Signal Processing Group Inc.
Examples of work done.
(1988 – present)

- A high voltage analog multiplexer (750V peak to peak analog input at 2kHz) using a 5.0V digital control signal. Process is a 800V trench isolated process.
- A CCD imager driver chip. This chip provides the drive waveforms for a charge coupled device. Typical voltage levels ±5.0 V, ± 15.0 V. Typical currents: Up to 7A peak.
- An RFID passive transponder. A receiver, transmitter and a 256 Bit EEPROM on the same chip.
- MMIC design (blocks included mixer, PA, VCO LNA etc) at Ku band and lower.
- PLLs for various applications: From 10 kHz to Ghz.
- Design of a Ku band block up converter.
- Design of a Ka band power amplifier.
- Low noise amplifiers and RF amplifiers.
- Computer peripheral chips.
- Sensor interfaces.
- Power factor correctors
- EL Drivers
- Present interests in sigma – delta data converters, high speed data converters, FIR filters.
- Analog sections of a large cable modem SOC: This work was done to implement the following analog cells into a large ASIC done in a 0.18um CMOS process.
  10 Bit A/D converter running at 26 Mhz
  10 Bit D/A converter running at 100Mhz
  PLL running at a dual reference of 25/36 Mhz and outputting 240Mhz (Phase noise < -96 dbC)
  A crystal oscillator was designed and fully characterized for phase noise (< -160 dBC)
  The critical problems solved were also the layout, placement and interconnection of the analog cells to minimize noise, crosstalk, delays etc. in this very large chip.

- Design and development of a CCD Imager driver using high voltage, high frequency process. Generation of programmable voltage levels between ±15.0 Volt using 5, 6 and 7 bit DACs and regulators with a built in voltage reference to allow extremely accurate operation (VREF was trimmed by an on chip 8 bit DAC to achieve sufficient accuracy). Multiple drivers were implemented on chip with load capacitances ranging from 10pF to 25nF (for vertical drive) and frequencies ranging from DC to 60 Mhz with rise/fall times ranging between 1ns (min).

- High voltage (800 volt peak to peak) multiplexer and multi-segment EL lamp driver. The chip uses a low voltage SPI interface to program the state of a set of 18 high voltage switches serving as a mux. The chip also has EL lamp bias control for each switch and lamp.

- A 3G cell phone chip. Designed and implemented the analog section of the SOC chip. The analog section uses high speed (25 – 50 Mhz, 10 bit ADC's and DACs) with a programmable PA for the transmitter with a proprietary algorithm. The control circuitry is digital and takes up the majority of the space. Device designed in 0.18um TSMC process.

- Designed and implemented a time base compensation chip which uses a real time clock and D/A converters to adjust a PWM duty cycle depending on elapsed time. Once switched on the clock keeps time down to seconds. An EEPROM stores the characteristic of the duty cycle versus time and switches the duty cycle of an oscillator as breakpoints in time are reached. When the clock stops running the elapsed time is stored in non- volatile storage.

- Designed and implemented a proprietary (customer) analog circuit for a SOC that is used to correct errors in multi – level large Flash Memories. The idea was to use 2-bits/ cell and 4 bits/cell and recover any lost bits using the techniques, which uses amplifiers, integrators and comparators.

- Carried out a large feasibility study for the design and implementation of a chip set for communications using Diffused Infra – Red techniques. The final partition was a receiver chip with a set of 4 very low noise trans-impedance amplifiers, followed by a complex analog signal processor and a LED driver. Breadboards were used to prove out sections of the design while simulation was used on those parts of the system that could not be bread-boarded because of parasitic capacitance.

- Designed an RFID SOC with a receiver, transmitter consisting of LNA, PLLs. In addition invented a technique to build a user programmable ROM using a standard BiCMOS process. The digital section contained the transceiver algorithm. The chip was low power so as to allow the power to be derived from the H-field of a radio signal. (Frequency range was 440 Mhz to 908 Mhz)

- Designed a transceiver consisting of a LNA, RSSI, detector, a Colpitts oscillator with an external SAW filter and a power amplifier (-15dBm) Frequency range was 303Mhz to 440Mhz. Application was RFID.

- Designed power management IC with multiple buck and boost converters and LDO's for a cell phone application. Design was done for output currents of up to 200mA.

- Designed and implemented a timer and fuse control chip for smart munitions for the US Army. The chip has a very accurate timer which is set at the time the munitions are fired and times out at 2.0, 10.0 and 24 seconds triggering a fusing mechanism (1.6 Joules of energy) which ignites the explosive.

- Designed A/D, D/A and band-gap reference for a large medical electronics company for use in various medical applications including cardiac pacemakers.

- Designed and implemented a complete RFID passive tag which consisted of a temperature sensor, receiver, transmitter, voltage reference, reference oscillator, comparators, digital control logic and 256 bits of EEPROM. All the EEPROM programming was on chip including the 1.2V to 20Volt charge pump. (Process was the Fairchild 1.0um EEPROM process)

- Designed a complete chip for a large medical electronics company which consisted of A/D, D/A converters, voltage reference, boost converters, sensing circuits, timers, accumulators and digital signal processing logic to control the dispensation of medicine through the skin.

- Designed all the analog blocks for a multimode digital driver circuit. Chip consisted of multiple RS232, USB, RS485 circuits and logic. Charge pump circuits were employed to raise voltage levels for the RS232 circuits.

- Designed an EL lamp driver circuit using dielectric isolation technology which generated ±160Volt single ended at 10mA output current. Designed the prototype for an H-bridge El Lamp driver and a single ended, single transistor EL driver. Output currents were of the order of 10mA and output voltages ranged from 125V peak to 400 Volt peak. Devices used DI Bipolar and High voltage bipolar technology.

- Designed three chips using a high voltage BiCMOS technology for use in the control of the drive motor for elevators. The first two chips were analog while the third chip was a DSP chip used for post processing, controlling the firing of power SCRs for the drive.

- Designed two chips for an RF earphone/microphone application. The first chip was a test chip to evaluate the design techniques for the final chip whose function was to provide short range communications using FM between a cell phone and a RF earphone/microphone combo. Chip used Frequency hopping in the ISM band. Analog functional blocks were PLLs, LNA, various modulators, demodulators audio pre and post processing circuits.

- Designed a TP3020 compliant Codec for a line card application.

- Designed a computer peripheral chip (ECLIPSE) for use as the analog front end for a 3 dimensional "mouse" application. The chip simply provides A/D, D/A, bandgap, reference oscillator, register files, memory for pre and post processing the data generated by a proprietary scheme for 3 dimensional mouse type interface.

- Designed a chip for use in monitoring, controlling and generating alarms and fuses for water well motors. Chip had band-gap references, oscillators, high current drivers, D/A and A/D converters and some digital control logic. Design was done in CMOS.

- Designed a special purpose extremely low power self-contained crystal oscillator for use in a large SOC. The total supply current for the crystal oscillator itself was only 200nA (typ) at 1.2 Volt supply.

- Designed an automotive control circuit for use in Anti – Lock braking for after market automotive components manufacturer. Chip has A/D, D/A, band-gap, oscillator and some digital control logic.

- Designed a PC board level circuit prototype for establishing a wireless communications network inside a large factory with hubs and nodes within the building communicating in a star network. The frequency band was ISM.

- Did a feasibility study for a very large Analog SOC, which was used for a cell phone application. The SOC had amplifiers, references, PLLs, receivers and transmitters. The feasibility study also involved some simulation, bread-boarding and system modeling of the channel itself and its characteristics. Used MATLAB and C++ for modeling.

- Worked as a member of a team and designed key analog blocks of a cell phone SOC. This chip is used right after the rf front end and does all the post processing of the IF, AGC, audio and detection functions. It has filters, a sigma delta A/D, various amplifiers, control logic and band-pass sigma - delta converters.

- Designed a single channel of a CMOS chip which acts as the pre and post processor for a laser based data storage system. Chip has 360 channels of identical circuits which are an RF amplifier, a comparator and a filter and some control logic.

- Designed the analog circuitry for timing using PLLs and a on chip crystal oscillator to be used in two very large SOC's (> 700 mil on a side) for a large semiconductor microprocessor maker. Also included on the second SOC was a trans-impedance amplifier which acted as a receiver.

- Designed the analog front end for use in a large system for the tracking circuits in the nose cone of a missile. The analog front end was used as the interface for PbS sensor arrays and also as the servo for the tracker head using IR. The entire system was designed using both ASICs/FPGAs as well as PCBs and cemented together with firmware also designed by the team. Project details were and still are classified secret.

- Designed a caller ID with call waiting prototype chip for a large Japanese Semiconductor manufacturer. The Japanese then modified the prototype and are manufacturing in volume for CIDCW phone features and adjunct boxes.

- Designed an analog front end to be used in RFID tags. Chip has a mux, control logic, amplifiers, A/D converters, band-gap reference etc. Its function is to work with a microprocessor and provide converted data for transmission. The data is derived from two pressure sensors and an on chip temperature sensor using a simple pn junction.

- Designed a complete broadcast band FM transmitter using CMOS technology.

- Designed Ku band mixers, VCO, power amplifier etc in SiGe technology.

- Designed cell phone power amplifier module building blocks.

- Worked as team member on the design of a RF transmitter and signal conditioning chip for Anti - Submarine Warfare sona-buoys. Designed a 200Mhz PLL for the transmitter.

- Worked as a member of the team to design the receiver with AGC and a 95dB RSSI circuit for a very large SOC frequency hopping transceiver used in battlefield radio. Frequencies of operation were from 230 Mhz to 440Mhz.

- Designed a prototype circuit for a SADARM military munitions project. The chip is used in a smart munitions shell . The functional blocks we were responsible for were the receiver and transmitter.

- Designed a 200 Mhz, peak detector circuit for Automatic Test Equipment used for Flash Memories. Circuit uses fast comparators and a proprietary code conversion circuit.

- Working as a team member designed a 10 Bit successive approximation A/D converter using switched capacitor technology and very simple inverter based auto-zeroing comparators. Invented and implemented a digital error correction circuit to extend the range of the A/D. Chip was used in a medical digitizer.

- Working as a member of a team designed analog functional blocks for: U – Interface and T – Interface for ISDN chips.

- Modeled and characterized partial response signaling for transmission on twisted pair cables.

- Worked as a member of a team on A/D and switched capacitor filter blocks for a general purpose 300/1200/2400 baud modem.

- Worked as a member of a team and designed a PCM filter for telecom central office applications using both continuous and switched capacitor filters, opamps, etc.

- Worked as a member of a team and designed a chip whose function was to match impedances of varying lengths of twisted pair lines. Chip had switched capacitor filters and high current analog drivers for interfacing to the transmission line. In addition designed on - chip lightening protection circuits for the chip.

- Worked on designing parts of a ping – pong ISDN data - over - voice chip in CMOS. Designed opamps and filters for the ping – pong chip.

- Worked as part of a team with systems designers and defined the Subscriber Line interface high voltage (220V) and low voltage chips.

- Designed a hands-free telephone chip which used echo cancellation techniques in CMOS.
- Designed x band communication chips and MICs using Gallium Arsenide.
- Designed CCD based programmable Transversal filters with fully programmable characteristics.
- Designed a CCD based Correllator for Anti Submarine Warfare
- Designed RF amplifiers for various frequencies and applications
- Designed Low noise amplifiers (NF ~ 1 dB)
- Designed RFMW detectors
- Designed frequency dividers
- Designed oscillators for various frequencies
- Designed RFMW VCOs, phase detectors
- Designed PLLs
- Designed cell phone IF/signal processing chip
- Designed a FM mod/demod chip with FM demodulation
- Designed a 3D mouse control chip

Device design and characterization activity.

- Characterized MOSFETs and Bipolars and extracted process parameters.
- Characterized active and passive device noise; did curve fitting to develop empirical models.
- Built device characterization test fixtures.
- Designed, fabricated, packaged GaAs FETs and characterized operation using MIC test beds.
- GAN devices modeling and usage
- Set up device design techniques and application notes for MOSFETs and Bipolars for use in analog device design.
- Using FIB techniques did failure analysis and fixes of fabricated chips.
- Bench test Integrated circuits and verification

Software

- Long time user of MATLAB
- Long time user of Octave
- C/C++/Windows
- Javascript
- HTML
- Python

Process technologies

- Very familiar with and long time user (< 30 years) of CMOS, BiCMOS processes
- Very familiar with and long time user of GAN devices

- Very familiar with and user of GaAs devices
- Very familiar with high voltage processes (DI, Trench isolated)