

Capabilities Brochure

A Quantum Leap in Digital Communications Providing real time Digital RF[™] Systems Worldwide

HYPRES. Inc., a complete superconducting electronics company offering design development, fabrication, testing and packaging in a commercial production environment.

www.hypres.com



Objective

To be the world class leader in Digital RF Systems both for Military, Commercial Wireless and Public Safety sectors.

The Company

Since 1983, HYPRES has been engaged in the development and commercialization of superconducting microelectronics. Superconducting integrated circuits (ICs) represent a significant advance over existing semiconductor technologies. HYPRES has established world-leadership in superconducting technology and is the premier commercial supplier of primary voltage standard circuits used in metrology laboratories worldwide.



Elmsford, NY

HYPRES Overview;

Founded by researchers from IBM in 1983 -a 26 year young company privately held

Location: Elmsford, Westchester County - 30 miles North of New York City. 18,000 sq. ft. facility. Facility cleared for secret level

Design capabilities: • VLSI IC computer-aided-design (CAD) workstations • Niobium (Nb) RSFQ, Si CMOS, SiGe HBT Electrical

& Mechanical packaging / modeling and design

Micro-fabrication manufacturing area including class 100 clean room. •12-level Niobium, 3.0 to 1.5 µm process

Silicon micro-machining.
Only commercial superconductor foundry in the world.

Testing: Multiple 20 GHz to 75 GHz test stations



Mission

HYPRES will maintain its world leadership in Superconducting Micro-Electronics (SME), offering design development, fabrication, testing, and packaging by providing Digital RF products for commercial wireless, DoD communications, MILSATCOM and SIGINT systems.

Core competencies

System engineering and design of Superconductor Micro-Electronics (SME) circuits for Communication and SIGINT Systems, Manufacturing and foundry for SME circuits, Program Management, Configuration Management, Logistics Support and Test Engineering

The Technology



Memory

HYPRES leads the industry in the development of random access memories (RAMs) as well as non-volatile memories for use with cryogenic ICs. In addition, we are also active in the design of FIFO (first in, first out) memory structures and shift registers for on-chip data acquisition at multi-GHz rates.

- Random Access Memory
 - Low-access time
 - Non-volatile
- Shift Register and FIFOs
 - Silicon-on-Insulator (SOI) CMOS interface ASIC design
 - 144 GHz SFQ Shift Registers

Digital Signal Processing Core

The Single Flux Quantum logic family is well suited for a variety of digital signal processing (DSP) functions because of the ultra-high speed and the naturally pipelined architecture of the technology.

- All-digital Correlators and Autocorrelators
- Multiplexers and Demultiplexers
- FFT blocks
- Digital Beamforming techniques
- True time delays
- General purpose blocks

Sensors and Detectors

HYPRES has a number of programs aimed at sensing and detecting electromagnetic radiation. Using both cryogenic and room temperature materials, our development programs aim to cover the spectrum from ELF (sub-hertz) through infrared and mmwave and up to X-rays.

Data Converters:

The unique properties of superconductivity lead to an unparalleled capability for the coding of data between various analog and digital forms. Quantum accuracy is enabled by HYPRES designs, which when coupled with ultra-fast multi-GHz operation, create some of the most powerful circuits ever developed.

Analog-to-Digital Converters (ADCs) Wide Bandwidth Flash ADC Dynamically Programmable High-Resolution ADC Ultra-sensitive Signal Digitizers

Digital-to-Analog Converters (DACs) AC Voltage Standard Direct Digital Synthesis

Time-to-Digital Converters (TDCs) Single-hit Multi-hit

Phase locked loops and Oscillators

HYPRES is active in the development of both digital phase-locked loops (PLLs) for on-chip clocking, as well as analog oscillators and resonators.

Phase-locked Loops Low-jitter resonators

Josephson Oscillators

Packaging and Interface Electronics

Years of HYPRES experience has resulted in a wealth of knowledge in the instrumentation of ultra-wide bandwidth digital data. Further, the necessity of cryogenic operation of many HYPRES circuits has motivated the development of stand-alone, simple room temperature interface electronics capable of delivering standard ECL logic levels to the user. www.hypres.com



Direct Digital-RF Technology Growth



Products from HYPRES include primary Josephson voltage standard chips and systems. The standard Volt worldwide is based on a superconducting Josephson junction array, and its realization at many International Standards Laboratories, including the Bureau International de Poids et Mesures (BIPM) in Paris, currently uses HYPRES superconducting 1-Volt and 10-Volt standard chips incorporating over 3,000 and 20,000 Josephson junctions respectively. HYPRES is the sole commercial supplier of both 1-Volt and 10-Volt voltage standard chips, made with our all refractory Niobium (Nb) technology. The circuits made with this process have demonstrated no signs of aging or deterioration when used for many years. The HYPRES all-Nb voltage standard chips were developed into a commercial product through close collaboration with the National Institute of Standards and Technology (NIST), which developed the original design of this device.



Complete self-contained microelectronics fabrication facility





Examples of Superconductor (Nb) ICs





Superconductor Digital-RF Infrastructure



Analog-to-Digital Converter (ADC)



Digital-to-Analog Converter (DAC)



Correlator



Multiplier



Shift Register



Random Access Memory (RAM)



Low-jitter On-chip Clock



Digital I&Q Converters







Optical I/O and Packaging





True- time Delay line



Examples of Commercial based products utilizing Superconducting Technology

Magneto-EncephalogramFetal Magneto-Cardiogram(brain currents detection)(fetal heart currents detection)





CTF MEG System

HYPRES/BTi FMCG System

These applications cannot be done using any other technology...

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Voltage Standard Product

Primary Voltage Standard for Metrology Markets Developed with DoD Dual use Resources



Technology so accurate it defines the volt, so sensitive it detects brain currents, so fast it digitizes signals 100 billion times a second

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All Digital RF Transceiver Product Line

Enables the All-Digital Software Radio



Total functionality in a single product excluding power amplifiers, antenna/tower, and standard ancillary equipment





Customer Base

NASA Goddard/GRC

AF Rome Labs

AF Kirkland Labs

AF Wright Patterson

Las Alamos

Government Customers

- ONR DOC/NIST
- DARPA
- NRL
- NIH
- **SPAWAR** CECOM
- NSF
- **MDA**
- DOE
- NAVAIR
- **US Army PM DCATS and WIN-T**

Prime Customers

- Raytheon
 - Northrop/Grumman
- **Argon ST**
- Lockheed/Martin
 - BAE
 - Cubic
- L-3

- ViaSat
- Boeing

- **SUNY Stonybrook**
- **Rochester University**
 - RPI
 - USC
- **Tristan Tech**
- Sumitomo
- Creare

- Sprint
- Nokia
- **Eriksson**
- **Orange UK**
- Sunpower
- TAI
- **Air Liquide**
- SAMSUNG
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- **Rockwell/Collins** Harris
- **SwRI**
 - STI
 - L-3

 - **General Dynamics**

ARL

NSA

SMDC

NSWC

IARPA

□ AF ESC

AF SWC

- Thales
 - Sarnoff Labs
- **Ball Areospace**

Commercial Customers



HYPRES was founded in 1983 and has since been active in advanced R&D programs while developing the second generation IC technology for superconductive electronics. This includes a reliable all-refractory niobium IC process that resolves the materials-related issues that had limited progress in the IBM Josephson computer program. In addition, a new logic family is now applied that takes full advantage of the intrinsic properties of superconductors and enables gate speeds approaching 1,000 GHz (770 GHz demonstrated in the laboratory).

The company is located in Elmsford, NY, and includes a complete superconducting integrated circuit fabrication line. The facility is totally self-sufficient and includes thin film and photolithography processing and support functions covering CAD, device testing, and cryogenics development. Our staff is expert in circuit design, circuit fabrication, packaging, and cryogenics. In addition to capabilities in superconductivity, other HYPRES technologies enable advanced microfabrication processes which lead to unique micromachined sensors for the detection of infrared and millimeter wave radiation without cooling.

Our staff includes a management team with proven performance, world experts in superconductivity and cryogenics with advanced degrees, an experienced engineering and operations team, and an efficient administrative team. At HYPRES, our mission is to develop and market products with performance significantly exceeding current technology for a comparable price and in a comparable package. We are dedicated and committed to complete customer satisfaction in the products and services we deliver.

Core advantage

HYPRES is a complete superconducting electronics company offering design development, fabrication, testing, and packaging in a commercial production environment.

IMPRES

HYPRES' design staff provides demonstrated expertise with proven designs. Examples of these include high performance analog-to-digital converters, shift registers, memory, SQUIDs and SQUID amplifiers, IR sensors, SIS mixers, and RSFQ logic gates.

The HYPRES facility includes high speed test equipment, UNIX-based CAD tools, process equipment, 2 and 3 stage closed cycle refrigerators, and clean room space for wafer processing. HYPRES' facility meets all environmental laws and regulations of Federal, State of New York, and local governments for airborne emissions, waterborne effluents, external radiation levels, outdoor noise, solid and bulk waste disposal practices, and handling and storage of toxic and hazardous materials.

HYPRES is still the only company in the world to have produced and marketed a digital superconducting electronics product to date: the PSP-750 and PSP-1000 digital sampling oscilloscopes. These units, with 70 GHz bandwidth, proved to be the world's highest resolution time domain reflectometers (TDRs). The bandwidth of the sampling head on these scopes was limited by the connector technology, not the sampling circuit. The PSP product line (1987-1990) demonstrated the ability of HYPRES to produce, market, and service a complex digital instrument which utilized superconducting electronics components. HYPRES is also the only company to have provided state-of-the-art SIS mixers to the radio astronomy community on a commercial basis. The Superconductor-Insulator-Superconductor (SIS) diode is the critical component of the most sensitive radio receivers in the world for frequencies from 65 to 1,000 GHz. HYPRES has provided SIS devices for SIS mixers since 1988. These mixers, developed jointly by the National Radio Astronomy Laboratory and HYPRES, have been sold to radio observatories in Australia, France, and the United States. HYPRES SIS diodes, purchased by University of California - Santa Barbara astronomers, have been to the South Pole where they were used to make extremely accurate measurements of the radiation which was produced by the explosion that started the universe.

HYPRES' SIS mixer customers for radio astronomy include: AT (Australia Telescope), Bell Labs, Bordeaux Observatory (France), CIT-OVRO, Haystack Obs, IRAM, NRAO 12-m Telescope, and UC-Santa Barbara.

HYPRES is currently developing unique products for wireless and optical communications. Leveraging the high performance of its circuits and the established need for higher bandwidth, higher dynamic range, and higher accuracy, HYPRES' new products are intended to facilitate the rollout of higher bandwidth beyond-2G wireless and enhanced optical systems while significantly reducing the capital expenditures and new infrastructure that would otherwise be required. HYPRES' unique technology is unrivaled in this domain and represents the foundation for the new products under development.



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