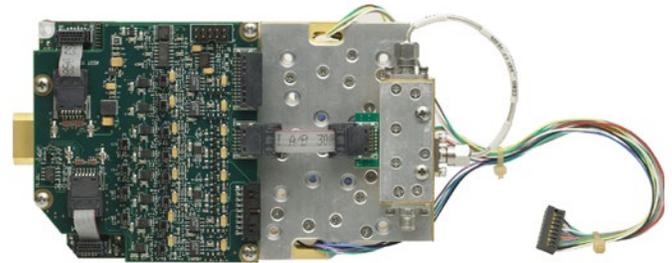


**SATCOM Transceiver**

Self contained transceiver for X, Ku or Ka-Band applications. High performance, low DC power and light weight.

### Solid State Power Amplifiers

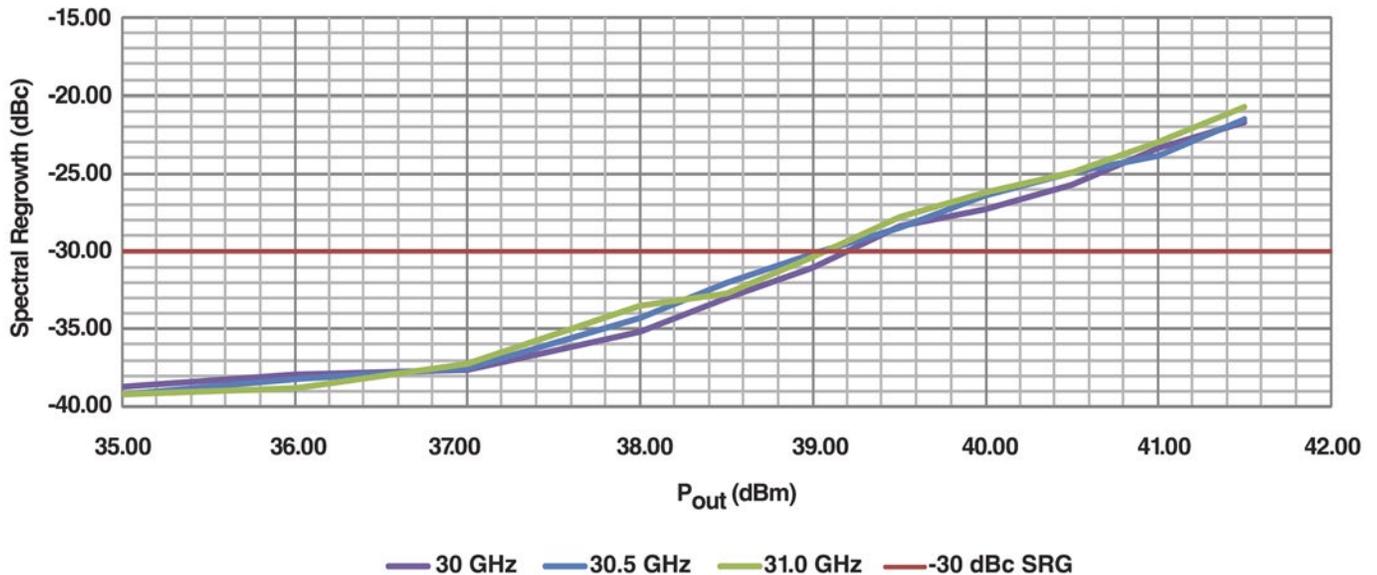
- Military SATCOM, COTM and ManPack Applications
- X-Band through Ka-Band
- Output Power Levels to 32W (P1dB)
- Ethernet, RS-485 (other standard interfaces available)
- High Linearity
- Very Small and Lightweight



Narda-MITEQ has developed and manufactured numerous reduced size, weight, and power (SWAP), high linearity, satellite communication (SATCOM) SSPA designs, spanning X-Band through Ka-Band, for use in earth terminal, Communications on the Move (COTM) and Man-Portable (Manpack) applications.

Narda-MITEQ possesses extensive experience developing Solid State Power Amplifiers (SSPAs) and holds a unique understanding of the electrical and mechanical design challenges confronted when developing high performance, producible power amplifiers. We have delivered hundreds of custom designs to a variety of SATCOM system providers for use in high data rate communication links operating under adverse environmental conditions and temperature extremes. Our present offering of amplifiers includes SSPAs that operate over standard SATCOM bands from X through Ka (including the 29-30 GHz commercial Ka-Band), many of which are currently in use on a number of programs including Ka-Band COTM for WIN-T and X, Ku and Ka-Band Manpack for USSOCOM and others. All of our SSPAs undergo extensive thermal analysis and many utilize custom designed housings made from high thermal conductivity, controlled expansion materials that allow for unprecedented reductions in size and weight. This careful selection of materials and innovative housing design also allows for improved electrical, thermal and reliability performance, making our SSPAs ideally suited for high temperature operation without the need for noisy and unreliable cooling fans.

### Ka SSPA Spectral Regrowth



### SSPA Design Considerations

All of Narda-MITEQ's Ka-Band SSPAs are micro-processor ( $\mu$ P) controlled, utilize custom designed power supply circuitry containing both DC-to-DC converters and low drop-out linear regulators, employ high current HEXFET drain switches and ample bias line filtering. All key voltages are continuously monitored to denote power supply health. Voltage variable attenuators (VVAs), digital-to-analog (D/A) converters and I2C temperature sensors are used to control gain and DC bias points over temperature. Output power detectors allows the  $\mu$ P to automatically shut down the SSPA to protect against over-power or high VSWR conditions. We routinely work with customers to incorporate custom features into the  $\mu$ P firmware, offering the user unmatched control over amplifier operating parameters and yielding system level benefits not available from other suppliers. All standard digital interfaces are supported, including RS-485 and Ethernet. We specialize in designing application specific solutions that offer our customers the best electrical, thermal and mechanical performance with very competitive lead times and price points.

Narda-MITEQ's SSPA assemblies utilize both commercial off the shelf (COTS) and custom GaAs MESFET, pHEMT and InP HVHBT discrete and MMIC-based devices. All COTS devices have been carefully selected, characterized and specified to insure that only the best linearity and highest efficiency devices are utilized. This allows us to achieve linear operation much closer to the 1dB compression point than most SSPAs on the market, without the use of linearizers. We are currently designing a Ka-Band SSPA MMIC based on InP HVHBT technology to cover both commercial and military SATCOM operating bands. HVHBT technology offers exceptional linearity and efficiency performance compared to COTS pHEMT devices and we plan to offer 12.5, 25, 45, and 90W P1dB versions in the very near future.

These next generation amplifiers will demonstrate linearity and efficiency performance not currently achievable with FET-based technologies and will offer significant performance improvements to Ka-Band SATCOM system providers.

From our current SSPA offerings and our future development efforts, Narda-MITEQ continues to push the boundaries of SSPA performance. Please contact your local representative if you have further interest in this product area.



**Ka-Band Outdoor Transceiver  
with 12.5W SSPA**

**Ka-Band BUC with 25W SSPA**

