RF & MICROWAVE

AMPLIFIERS & SUBSYSTEMS

LINEAR, HIGH POWER, SOLID-STATE

OPHIR RF

THE ART OF WIRELESS™

Company Capabilities Presentation

2005

Overview

- $OPHIR_{RF}$ History & Facilities
- Why $OPHIR_{RF}$?
- Program & Product Profiles
- Government & Commercial Customers
- Total Integrated Solutions by $OPHIR_{RF}$
- Summary

Company History

- First Established in 1992 as GTC RF
- Incorporated as "***OPHIR$_{RF}$***" in 1997
- Privately Owned Small Business ($8 – 10M)
- Began with Broadband, Linear Amplifiers
- Today – Broadband & Band Specific from 10kHz to 8 GHz @ 1 Watt to above 2 KiloWatts
- Communications, EMC, Medical, Test & Measurement & other Scientific Applications
- Government, Defense, & Commercial Customers

Our Facilities

5300 Beethoven Street
Los Angeles, CA 90066

- **Integrated Headquarters Building**
  - 40,000 Square Feet
  - Company Offices
  - Engineering Laboratories
  - Production Facilities
  - Customer Support
- **Convenient Southern Cal. Location**
  - 6 Minutes from LAX
  - Easy Freeway Access
- **Security Arrangements**
  - Available by Customer Request
  - On-site or Remote

Engineering Personal

4 RF & Microwave Design Engineers
1 Digital Design Engineer
2 Mechanical Designers
3 Mechanical drafters
4 Engineering Technicians
1 Application & System Engineer

Team of strategic Partners

Mission Statement

Provide RF Power Amplifier Solutions that exceed our customer's expectations for:

Quality, Reliability, Performance and Service.

Why OPHIR RF ?

- Specializing in High Power, High Density, COTS HPA Products, Expeditiously Adapted to Specific Applications
- Noted for Quick Reaction/Rapid Turn-around for Critical, Time Sensitive Programs
- Modular Design Concepts Saving Time & Money
- Light-weight, Reliable, Cost Effective Solutions

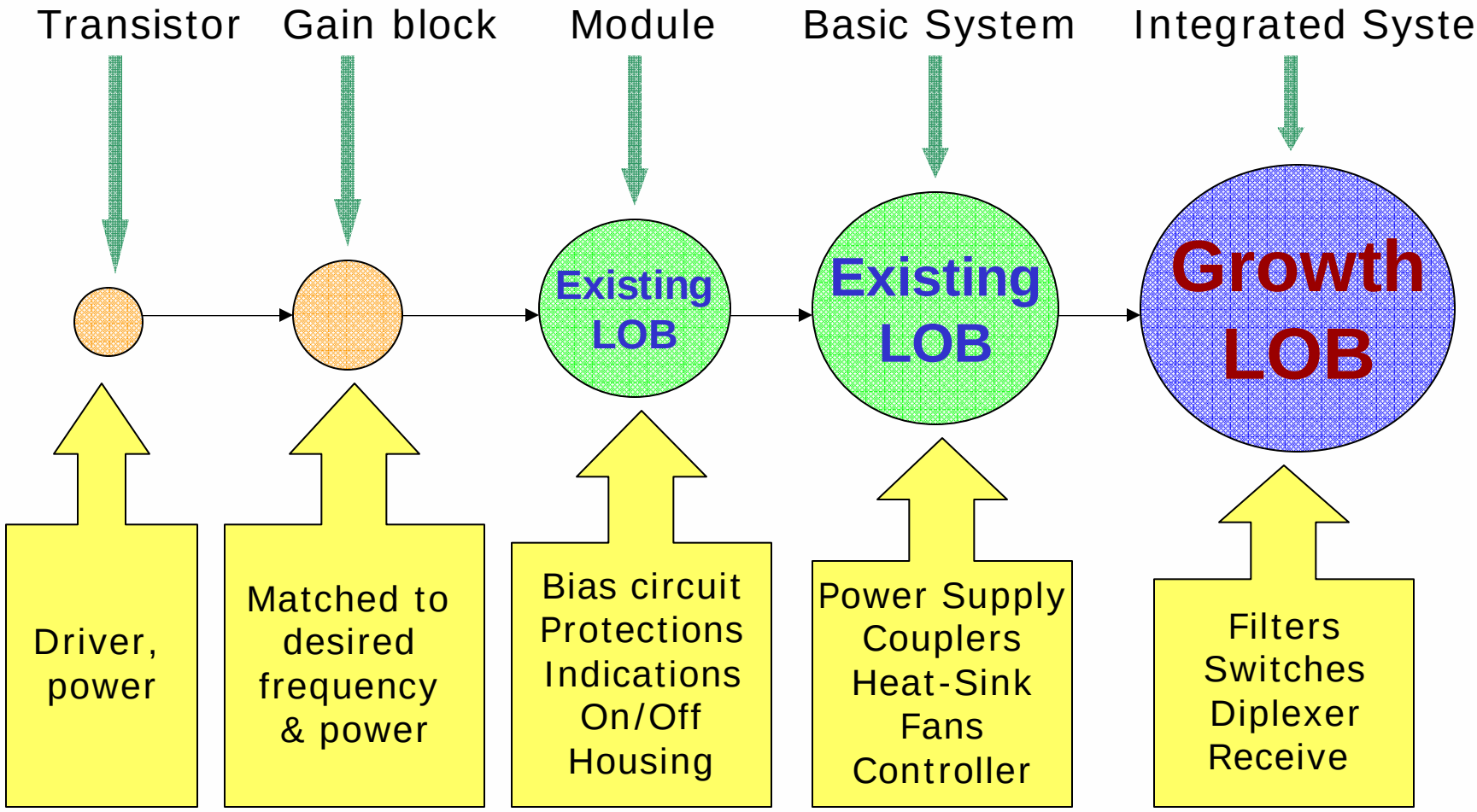
Business Goals

- Develop and secure captive customers
  - Develop long term technical relationships
  - Visits
  - Offer innovative solutions
- Understand & meet customer requirements
  - Electrical, Mechanical, Reliability
  - System application and peripheral
  - Modulation, Waveforms
  - Program goals; schedule, deliverables

Business Goals

- Understand the Application
  - EW, Jamming, and Defense
  - EMC and Test labs
  - Pulse amplifiers; Radar and other
  - Wireless, Base station
- Know the Market, Know Trends
  - Track and monitor government programs
    - Know all players
    - Approach all players
  - Competitive analysis
- Provide ‘Solutions’ versus ‘Amplifiers’

Application Development



DOD as an End User

Model XRF315
1.35-1.85 GHz, 50 Watts

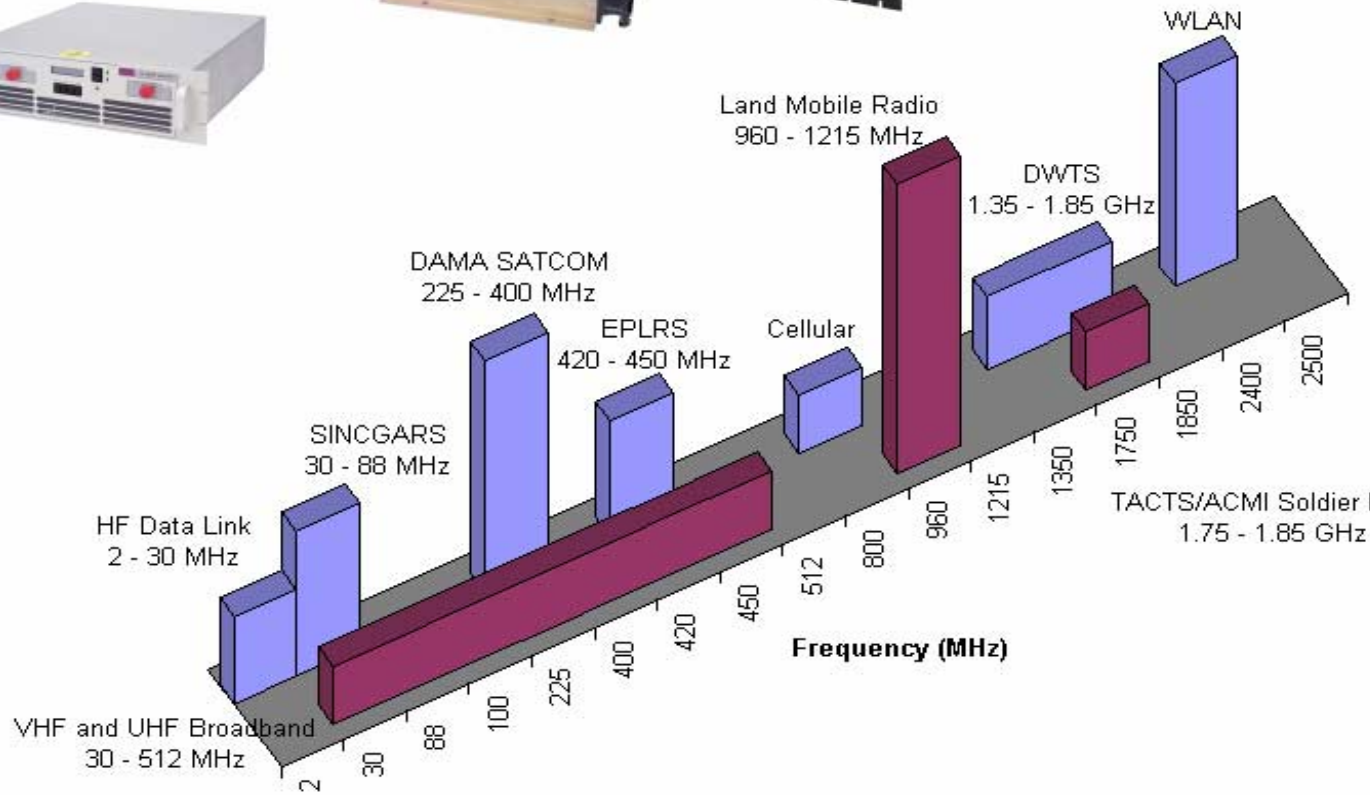
Model 4028
1.75-1.85 GHz, 500 Watts

Model 5302023
960-1215 MHz, 10 Watts

Model 5123
225-400 MHz, 125 Watts

Model 4043
2-30 MHz, 1000 Watts

Model 5303074
30-512 MHz, 40 Watts



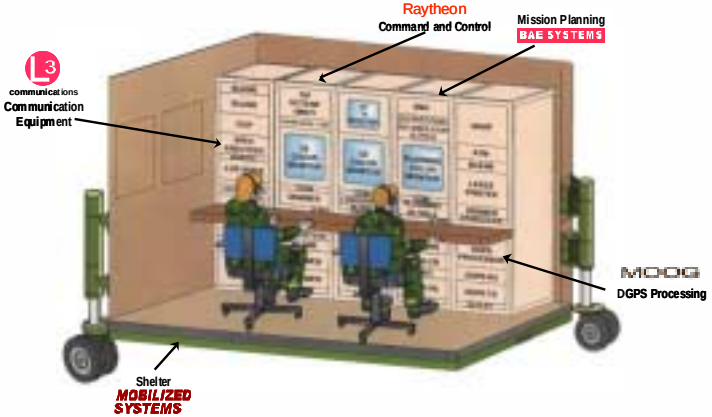
Digital Wideband Transmission System (DWTS)

PA Installed on HMMWV

Production Line

- **End User:** US Marines & US Navy
- **Customer:** Navy/SPAWAR
- **Platform:** HMMWV
- **Product/Program Description:**
  - L-Band, Line-of-Sight, wideband (2Mbps)
  - Ships to Marines ashore communications
  - Digital voice, data, & imagery
  - Secure & Non-Secure
- **Key Parameters:**
  - 30 Meter Mast
  - 1.35 – 1.85 GHZ
  - $OPHIR_{RF}$ Model XRF315 (Proprietary)
  - 19” x 5.25” 20” (Chassis)

Digital Global Positioning System (DGPS)

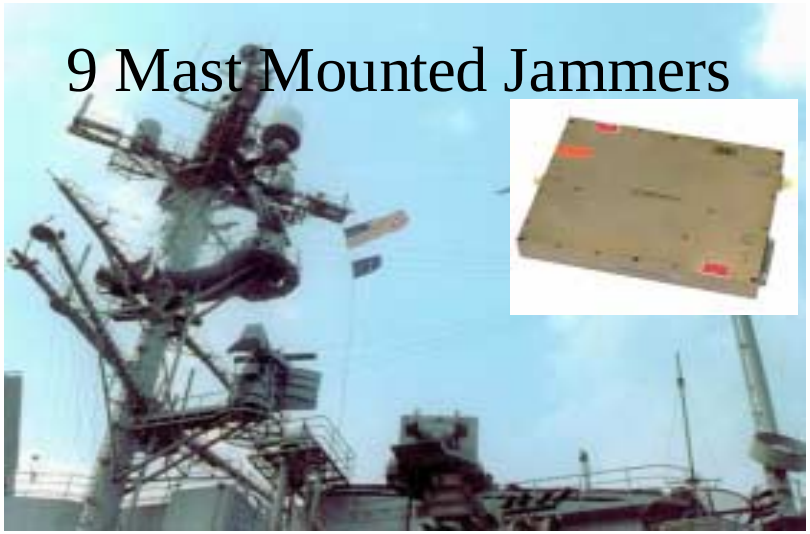


- **End User:** US Air Force
- **Customer:** Raytheon
- **Platform:** Global Hawk UAV
- **Product/Program Description:**
  - Supports DoD Intelligence, Surveillance, & Reconnaissance Missions Worldwide
  - Integrated EO, IR, & SAR Sensor Suites
  - SIGINT Capability on Line
  - $OPHIR_{RF}$ HPA in LRE Unit
- **Key Parameters:**
  - 100 – 120 MHz – 100 Watts (Model 5044NH)
  - 19” x 5.25” x 20” (Chassis)

Electronic/Information Warfare (USAF)

- **End User:** USAF/527th Space Aggressor Sqd.
- **Customer:** TMC Design Corporation
- **Platform:** EW Communications Suite
- **Product/Program Description:**
  - PA for final amplifier in EW Suite
  - Emulation of foreign jammers
  - Operational Test & Evaluation Support
  - 0.8 to 2.0 GHz & 0.8 to 4.2 GHz
- **Key Parameters:**
  - Model XRF338 – 19" x 7" x 20 " (Chassis)
  - Broadband 100 Watt HPA

Electronic Warfare (US Navy)



- **End User:** US Navy
- **Customer:** TMC Design Corporation
- **Platform:** Navy MSC-Ocean Surveillance Ship "Prevail"
- **Product/Program Description:**
  - HPA for final amplifier in EW Suite
  - Emulation of foreign jammers
  - Stand Alone EW Devices
  - Homeland Security Support
- **Key Parameters:**
  - 10 – 1000 MHz – 50 Watts (Model 5303039)
  - 10 – 1000 MHz – 10 Watts (Model 5303052)
  - 7.9" x 5.4" x 1.2" (Module)

Extended Littoral Battlefield (ELB)

- **End User:** US Navy
- **Customer:** NavAir/NAWC & Office of Naval Research
- **Platform:** P-3 Orion
- **Product/Program Description:**

  - 2 – 4 GHz, 50 Watt Broadband Solid State HPAs for crucial NAWC testing at both Pax River and Point Mugu.
  - Air to Ship to Ground Communications
  - Operational Test & Evaluation Support

- **Key Parameters:**

  - Also 0.8 – 2.0 GHz – 200 Watts HPAs
  - 19” x 8.75” x 20” (Chassis)

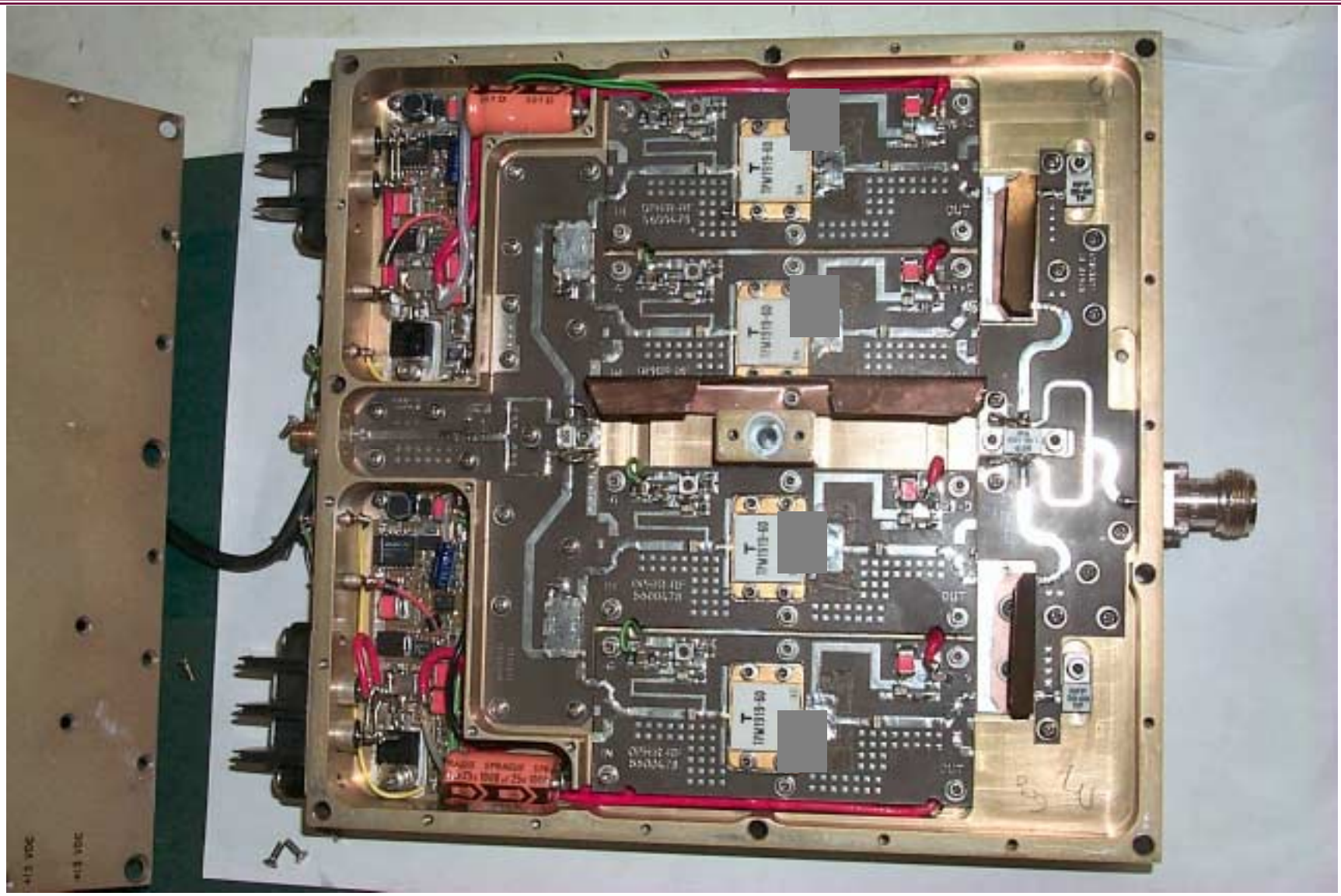
Air Force Satellite Control Network (AFSCN)

- **End User:** US Air Force
- **Customer:** Honeywell Technical Services
- **Platform:** Data Link Terminals (DLTs)
- **Product/Program Description:**
  - Global Infrastructure of 15 common user antennas, 2 Control Sites, & 4 DLTs for world-wide operational control of military satellites.
  - Supports surveillance, navigation, intelligence, communications & weather satellite operations.
  - Project supported for 10 years, currently at phase 3.
- **Key Parameters:**
  - 500 & 1000 Watt HPAs for RCUs & DLTs
  - 1.75 – 1.85 GHz, 500 Watts (Model 4028)
  - 1.75 – 1.85 GHz, 1000 Watts (Model 4029)

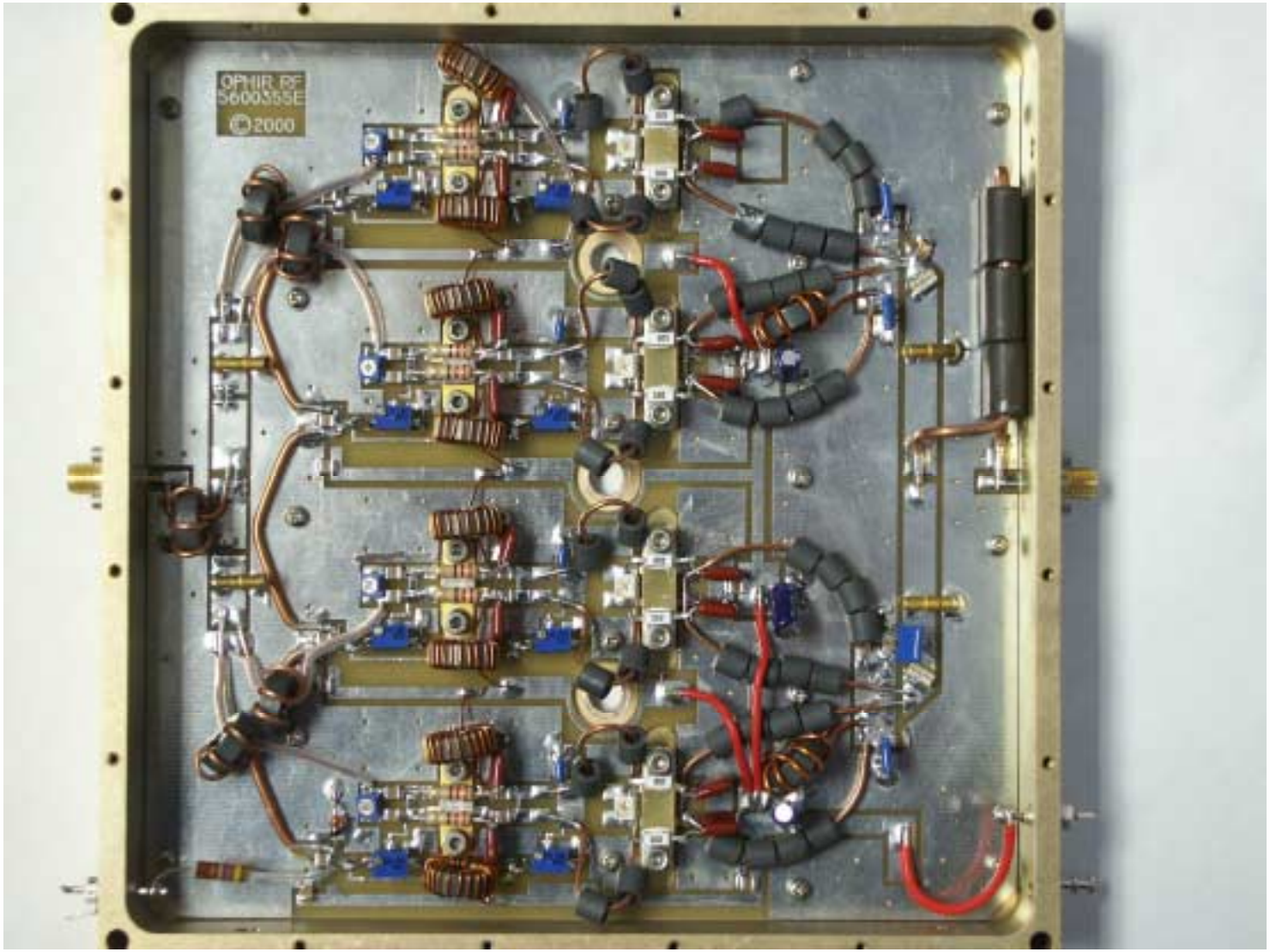
Shanghai Metro Underground Communications Network

- **End User:** Shanghai Metro
- **Customer:** Wuhan Research Institute of Posts and Telecommunications
- **Platform**: Shanghai Subway/Metro System
- **Product/Program Description:**
  - Provides extension of cell phones in tunnels
  - Base Station HPAs and Repeaters
  - On-going Program; Upgrades & Enhancements
  - OPHIR won contract in 4 of 5 Planned Stages
  - 100% Redundancy & Backup
- **Key Parameters:**
  - 1.8 – 2.0 GHz Band Specific (Model 5302030)
  - 800 – 1000 MHz (Model 5302063)
  - 925 - 960 MHz 200W base stations

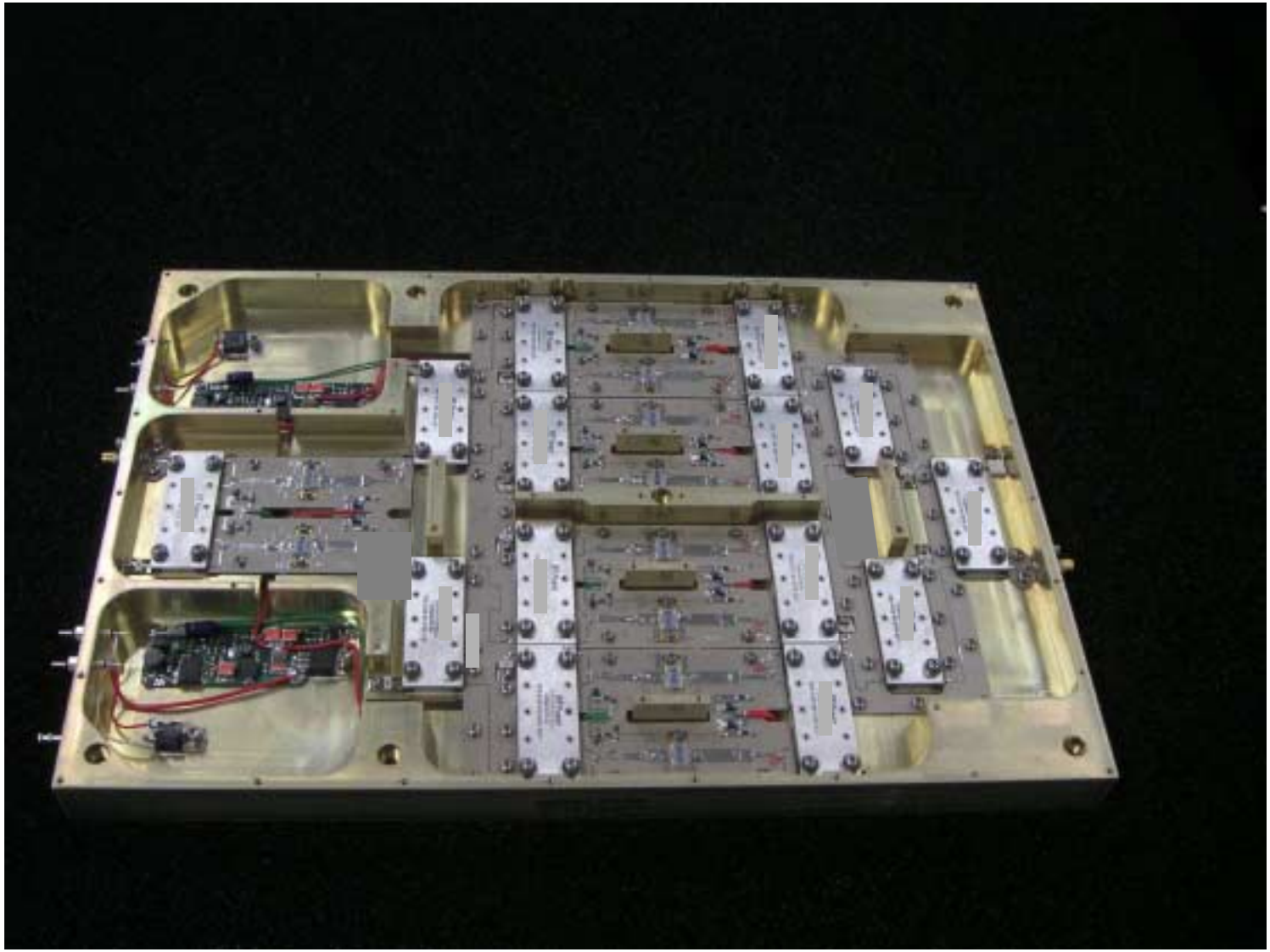
200W, 1.75 to 1.85 MHz



100W, 20 to 1000 MHz



50W, 800 to 2500 MHz



Typical OPHIR$_{RF}$ Customers

* Boeing
* Agilent (HP)
* Ericsson
* Honeywell
* Lockheed Martin
* TMC Design
* US Navy/NavAir
* BAE Systems
* General Dynamics
* Northrop Grumman
* Raytheon
* L-3 Communications
* ViaSat
* Booz-Allen & Hamilton
* Freescale Semiconductor
* Applied Materials

OPHIR$_{RF}$ In The News

Article From:

Military & Aerospace Electronics

EW Application for Syndetix

- Rugged Broadband HPA
- Developed from Spec – 2 wks
- Hybrid Mod. of Ophir Models
- Harsh Environmental Tests
- Quick Reaction & Quick Turn-around following 9/11 Attack & US Government Responses.

Ophir RF amplifier used to combat terrorism

by John McHale

LAS CRUCES, N.M. — Officials at Syndetix in Las Cruces, N.M., last year used a rugged broadband power amplifier from Ophir RF in Los Angeles to help combat terrorism in the Middle East during the months following the terrorist attacks of September 11, 2001.

Syndetix officials needed the device adapted and ruggedized for their specifications in two weeks time, when it normally takes six to eight weeks for that type of specification, says Thomas Mullineaux, director of sales and marketing at Ophir. "We had all hands working around the clock, it was really a race against time."

The device for the Syndetix application was a hybrid of Ophir's Model 4059 and Model 4039 broadband power amplifiers, he says. Mullineaux declined to comment in detail on the device or the application due to the nature of the mission.

During that two weeks Ophir engineers were able to meet the exact Syndetix specifications and perform all the ruggedization, and harsh-environment testing so the amplifier would function efficiently in mission-critical situations, Mullineaux says. Ophir officials also did not have to worry about shipping delays, because the military took care of that part, he adds.

Ophir's amplifiers are commercial-off-the-shelf devices, however for most military applications they are modified according to customer specifications, Mullineaux says. "The Syndetix application demonstrated how fast we can turn a product around."

Ophir designs and manufactures high-power, solid-state, broadband, and band-specific amplifiers. The company's products range in frequency from 10 kilohertz to 8 gigahertz, with power levels from 1 watt to more than 2 kilowatts.

Communication applications include cellular and personal communication services, multi-point distribution service, wireless local loop, satellite communications, and frequency relocation. Broadband applications include electromagnetic compatibility and radio frequency interference testing and traveling wave tube replacement.

Syndetix has expertise in electronic warfare technology and electromagnetics. The company has a methodology for electrical/electronic systems design, development, and fabrication, modeling and simulation, and software development. Syndetix has also recently expanded into the commercial market in such applications as oil sludge reclamation systems.

Ophir RF's broadband power amplifier was used in efforts to combat terrorism.

For more information Ophir RF Inc., contact Hannah Markowitz by phone at 310-306-5556, by fax at 310-577-9887, by mail at Ophir RF, 5300 Beethoven Street, Los Angeles, Calif. 90066, by email at hannah@ophirrf.com, or on the World Wide Web at http://www.ophirrf.com.

For more information on Syndetix Inc., contact the company on the World Wide Web at http://www.syndetix.com.

Custom System

	Parameter	Specification
Programmatic	Customer name	
	Application	
	Module/System/Assembly	
	Initial Quantity	
	Potential per Year	
	Target price	
	Schedule	
	Contact person	
	Business Telephone	
Electrical	Frequency Range	
	Class of Operation	
	Power Out @ 1dB from Saturated Power	
	Power Out - saturated	
	Small Signal Gain	
	Small Signal Gain Flatness	
	Input / Output VSWR	
	Harmonics	
	Spurious Signals	
	Variable attenuator (output power settings)	
	Power into VSWR 2:1	
	AC Input Power	
	Contoller type	
	RF Input	
	Maximum RF drive	
	IMD	
	Special Unique	

Custom System

	Parameter	Specification
Protections & indication	Input Power reporting	
	Output Power reporting	
	Temperature indication	
	PS indication	
	Temperature protection	
	Open/short	
	Communication protocol	
	LEDs	
	Operating temperature	
	Dimensions	
Environmental	Weight	
	High Power Connectors	
	Low power Connectors	
	Control connector	
	AC connector	
	Cooling method	
	Mounting	
	Special Unique	
	Operating Humidity	
	Operating Altitude	
	Shock and Vibration	
	Dust	
	Salt Fog	
	EMI requirement	

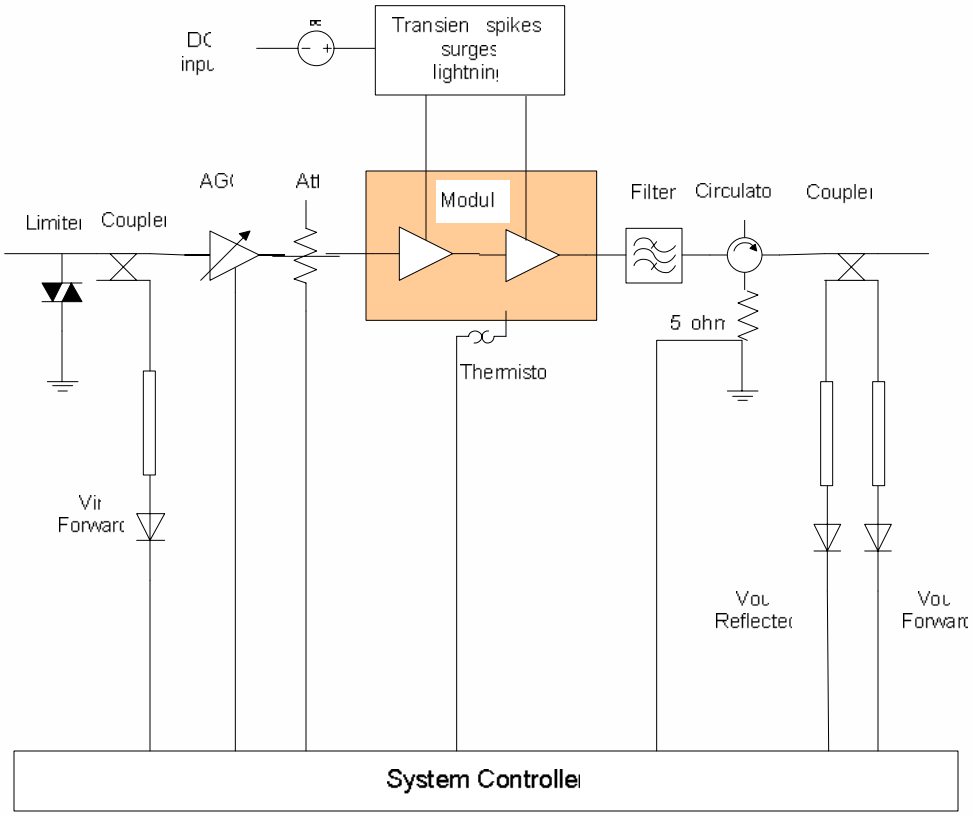
Product Design Flow

- Review and Understand Customer Requirements:
- Detailed Budget Analysis:
  - Noise Figure, Gain, Power, IP3, Thermal
- Functional Block Diagram of Module / Amplifier
- RF Simulation and Design of Module / Amplifier
- Prototype Build and Product Development of Module / Amplifier System:
  - PCB and RF Module Layout (RF, Microwave and Digital PCBs)
- Review Prototype's Data with Customer

Product Design Flow

- Finalize Product Documentation Package:
  - Drawings: Specifications, Block Diagram, Wiring Diagram, and Assembly
  - Parts Lists: Assemblies & Subassemblies
  - Test Data: Performance Data: RF, Temperature, Environmental, EMI and RFI
  - Acceptance Test Procedures
  - User Manual
- Material Management:
  - Identify potentially long lead delivery Items
  - Order and Kit components and sub assemblies.

Module Application



Protection & Operational	Design provision
DC surges, spikes, ripples, lightning	Suitable Power Supply, or additional DC filtering
Excessive Input drive	Adding a Limiter
Mismatch, Open/Short	Adding a Circulator if possible
Thermal protection	Adding a Thermistor, monitor the temperature and turn off the DC in or the RF drive
Input power reporting	Add input Coupler
Forward and Reverse output reporting	Add Directional Coupler and RMS (or peak) Detectors
Control input drive to the module	Add Variable step attenuator or AGC
ALC (automatic level control)	All above
Cooling Method	Adequate heat-sink design (surface area, fans, surface flatness)

Technical Progress

- Addition of fast On/Off switching to our modules
  - 10uS On, 1uS Off
  - Suitable for LDMOS, VDMOS, GaAS devices
- Improved protections
  - Front limiter to prevent overdriving
  - New IEEE RS232 controller
    - Include software/hardware active power limiting
  - Thermal protection
- Rack Mount Power Supply
  - To be used at Very high power system (>500W)
  - Hot swappable (N+1) for redundancy
  - Include AC and DC distribution and circuit breaker
- LDMOS as a preference for new designs

Technical Progress

- Broadband solutions
  - 4 channel system for EW application
    - 1 to 30MHz
    - 30 to 500MHz
    - 500 to 1000MHz
    - 1 to 2.5 GHz
    - 5U (8.75” high), 19” rack
  - 2 Channel system for EW application
    - 20 to 1000MHz
    - 1 to 2.5 GHz
    - 3U (5.25” high), 19” rack
  - Airborne surveillance application
    - 2 to 2.4 GHz, 400W
    - Altitude of 45,000 feet
    - 40% overall efficiency
    - Less than 30Kg

Summary

OPHIR$_{RF}$ Represents:

- Totally Integrated, Custom/COTS Solutions for Government & Commercial Customers
- State-of-the-Art Thermal Management, Linearity, & Co-site Enabling Research & Development
- Fast Reaction (QRC) Response Reputation
- Reliability, Scalability, & Cost Effectiveness
- Value, Efficiency, & Customer Service

OPHIR$_{RF}$ Amplifiers…

The Art of Wireless since 1992.