Space Capabilities Presentation

6/13/2017
API Overview
Company Overview

API Technologies Portfolio Differentiators

- One of the largest non-Prime providers of RF/microwave and microelectronics
- World’s largest market share of EMI filter products
- Value-added integration capabilities

Key Facts

- **Headquarters:** Marlborough, MA
- **Employees:** ~1700, worldwide
- **Company:** Privately owned
- **Technologies:** RF, microwave, millimeterwave, microelectronics, power, electromagnetic and security solutions
- **Programs:** 70+ years of extensive, diverse program experience
## What We Do

<table>
<thead>
<tr>
<th>RF and Microwave Signal Conditioning &amp; Management</th>
<th>Electromagnetic Spectrum Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF, microwave, millimeterwave, and power solutions to enable the wireless link across global defense, commercial, space and test applications.</td>
<td>Electromagnetic and security solutions to mitigate interference and protect the safe transmission of data in high performance defense and mission critical applications.</td>
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Diverse Portfolio with a Focus on Integration

Well-respected industry leader with ability to support customers on any level, from components to subsystem solutions.
# API Businesses & Applications

## RF and Microwave Signal Conditioning & Management

<table>
<thead>
<tr>
<th>Business</th>
<th>Description</th>
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<tbody>
<tr>
<td>I &amp; W</td>
<td>Inmet &amp; Weinschel</td>
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<tr>
<td>RF2M-US</td>
<td>RF, Microwave, Microelectronics &amp; Power – US</td>
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<tr>
<td>RF2M-UK</td>
<td>RF, Microwave, Microelectronics – UK</td>
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- **High-reliability components and surface mount resistives**
- **Programmable assemblies and subsystem solutions**
- **High-performance components, modules and subsystems**
- **Power conversion and distribution products**
- **AESA radar subsystem solutions**
- **High temperature microelectronics and hybrids for harsh environments**
- **Components for space**

## Electromagnetic Spectrum Management

<table>
<thead>
<tr>
<th>Business</th>
<th>Description</th>
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<tbody>
<tr>
<td>EIS</td>
<td>Electromagnetic Integrated Solutions</td>
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<tr>
<td>SSIA</td>
<td>Secure Systems &amp; Information Assurance</td>
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</tbody>
</table>

- **Components for electromagnetic compatibility compliance, energy efficiency and power management**
- **Magnetics, inductors and coils**
- **Secure communications products**
- **TEMPEST, rugged, secure networking and hardware solutions**
Space Capabilities
Space Design and Manufacturing Locations & Mix

Space Design/Manufacturing Centers
- Ann Arbor, MI
- Nashua, NH
- State College, PA
- Marlborough, MA
- Philadelphia, PA
- Delmar, DE
- Great Yarmouth, UK
- Milton Keynes, UK
- Frederick, MD

Space Geographic Mix
- U.S.: 37.2%
- Europe: 62.4%
- Asia: 0.4%

Space Market Mix
- Commercial: 41.0%
- Military: 59.0%

Map Key
- Blue: Space Design/Manufacturing Centers
- Purple: Class H & K Certified Facilities
# Space Program Heritage

## Communications
- GPS-2F/GPS3
- Prima O3B
- Immarsat
- Intelsat
- Sirius Radio
- Direct TV
- Optus 10
- Thor 7
- MUOS
- Hot Bird
- MARECS
- Olympus
- SkyNet
- Eutelsat

## Deep Space
- Galileo
- USERS
- Selene & Okina
- Mars Phoenix
- Lunar Reconnaissance Orbiter
- OCO
- LCROSS
- Mars Science Lab
- ISS Kibo EF

## Scientific Missions
- SAOCOM
- Hershel Plank
- AMS-02
- Aquarius (SAC-D)
- Lisa Pathfinder
- Juno
- Grail
- EnMap
- Vegetation
- Cassini
- Meteosat
- Europa Clipper
- JPSS 3/4

## Launch & Re-entry
- Taurus
- IRBM
- Minuteman
- H-II
- Falcon 9
# Space Market

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Payloads</th>
<th>Launch Vehicles</th>
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<tbody>
<tr>
<td>Microsatellites</td>
<td>Large/Medium</td>
<td></td>
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<tr>
<td><strong>Market Size</strong></td>
<td></td>
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<tr>
<td>$2.9B</td>
<td>$17.4B</td>
<td>$11.84B</td>
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<tr>
<td><strong>2017-2022 CAGR</strong></td>
<td>20.8%</td>
<td>1.1%</td>
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<td><strong>Drivers</strong></td>
<td>• Global coverage</td>
<td>• Greater bandwidth; higher speeds</td>
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<td></td>
<td>• Satellite redundancies</td>
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<tr>
<td></td>
<td>• Lower cost manufacturing</td>
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<tr>
<td><strong>Key Applications</strong></td>
<td>• Communications</td>
<td>• Command &amp; Data Handling</td>
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<td></td>
<td>• Scientific Research</td>
<td>• Comms</td>
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<td></td>
<td>• Remote Sensing</td>
<td>• Navigation</td>
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<td></td>
<td>• Navigation</td>
<td>• Surveillance</td>
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<tr>
<td><strong>Target Growth Programs</strong></td>
<td>• OneWeb</td>
<td>• ViaSat-3</td>
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<tr>
<td></td>
<td>• LEOVantage</td>
<td>• GPS III and GOES (A2100)</td>
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<tr>
<td></td>
<td>• Boeing V and C Bands</td>
<td>• GEOStar</td>
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Satellite Solutions

Product Capabilities:
• Low noise amplifiers
• Mixers
• Microwave diodes
• Limiters
• Passive components

Strengths:
• Integration and assembly expertise
• Performance in broadband, high IP2 intercept, low noise
• Established market position as an approved supplier of passive components for space applications
• Diverse portfolio of existing designs
Payload Solutions

Product Capabilities:
• Low noise amplifiers, filters, mixers, couplers, phase shifters, power dividers, oscillators
• Microwave diodes
• Surface mount resistive components
• Attenuators & terminations
• DC to DC converters
• Optical Transceivers
• Integrated microwave assemblies
• Transmit/receive modules

Strengths:
• Design expertise in SWaP and miniaturization
• Digital beam forming component designs
• European space agency and MIL-STD qualified
Launch Solutions

Product Capabilities:
• Low noise amplifiers
• Mixers
• Passive Components
• Filters and filter-based assemblies
• Integrated microwave assemblies

Strengths:
• Integration expertise; complex filter-based assembly capabilities
• Advanced precision in rocket and asset tracking through amplification design techniques
Space Product Portfolio
API Space Portfolio

- Diodes
- Low Noise, Small Signal Hybrid Amplifiers
- VCOs
- High-Rel Fixed Attenuators
- High-Rel Fixed Terminations
- Hybrids & MCMs
- VCSOs
- SAW Oscillators
- SAW Filters
- Surface Mount Attenuators & Resistors
- Switches
- Power Dividers
- Couplers
- Single & Multifunction Filter Assemblies
- IMAs

- Company Confidential -
API Technologies Corp.
Diodes

Technologies & Performance:
• Silicon microwave diodes
• Broadband performance from 1 MHz to 20 GHz

Topologies:
• Frequency Multiplier, Step Recovery
• Ceramic Packaged Tuning Varactor
• PIN and NIP Diodes

Differentiators:
• ESA-Qualified Product Listings
• Manufactured in a Class H & K facility
• Tested to MIL-STD-883 and MIL-STD-202
API Space Portfolio

Technologies & Performance:
• Full octave performance from 25 MHz to 7000 MHz
• Chip & Wire architecture.
• Hermetic Kovar Based Packaging

Topologies:
• Frequency Multiplier, Step Recovery
• Ceramic Packaged Tuning Varactor

Differentiators:
• Manufactured in a Class H & Class K facility
• Tested to MIL PRF 38534 Class H and Class K Screening Standards
Low Noise, Small Signal Hybrid Amplifiers

Technologies & Performance:

- Broadband performance, frequencies from 1 MHz to 6 GHz.
- Low Noise as low as 1 dB.
- Output power to 1 watt.
- Customizable Designs to meet customer specific performance requirements.

Differentiators:

- Manufactured in a Class H & K facility
- Tested to MIL PRF 38534 Class H and Class K Screening Standards.
Hi-Rel Attenuators and Terminations

Technologies:
• Solderless assemblies
• Injection molded connectors
• Broadband performance from DC to 40 GHz
• Connector types: SMA, SMK and Type N

Differentiators:
• Space qualified to individual customer specifications
• Largest provider of Hi-Rel attenuators for space applications
• Designed to withstand mechanical shock/vibration and thermal extremes
• Designed to meet environmental requirements of MIL-DTL-3933
Hybrid & MCMs

Performance:
• Hermetically Sealed hybrid microcircuits designed for harsh environments
• Operating temperatures of 150 – 165 C
• Thick film designs up to 225 C

Technologies:
• PCB, Thin Film, Thick Film, LTCC

Differentiators:
• Manufactured in a Class H & K facility
• Environmental testing against IECQ, MIL-STD-883 and MIL-STD-202
• Can be certified to ESA requirements (UK operations)
API Space Portfolio

Technologies & Performance:
• Superior communication distances for frequencies of 350 MHz to 4 GHz
• Low Phase Noise: -109 dBC/Hz at 1 kHz
• Low Vibrations Sensitivity: 2 x 10^-9 per g
• Hermetic Kovar Package: 1.0" x 1.0" x .2" SMT
• Operating Range: -55°C to +100°C

Differentiators:
• Ruggedized Hybrid Construction
• Manufactured in a Class H & K facility
• Tested to MIL-STD-883 and MIL-STD-202
Filters

Core Competencies:
• Lumped Element Filters
• Cavity/Combline/Interdigital Filters
• Tubular Filters
• Waveguide Filters
• Ceramic
• Suspended Substrate Stripline
• Surface Acoustic Wave (SAW)
• Diplexers & Multiplexers
• Switched Filter Banks

Key Strengths:
API works with customers to understand their priorities and challenges in order to achieve their application-specific requirements in a cost conscience environment
Surface Mount Attenuators & Resistors

Technologies:
• TaN and thick-film resistors
• Thin and thick-film conductors
• Tinned and gold terminal finishes

Topologies:
• Flange, tabbed, and pill packages
• Surface-mount and wire-bondable chips

Differentiators:
• Extended Hi-Rel and Space heritage
• Large portfolio of proven designs
• Engineering and Production Teams to develop and support new designs
• Testing to MIL-PRF-55342/MIL-DTL-3933
Switches

Technologies & Performance:
• GaAs FET
• High isolation designs up to 22 GHz

Topologies:
• PIN Diode
• SPST to SPST

Differentiators:
• Kovar packaging; resistance to shock and durability in harsh environments
• Manufactured in a Class H facility?
• 100% testing and hermetic sealing
Detectors

Technologies & Performance:
• Up Ka-Band

Topologies:
• Schottky Diode

Differentiators:
• Manufactured in a Class H & Class K facility. Tested to MIL PRF 38534 Class H and Class K Screening Standards.
Couplers and Power Dividers

Technologies & Performance:
• High Isolation, High Directivity
• Exceptional Phase Balance
• Low Loss, Low Flatness
• Phase matching

Topologies:
• Quadrature Hybrid
• Directional Couplers

Differentiators:
• MIL-E-5400 Class 3 Designs
• Manufactured in an ISO9001 up-screened facility
Single & Multi-Function Assemblies

Technologies & Performance:
- Robust designs covering 10MHz - 50GHz

Topologies:
- Coaxial designs (TEM cavity / combline)
- Dielectrically loaded waveguide designs (ceramic resonator “pucks” TE$_{015}$)
- Lumped Element designs (aka LC or chip and wire or discrete component)
- Bandpass, Highpass, Lowpass, Bandreject, Duplexers, Duplexers, Multiplexers, Delay Filters, Integrated Assemblies
- Surface Acoustic Wave (SAW)

API works with customers to understand their priorities and challenges in order to achieve their application-specific requirements in a cost conscience environment.
IMAs

Key Attributes:
• Multi-disciplined engineering expertise focused on single function component integration, assembly and test optimization
• Flight heritage designs

Integrated Technologies:
• Frequency converters
• Complex Filters; Switched Filter Banks
• Multifunction Assemblies
• Amplifier based assemblies

Differentiators:
• Radiation tolerant, temperature extreme tolerant, ruggedized designs
• Packaging of API integrated components
The API Advantage

• 40+ years space heritage
• Diverse breadth of product and services offering
• Program Management
• Class H & K manufacturing facilities
• Experienced design and production teams
• Centralized design vault
• Standardized quality management system
• Up-screening of MIL-STD products
• Customer-driven designs