

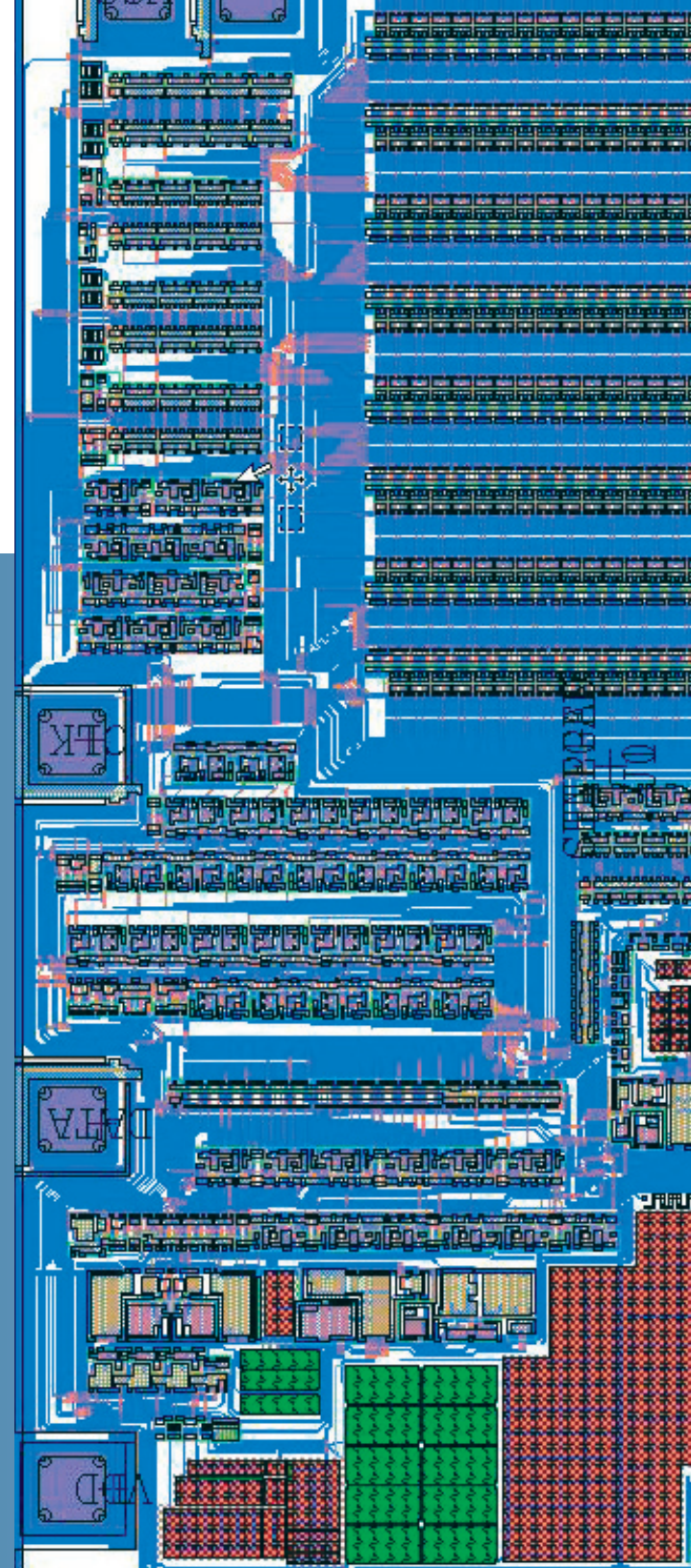
Mixed Signal Integration

Analog & Mixed-Signal Integrated Circuit Solutions

High Performance
General Purpose IC Filters

Communications and Specialty ICs

Audio/Video ICs



Incorporated in 1997 and located in San Jose, California, USA, Mixed Signal Integration (MSI) is a fabless semiconductor company specializing in analog and mixed signal Integrated Circuit (IC) solutions for the Communications, Industrial and Audio/Video markets.

A corporate commitment to continued research and development has allowed MSI to innovate in the areas of low-power and low-noise analog signal processing, low distortion audio, high frequency filtering and low voltage operation. The company leverages its strong technology and system expertise to define and develop IC solutions for customers worldwide.

Technology Expertise

- Switched Capacitor, Continuous Time and Comb Filters
- Low Power, Low Noise Analog Signal Processing
- Phase Locked Loops
- Limiters and Componders
- Op Amps and Comparators
- Automatic Gain Controls and Low-Noise Amplifiers
- Voltage Controlled Oscillators and Mixers
- Voltage Regulators and References
- Analog Front Ends
- Data Converters – ADCs and DACs
- Serial Port Interfaces

System Expertise

- Sensor Interfaces
- Security Systems
- Medical Diagnostic Equipment
- RF and Mechanical Energy Harvesting
- Communications Systems
- Audio, Video and Telecom Filtering
- Automatic Test Equipment
- Radio Receivers
- Cellular Phones
- Sonars and Sonobuoys
- Audio and Sound Enhancement Systems

MSI offers high performance standard and custom products

We provide direct and channel sales support as well as outstanding technical applications assistance to our customers worldwide. MSI has established partnerships with select foundry and assembly/test vendors to offer its customers a broad choice of processes and packages to meet their stringent requirements.

Standard Product Categories

- High Performance General Purpose IC Filters
- Communications and Specialty ICs
- Audio/Video ICs

Custom Product Capabilities

- Highly Integrated Turn-Key ASIC Solutions
- From Product Definition to Production Shipment
- Optimized for Performance and Cost Efficiency

Markets and Applications

Communications/Specialty ICs

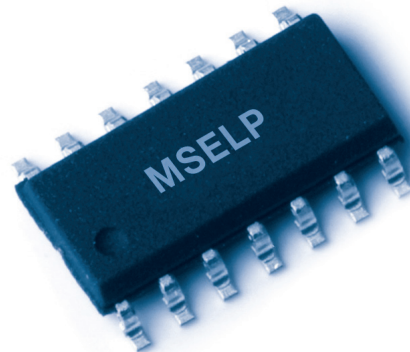
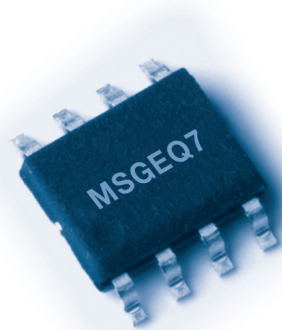
- Homeland Security
- Radio Receivers
- Optical Amplifier Line Cards
- Distortion Meters
- Land Mobile Radios
- Power Line Modems
- Cable testers
- Sonars & Sonobuoys
- Wireless Systems

Industrial

- Sensor Signal Conditioning
- Security Monitoring
- Medical Diagnostics
- Energy Harvesting
- Automatic Test Equipment
- Instrumentation
- Solar Panel Charging
- Sound Pressure Meters

Audio/Video

- Graphic Equalizer Displays on Stereos and TVs
- Light Displays and Decorations
- LED Cubes
- Sound Enhancement
- Hearing Aids
- Audio Filtering
- Video Filtering



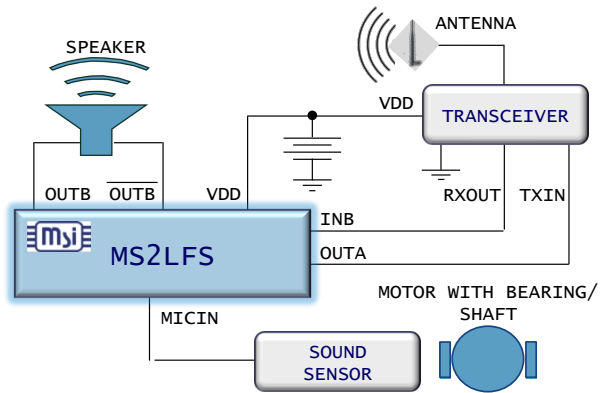
High Performance General Purpose IC Filters

<i>Name</i>	<i>Filter Type and Description</i>	<i>Features</i>	<i>Benefits and Comments</i>
MSELP*	Switched Capacitor Elliptic Lowpass Filter	Low power; 2 uncommitted op amps Internal or external clock	No ext. components; low current <1mA Built-in oscillator eliminates need for ext. clock
MSEPAF	Electrically Programmable Active Filter	Up to 18MHz filtering On-chip E2PROM	No need for external sampling clock 16-pin bench programmable
MSFS1-6* MSHFS1-6*	Selectable Switched Capacitor Lowpass/Bandpass Filter (FS: Audio Freq., HFS: High Freq.)	7 or 6-pole lowpass & 6-pole bandpass Adjustable gain 0, 10 or 20 dB	FS: Up to 40kHz, HFS: Up to 2.5MHz No ext. components; small 8-pin package version
MSHN1-6*	Selectable Switched Capacitor Highpass/Notch Filter	8 or 7-pole highpass & notch Adjustable gain 0, 6 or 12 dB	2.7 min. operating voltage and low power <1mW No ext. components; small 8-pin package version
MSLE5L/M* MSLB5L/M*	Switched Capacitor General Purpose Lowpass Filter (E: Elliptic, B: Butterworth; L:5kHz max., M:20KHz max.)	5-pole lowpass Internal or external clock	2.7 min. operating voltage and low power <1mW No ext. components; small 8-pin package version
MSLFS MS2LFS*	Selectable Switched Capacitor Low Voltage Lowpass/Bandpass Filter (LFS: Single, 2LFS: Dual)	Operating voltage down to 1V Adjustable gain 0, 6 or 12 dB	1V min. operating voltage and low power ~0.5mW Ideal for portable applications; no ext. components
MSNBLP*	Switched Capacitor Butterworth Lowpass Filter	2 uncommitted op amps Internal or external clock	No ext. components; low current <1mA Built-in oscillator eliminates need for ext. clock
MSRAAF MSRAHF	Resistor Programmable Active Audio Filter (RAAF:20kHz max., RAAHF:1MHz max.)	Adjust Q, freq. and gain independently Low sensitivity to ext. resistor variation	Configurable for either a lowpass, bandpass, highpass, allpass or notch filter; no clock needed
MSU1F1-4* MSU2F1*	Resistor Programmable Universal Active Filter (40kHz max.)	Wide Q range 0.5 to over 200 Adjustable gain	Configurable for either a lowpass, highpass, elliptic, allpass or notch filter
MSU1HF1-4 MSU2HF1*	High Frequency Resistor Programmable Universal Active Filter (500kHz max.)	Wide Q range 0.5 to over 20 Adjustable gain	Configurable for either a lowpass, highpass, elliptic, allpass or notch filter
MSVHFS1-6*	Selectable Very High Frequency Lowpass/Bandpass Filter	6-pole lowpass & 6-pole bandpass Adjustable gain 0, 10 or 20 dB	Up to 5MHz No ext. components; small 8-pin package version
MSMXVHF*	High Frequency Mixer and Selectable Very High Frequency Lowpass/Bandpass Filter	Ultrahigh frequency mixer Adjustable gain 0, 10 or 20 dB	No ext. components; Integrated filter and mixer for IF External clocks for mixer and filter functions

* Evaluation Board Available

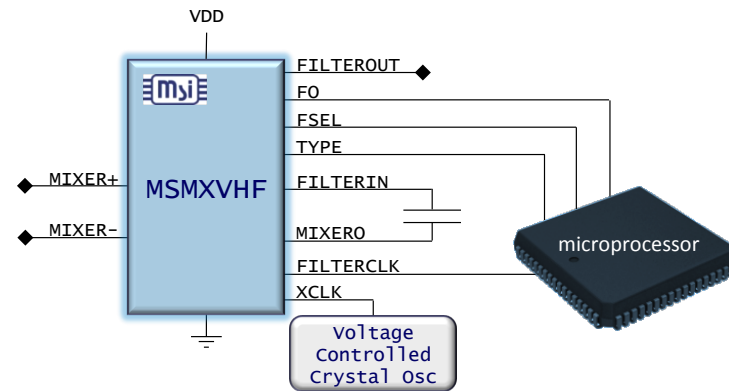
Application Examples

Remote Sensor Interface

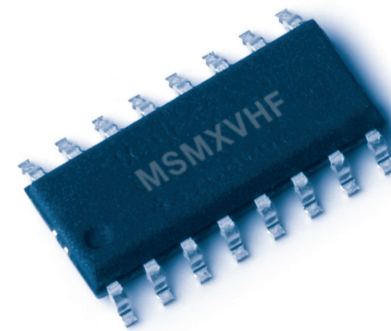
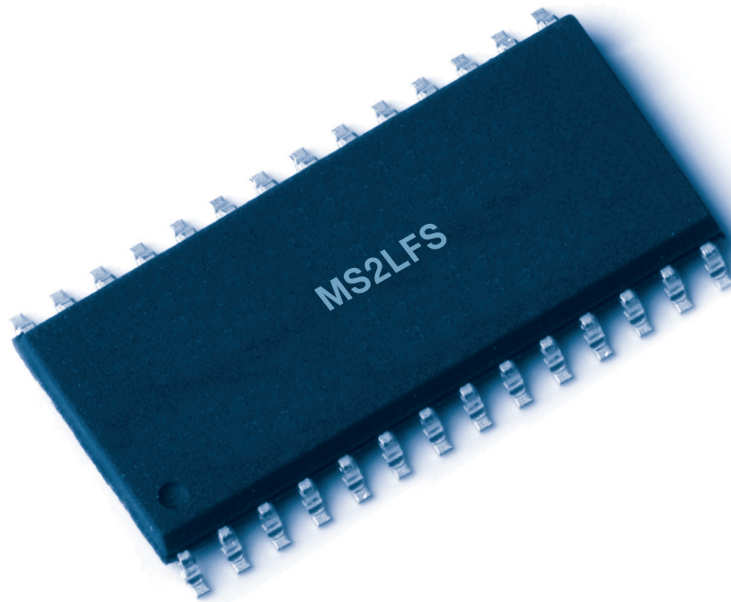


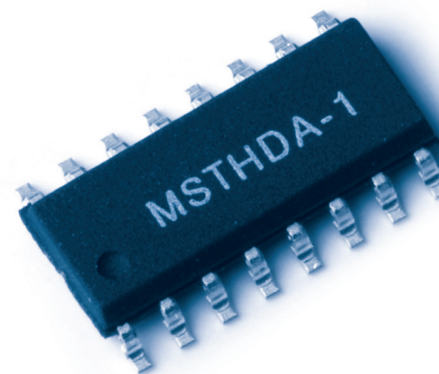
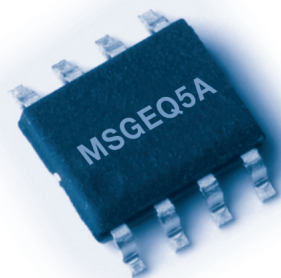
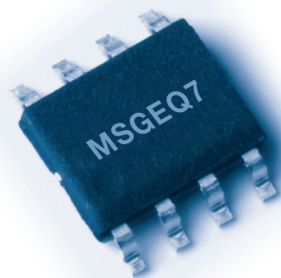
- Uses 1V battery for power
- Bandpass filtering for sensor harmonic analysis
- Receive channel for annunciation for motor failure

Mixer & Tunable Lowpass/Bandpass Filter



- Downconverter for signal analysis
- Tune bandpass to detect signals
- Tune lowpass for telecom/voice discrimination





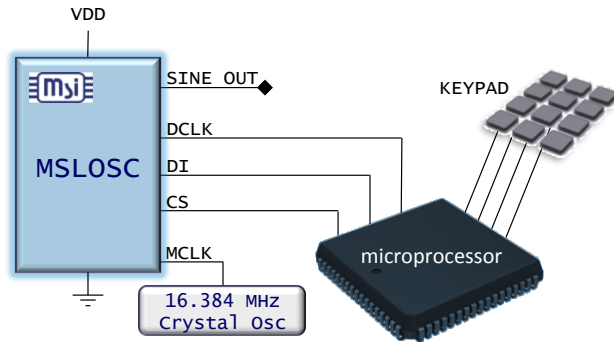
Audio/Video ICs

<i>Name</i>	<i>Filter Type and Description</i>	<i>Features</i>	<i>Benefits and Comments</i>
MSGEQ5A*	Five Band Graphic Equalizer Display Filter (100Hz, 330Hz, 1kHz, 3.3kHz and 10kHz)	Low current < 1mA On-chip oscillator and 20 dB of gain	Fewest ext. components of any competing solutions Low power consumption ideal for portable devices
MSGEQ7*	Seven Band Graphic Equalizer Display Filter (63Hz, 160Hz, 400Hz, 1kHz, 2.5kHz, 6.25kHz and 16kHz)	Low current < 1mA On-chip oscillator and 20 dB of gain	Fewest ext. components of any competing solutions Low power consumption ideal for portable devices
MSLOSC*	15 Hz to 64 KHz All Silicon Sine Source	Programmable freq. and amplitude Low distortion	Small 8-pin device for board space savings Programmable freq. from 15Hz to 64kHz
MSVL14	14 MHz Video Lowpass Filter	4th order Butterworth continuous time filter Low distortion	No clocking noise unlike digital or sample data filters Low noise and low distortion
MSTHDA*	Total Harmonic Distortion Analyzer	Harmonic measurements to 2MHz No microprocessor needed	5 Bandpass filters harmonically spaced Ideal for audio distortion analysis applications

* Evaluation Board Available

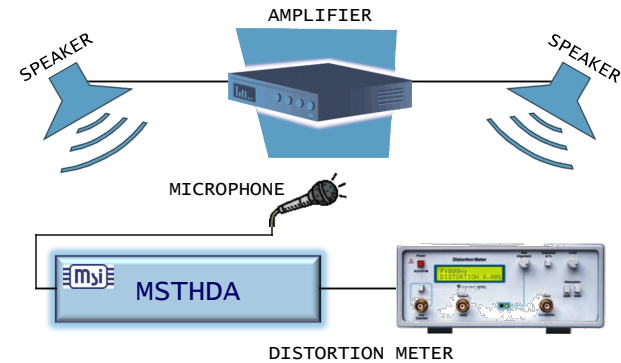
Application Examples

Low Distortion Sine Source

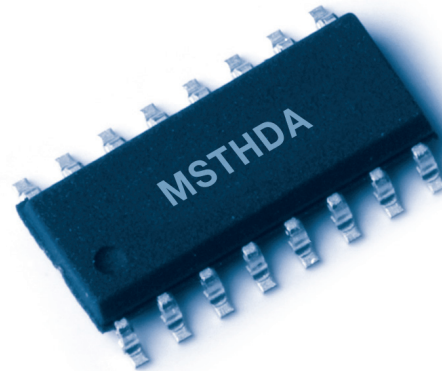


- 15 Hz to 64 kHz
- Digitally controlled
- Ideal for ATE or portable test equipment

Distortion Meter



- Use microphone input for room audio analysis
- Use uncommitted op amp on MSTHDA to sum filter outputs
- Use line out for amplifier distortion tests



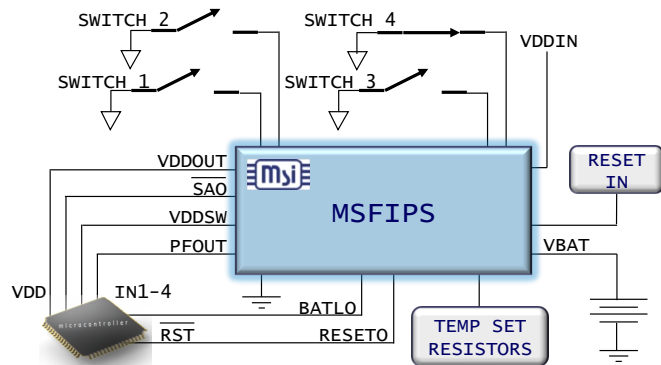
Communications and Specialty ICs

<i>Name</i>	<i>Filter Type and Description</i>	<i>Features</i>	<i>Benefits and Comments</i>
MSSPSI*	Smart Programmable Sensor Interface	Low noise input: $<30\text{nV} / \sqrt{\text{Hz}}$ at 100 Hz External processor control; on-chip 12-bit ADC Offset adjust and temperature sensor Adjustable gain up to 18 dB	3.3V to 5.5V operation Process signals from a sensor or MEMS device 6-pole Elliptic anti-aliasing, 6-pole Butterworth highpass, 7th order Elliptic lowpass filters, can be bypassed via the serial interface
MSCPSI	Controller Programmable Sensor Interface	Low noise input: $<30\text{nV} / \sqrt{\text{Hz}}$ at 100 Hz Internal PICTM processor; on-chip 12-bit ADC Offset adjust and temperature sensor Adjustable gain up to 18 dB	3.3V to 5.5V operation Process signals from a sensor or MEMS device 6-pole Elliptic anti-aliasing, 6-pole Butterworth highpass, 7th order Elliptic lowpass filters, can be bypassed via the serial interface
MSCBT*	Communications Baseband Transceiver	50 CTCSS squelch tones filtered CDCSS code filter	Bi-directional transmit and receive gain volume and filtering Internal highpass filter prevents voice from effecting tone transmission
MSDET*	Tone Detector	Low power of less than 2 mW at 2.7V I and Q detector driven by on-chip VCO	Analog PLL provides better noise immunity than digital designs Center frequencies from 1 Hz to 100kHz detected and FSK decoded
MSFIPS*	FIPS-140 Level 4+ Security Supervisor	Temperature sensor Bandgap reference for under/over voltage detection Four switch inputs (three with polarity control) Automatic battery switchover	Provides the sensor interfaces needed for the Federal Information Processing Standard (FIPS) 140 Wide operating voltage range from 2.4V up to 5.5V
MSLSA*	Low Power Spectrum Analyzer	6 Filters with sixth octave spacing Adjustable gain 0, 10 or 20 dB	Center frequency to 100 kHz No ext. components, clock programmable frequency
MSRFIF*	Radio Frequency Interface Front End	Self powered to 250MHz AM Modulator; AM/BPSK Demodulator	Powered by RF energy from reader Voltage output for low power controllers Ideal for energy harvesting apps
MSSCSA*	Single Chip Spectrum Analyzer	6 Filters with sixth octave spacing Adjustable gain 0, 10 or 20 dB	Center frequency to 2.2 MHz No ext. components, clock programmable frequency
MSTHDA-1*	Total Harmonic Distortion Analyzer	Harmonic measurements to 3.4MHz No microprocessor needed	5 Bandpass filters harmonically spaced Ideal for RFID applications

* Evaluation Board Available

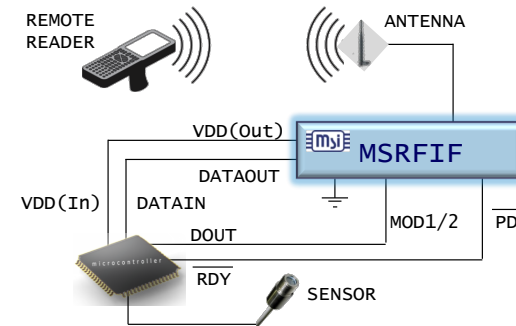
Application Examples

Advanced Alarm Security

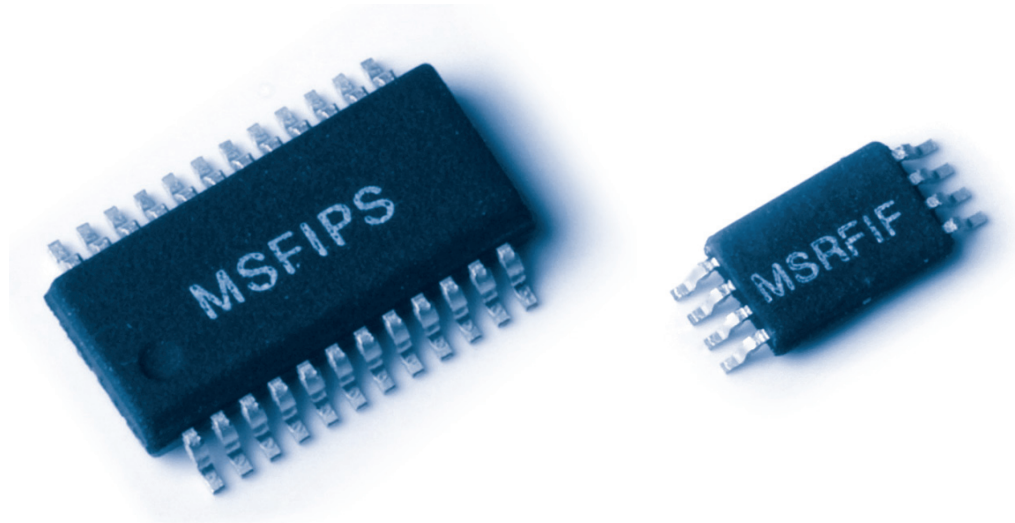


- Monitor Reset line to catch “glitchers”
- Anti-tamper detection for alarm box
- Voltage monitor for battery switchover
- Temperature monitoring for freeze spray hack

Energy Harvesting



- Uses RF to power the system; no battery
- Use micro power microcontroller for control
- Transmits sensor data on received carrier



Filter Selection Guide

PART NUMBER	LOW PASS			BAND PASS			CLOCK TO CORNER		GAIN SELECT	SUPPLY CURRENT	MAX FREQ	Fo ADJUST	PACKAGE	
	Butter-worth	Bessel	Elliptic	Full Octave	Third Octave	Sixth Octave							DIP	SOIC
MSFS1	X	X	X	X	X	X	50:1	100:1		1 mA	20 kHz	CLK	8	8
MSFS2	X	X	X	X	X	X	50:1	100:1	X	1 mA	20 kHz	CLK	16	16
MSFS3	X	X	X	X	X	X	50:1			200 uA	3 kHz	CLK	8	8
MSFS4	X	X	X	X	X	X	50:1	100:1	X	200 uA	3 kHz	CLK	16	16
MSFS5	X	X	X	X	X	X		100:1		1 mA	20 kHz	CLK	8	8
MSFS6	X	X	X	X	X	X		100:1		200 uA	3 kHz	CLK	8	8
MSLFS	X	X	X	X	X	X	42.65:1	85.3:1	X	200 uA ~ 1.5 mA	6 kHz	CLK	16	16
MS2LFS	X	X	X	X	X	X	42.65:1	85.3:1	X	200 uA ~ 2.7 mA	6 kHz	CLK	28	28
MSHFS1	X	X	X	X	X	X	6.5:1			24 mA	3 MHz	CLK	8	8
MSHFS2	X	X	X	X	X	X	6.5:1	12.5:1	X	24 mA	3 MHz	CLK	16	16
MSHFS3	X	X	X	X	X	X	6.5:1			4 mA	1 MHz	CLK	8	8
MSHFS4	X	X	X	X	X	X	6.5:1	12.5:1	X	4 mA	1 MHz	CLK	16	16
MSHFS5	X	X	X	X	X	X		12.5:1		24 mA	3 MHz	CLK	8	8
MSHFS6	X	X	X	X	X	X		12.5:1		4 mA	1 MHz	CLK	8	8

PART NUMBER	HIGH PASS			NOTCH			CLOCK TO CORNER		GAIN SELECT	SUPPLY CURRENT	MAX FREQ	Fo ADJUST	PACKAGE	
	Butter-worth	Bessel	Elliptic	Narrow	Wide	Deep							DIP	SOIC
MSHN1	X	X	X	X	X	X	100:1			1 mA	20 kHz	CLK	8	8
MSHN2	X	X	X	X	X	X	100:1	1000:1	X	1 mA	20 kHz	CLK	16	16
MSHN3	X	X	X	X	X	X	100:1			200 uA	5 kHz	CLK	8	8
MSHN4	X	X	X	X	X	X	100:1	1000:1	X	200 uA	5 kHz	CLK	16	16
MSHN5	X	X	X	X	X	X		1000:1		1 mA	5 kHz	CLK	8	8
MSHN6	X	X	X	X	X	X		1000:1		200 uA	500 Hz	CLK	8	8

Custom Product Capabilities

Engineers working for Mixed Signal Integration have successfully completed more than 100 custom integrated circuit designs (ASIC). Each designer is an experienced veteran in both analog and mixed signal technologies. MSI is especially well known for its command of both switched capacitor and integrated RC active filters.

MSI's designers offer several key design capabilities:

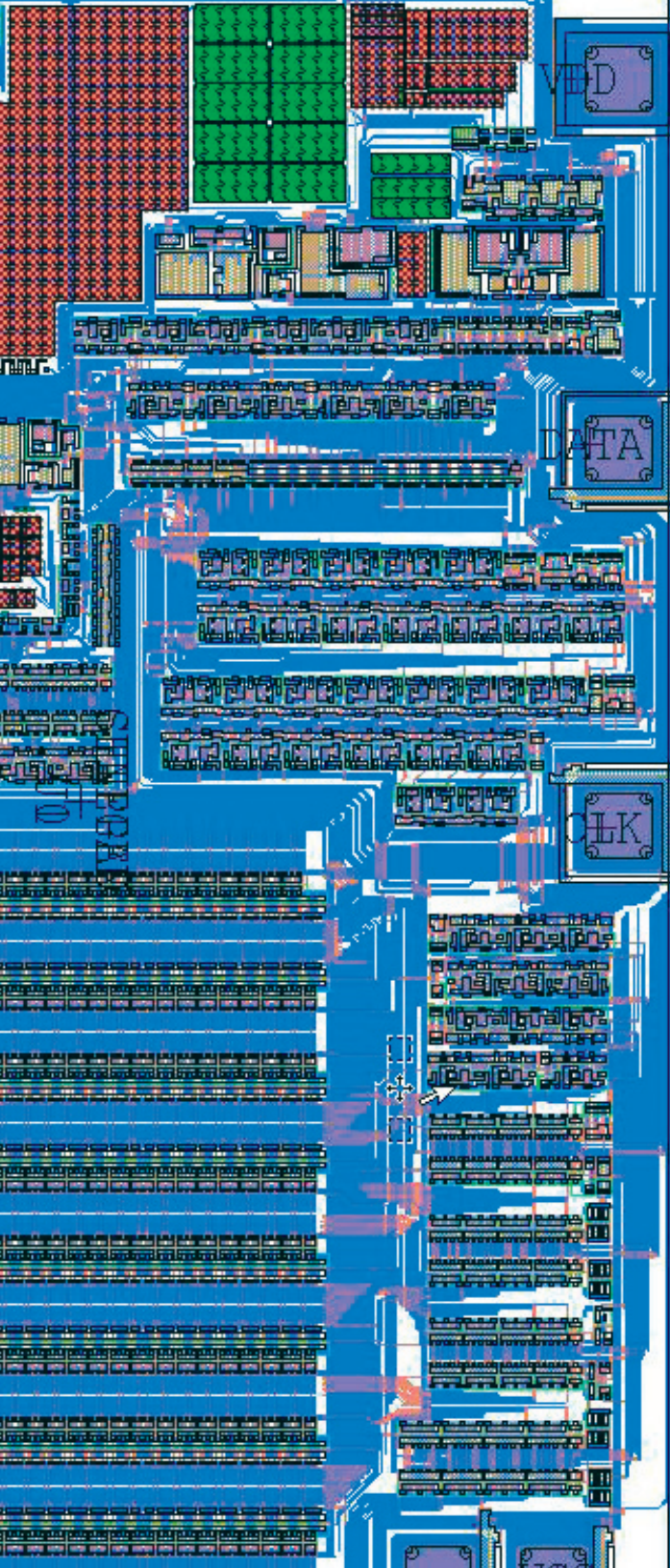
- Ultra-low power consumption and low voltage operation down to 1V supply
- Switched capacitor and active filters including high frequency filtering
- Low noise, low distortion audio



System designs using off the shelf components can be expensive to manufacture and readily copied. Integrating your design will reduce production costs, increase performance, and protect your research and development from competitors. It can also increase the reliability of your system, decrease the board space required, alleviate inventory costs, and cut down on power consumption and heat dissipation. Often alignment and tuning routines can be eliminated by using a custom IC design.

MSI is especially skilled in chip partitioning and system integration. Our engineers can work with you to suggest other portions of your system for integration. This leads to a better payoff for your custom chip development. MSI can also show you the optimum cost and performance trade-offs. We will recommend the correct technology for your project, which can often lead to a higher level of integration.

MSI provides a turn-key ASIC solution. In addition to design and development of the ASIC, MSI manufactures the production volume parts for its customers. This includes foundry, packaging and testing of the ASICs prior to shipment.



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