ASELSAN’s expertise includes the design and manufacture of high frequency hybrids and modules for harsh environments at the extremes of temperature, vibration and humidity.

ASELSAN is a cost-efficient supplier of high reliability microwave products for the aerospace and defense electronics markets worldwide. To meet the demands of these markets, design and manufacturing facilities are organized to satisfy the requirements defined in MIL-PRF-38534, Class H (Military) and Class K (Space). Product screening & qualification is achieved via MIL-STD-883 test methods.
OVERVIEW

ASELSAN has design and manufacturing experience in microwave multi-function modules. Engineering expertise includes circuit design and microelectronic layout skills. This is supported by various state-of-the-art circuit synthesis and analysis tools, 2D/3D EM solvers and electromechanical and thermal design tools.

Microwave Multi-Function Module Design
• T/R Modules
• Channelizer Down Converters
• Superheterodyne Up/Down Converters
• Antenna Front-Ends & Switch Assemblies
• PA Modules
• LO Multipliers
• Radar and ESM Synthesizers
• Detector Logarithmic Video Amplifier (DLVA’s)
• Filters
• Switched Multiplexer
• Digital Frequency Discriminator (DFD)
• Thin-Film Circuits

ASELSAN, your cost-efficient microwave solution provider, offers both readily-designed products and custom solutions to meet your specific needs. ASELSAN promises engineering perfection and state-of-the-art manufacturing with a delicate touch of Turkish craftsmanship.

PRODUCTION

Manufacturing activities are carried out in controlled environments (Cleanrooms [Class 6 (1000) and Class 7 (10,000) per ISO-14644-1]) with specialized equipment. Total cleanroom area is more than 2000 square meter (21500 square feet).

- Microwave Module Production
  - Fully Automatic, Semi-Automatic and Manual Die Bonding
  - Screen Printing
  - Daubing (Pin Transfer)
  - Automatic and Manual Dispensing
  - Eutectic Soldering
  - Interconnections
    - 0.7 to 2 mil Thermosonic Gold Wire Bonding
    - 3 to 10 mil Thermosonic Gold Ribbon Bonding
    - 10 to 20 mil Resistance Gap Welding
  - Automated Optical Inspection

- Hermetic Packaging and Hermeticity Testing
  - Laser Welding & Delidding
  - Open Can, Fine & Gross Leak, Optical Leak Testing

- Destructive and Non-Destructive Analysis
  - Destructive and Non-Destructive Bond Pull, Tweezer and Bond Shear Tests
  - Die Shear Test
  - Scanning Acoustic Microscope (SAM) Analysis
  - Internal Gas Analysis
  - Radiographic Inspection
Specifications are subject to change without any notice. Integrated Microwave Modules
PRODUCTION

- In house Thin-Film integrated passive device design and fabrication
  - Photomask design and generation
  - Laser trimming and drilling
  - Sputtering and plating capabilities
  - Air Bridges with polyimide
  - Various metallization and dielectric material selection
  - Solid and wall-plated via fabrication
  - High reliability screening per MIL-STD-883
Specifications are subject to change without any notice. Integrated Microwave Modules
TESTING

All tests required to verify the functionality and reliability of the manufactured microwave assemblies and Thin-Film products are carried out in-house.

RF/Microwave Tests
• Multi resonator filter structures and supported measurements
  - S-parameter
  - Frequency conversion
  - NF, P1dB, IMD3
  - Pulsed RF
  - Time domain (multi resonator tuning)
  - Spectrum analysis
• ATE/Test branches for specific functional modules
  - T/R modules
  - PA modules
    - Load-pull test set
  - DLVA
  - Frequency Up/Down Converters
• Hot-cold Plates for functional temperature tests
• Probe Stations
  - On wafer testing
  - Hybrid testing
  - Module debugging

ESS and Qualification in compliance with:
• MIL-PRF-38534
• MIL-STD-883
HYBRID MICROWAVE MODULE PRODUCTS

ASELSAN focuses on custom designed products to meet specialized integrated microwave assembly requirements. Sample products are shown below.

**T/R Modules**

T/R modules for X-band phased array radar and I/J band repeater-jammer applications.

- Custom designed for various output power levels up to 40W for X-band radar and 6W for I/J band repeater jammers
- Low NF on receive path
- Specially designed and packaged in small footprints for mass production

**PA Modules**

Wide range of microwave power amplifiers covering frequencies from 6 GHz to 26 GHz for military and space applications.

- State of the art GaAs MMIC amplifiers and/or bare GaN dies incorporated to achieve the best frequency performance, power density and efficiency
- Custom designed to deliver up to 40W for X-band and 8W for 6-18 GHz
- High efficiency
- Fast switching times with integrated bias sequencing circuitry
ANTENNA FRONT-ENDS & SWITCH ASSEMBLIES

These units are essential building blocks in multi antenna ESM/ELINT/ECM systems with multi-octave frequency bands within 0.5-18 GHz.

- Utilize high-power limiters, broadband amplifiers, reflective/absorbptive switches and power combiners/dividers with high isolation crossovers
- Less than 5dB NF
- 60dB isolation between any two ports
- Less than 100nsecs switching time
**SUPERHETERODYNE UP/DOWN CONVERTERS**

Depending on the frequency planning to achieve best spurious performance, these units can be configured for dual/triple downconversion architecture.

- Designed to meet ESM/ELINT and DRFM applications requirements
- Selectable instantaneous bandwidths up to 1 GHz
- 50dB spurious-free dynamic range
- Less than 100nsecs switching time
- High selectivity RF/Microwave filters designed using SSS, microstrip and/or cavity combline/interdigital filter technologies
- Low-IF filters designed using ceramic resonators
CHANNELIZED RECEIVERS

Utilizing switch filter banks, block down conversion stages and channel amplifiers, these broadband units are custom designed for RWR/ESM/ELINT applications.

- Designed to cover 0.5-18 GHz and 18-40 GHz
- Precisely tuned for reliable performance
- SSS/Microstrip and/or Cavity combline/interdigital filter technologies incorporated depending on selectivity requirements
INTEGRATED MICROWAVE MODULATIONS

Active broadband frequency doublers and quadruplers for broadband ESM/ELINT Synthesizer applications.

- Gain stages allow low input power levels
- Capable of generating up to 20dBm output power levels with 50dBc undesired harmonics isolation (undesired harmonics suppression filters between doubler stages)
- Output frequencies as high as 40 GHz

DLVAs/ERDLVAs

DLVAs/ERDLVAs are multi octave units designed for RWR/ESM applications.

- 0.5-18 GHz frequency range
- 70dB dynamic range
- Less than ±1.5dB frequency flatness
- ±1dB log linearity
- Good temperature stability
- Fast rise/fall times
- AC or DC coupled, CW or Noise Immune
- Configured with two or three Schottky/tunnel diode detector stages, low noise amplifiers, broadband couplers and logarithmic amplifiers depending on requirements

LO MULTIPLIERS

Active broadband frequency doublers and quadruplers for broadband ESM/ELINT Synthesizer applications.

- Gain stages allow low input power levels
- Capable of generating up to 20dBm output power levels with 50dBc undesired harmonics isolation (undesired harmonics suppression filters between doubler stages)
- Output frequencies as high as 40 GHz
RADAR AND ESM/ELINT SYNTHESIZERS

ESM/ELINT synthesizers combine the benefits of DDS and PLL techniques to cover broad bandwidths within 2-18 GHz.

- -50dBc harmonic, -40 dBc spurious
- Less than 10μsec settling time
- -90dBc/Hz phase noise @ 10 kHz offset

X-band radar synthesizers, developed using PLL and/or direct analog techniques, have operational bandwidths up to 1 GHz and utilize low phase noise fixed frequency sources, mixers and/or step recovery diode multipliers and frequency dividers as main blocks.

- 20 MHz step size
- -50dBc harmonic, -65dBc spurious
- 1usec settling time
- Phase noise -75dBc/Hz @ 100 Hz, -105dBc/Hz @ 1 kHz and -115dBc/Hz @ 10 kHz offset frequencies
SWITCHED MULTIPLEXERS

An adaptive filtering unit with 8 equally spaced channels which can be switched “ON” or “OFF” by using 8 distinct TTL bits, allowing 256 possible combinations of overall filter response from input to output.

- 2-18 GHz operating frequency range
- Passband Insertion Loss from 0 to +4dB
- Input Return Loss < -9dB
- Output Return Loss < -9dB
- Operation temperature between -40°C and 85°C

DIGITAL FREQUENCY DISCRIMINATOR (DFD)

DFD module measures frequency of pulsed and CW signals and outputs 14-bit digital word of the measured frequency.

- 2-18 GHz operating frequency range
- 4.5 MHz(rms) frequency accuracy at 3dB SNR
- Throughput Time < 350 ns
- Recovery Time After High Power Pulse Input < 120ns
- Shadow Time: 50 ns
- Operation temperature between -40°C and 85°C
FILTERS

Various designs from 0.1 to 50 GHz were implemented having different types of responses, topologies using different processes and production technologies. Main types are:

- Lumped Filters (0.1-6 GHz) (drop-in, SMD, connectorized)
- Microstrip Filters (6-40 GHz) (drop-in, SMD, connectorized)
- Suspended Substrate Filters (2-20 GHz)
- Cavity Filters (6-20 GHz) (drop-in, connectorized)
- Waveguide Filters (33-50 GHz)
MMICs

ASELSAN has high level capability of designing MMICs.

High Power Amplifier MMICs
- State of the Art Output Power Levels
- Suitable for CW and Pulsed Operations
- Operable Under High Temperature (T_{j}<85°C)
- Designs Starting from 700 MHz up to 40 GHz

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-18 GHz</td>
<td>4.5W</td>
</tr>
<tr>
<td>8-12 GHz</td>
<td>16W</td>
</tr>
<tr>
<td>750 MHz</td>
<td>10W</td>
</tr>
<tr>
<td>16-17.5 GHz</td>
<td>10W</td>
</tr>
<tr>
<td>32-39.5 GHz</td>
<td>2.5W</td>
</tr>
</tbody>
</table>

Phase Shifter MMICs
- Frequency Range of 6-18 GHz
- 6-Bit Resolution
- 360° Phase Control
- Low RMS Phase Error
- Fast switching

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-18 GHz</td>
<td>6-Bit</td>
</tr>
<tr>
<td>8.5-9.5 GHz</td>
<td>7-Bit</td>
</tr>
</tbody>
</table>
Specifications are subject to change without any notice. Integrated mIcrowave moduleS

aselsan