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To download Filter Products please refer back to "Filters" link.

Today's crowded communications bands and closely located receivers and transmitters operated simultaneously (SIMOP) require RF system designers to pay increasing attention to their equipment's generation and rejection of signals and noise. The receiver must operate in the presence of large interfering signals on adjacent channels while the transmitter noise and spurious can artificially raise the system noise floor for collocated (cosite) receivers with the end result of system desensitization and diminished communications range.

Pole/Zero® offers a full suite of products for these high-interference environments. For the equipment designer, Pole/Zero® offers multiple families of rapidly tunable notch filters, bandpass filters and pre/post-selection filters for incorporation into our customers' equipment. For the system engineer with the challenge of enhancing a modern transceiver's performance in a cosite environment, Pole/Zero® offers our Integrated Cosite Equipment (ICE) which directly interfaces with the transceiver to provide the required cosite interference mitigation – even under fast frequency hopping applications.

Pole/Zero® offers a Cosite Analysis and Integration service to our customers to determine the level of cosite interference mitigation required for a specific communications application. The goal of this analysis is to determine the level of mitigation required to meet the system's concept of operations and ensure full communications range at minimum cost.



COSITE COMMUNICATION SOLUTIONS

Pole/Zero® History

Pole/Zero® designs and manufactures a comprehensive suite of RF interference mitigation products including tunable filters, Integrated Cosite Equipment (ICE), Low Noise Amplifiers (LNA), cosite power amplifiers and other products that are ideal for solving communication problems caused by various types of RF interference. These interfering sources can include self-interference due to collocation of transmitters and receivers (known as cosite interference), intentional jammers, broadband noise, spectral splatter and spurious transmit signals, rusty bolt effects or any number of other sources. Our approach to business and our ability to cost-effectively solve the most difficult interference problems has made us one of the fastest growing companies in our field.

The company was founded in 1989 with the belief that the military and commercial RF markets were changing. Although military budgets were shrinking, the role and the requirements of the military were not. In fact, one may argue that the role of the conventional military was expanding with the global police force and peacekeeping actions being taken. At the same time, real battlefield situations demonstrated that commercial equipment can provide the sophistication and reliability required in a military environment.

Using current state-of-the-art technology we focused on the technological advances of the last couple of decades and applied it to solid-state tunable filters. The result was a leap forward in miniaturization and standardization, permitting a totally self-contained single structure with improved production capability and reduced cost. In addition to these filters, we have developed other building blocks such as low noise amplifiers, cosite power amplifiers, solid-state switches, mixers and synthesizers that now make up a catalog of “off-the-shelf” building blocks. These building block modules are available to the industry as stand-alone modules and also form the basis of the systems we supply. These products share a common attribute in the support of very high dynamic range communications.

In 1994 Pole/Zero® branched into the Integrated Cosite Equipment (ICE) field with the development of both an airborne and shipboard filter/amplifier cascade product. ICE integrates elements of our standard product line to achieve enhanced performance beyond that achievable with our basic products. Both of these ICE units are still in production. Further, Pole/Zero® has significantly expanded the breadth of ICE products, providing our customers the ability to select optimum cost-effective solutions for their interference mitigation needs. Many of our products are purchased as commercial items, while other customers require modification to the existing products to meet their needs. In both cases, Pole/Zero® provides low risk, cost-effective solutions. Our products can be found in the harshest RF environments on C4ISR (command, control, communications, computers, intelligence, surveillance and reconnaissance) platforms and tactical applications.

Today, Pole/Zero® is delivering hardware to customers around the world for a variety of applications. For the military, our equipment is flying on airborne command posts and jet fighters and is fielded in both ground-fixed and ground-mobile systems. The same hardware is being used in commercial applications from radio telescopes to wireless office communications and from industrial inspection equipment to MRI machines. Applications for our filters range from stand-alone units in a test environment to units embedded in the design of high performance communication equipment.

As we continue to grow in number of employees and yearly sales, we have maintained our focus on supplying readily available, digitally tuned hopping filter modules and components with wide dynamic range performance to provide new flexibility to the RF system designer. Additionally, Pole/Zero® has increased its focus on providing quality products to our customers by instituting the following quality policy: “Pole/Zero® is dedicated to providing defect-free products on time to internal and external customers. Customer satisfaction, quality and continuous improvement are the personal responsibility of each employee.” Building on this policy, Pole/Zero® has established and complies with many processes focused on improving performance throughout the company. As a result, Pole/Zero® has maintained third-party certification of our conformance to the ISO9001:2008 standard with AS9100:2009, Revision C, since October 2005.

All products are manufactured and thoroughly tested in our West Chester, Ohio facility, which is fully equipped with modern computer controlled testing and manufacturing equipment.

Pole/Zero® is dedicated to innovation, quality and absolute customer satisfaction.



Cosite Analysis & Integration

Command & Control (C2) platforms require multiple RF communications channels to ensure force coordination over long distances. Unbeknownst to the warfighter, quite often these critical communication requirements are not met due to self-generated or cosite interference that severely degrades communication range. To ensure this does not happen to your platform, Pole/Zero® can provide a comprehensive evaluation of your platform's communication performance level, enabling peak operation even in the most dense electromagnetic environments. Pole/Zero's Cosite Interference Analysis takes into account the adversaries to your communications link including:

- Radio spurious output
- Broadband noise
- Simultaneous co-channel operation
- Limited antenna isolation
- Receiver desensitization
- Reciprocal mixing
- Cross modulation

The dynamic interaction of these phenomena in your Command & Control (C2) communication architecture can severely hinder the warfighter's ability to communicate if not properly addressed. Whether during the development phase, a communication upgrade or on an existing deployed system, Pole/Zero® will assist your team to ensure optimum performance without the risk of either inadequate interference mitigation or costly overdesign. The end result is a cost-effective solution with maximum communication range!

Cosite Analysis & Support Capability:

Analysis support for system integration

- Derive platform configuration
- Interpret performance requirements
- Derive comm scenarios
- Determine and resolve cosite effects on system performance

Process Analysis Components:

- Leverages equipment performance database
- Utilizes proprietary routines for predictions of interference effects

Cosite Analysis Overview



Example Receiver Performance Improvement

Receiver Performance	Improvement	Cosite Enhanced Performance
Noise figure = 12 dB	8 dB	Noise figure = 4 dB
IF BW = 38 kHz		IF BW = 38 kHz
Sensitivity = -106 dBm	8 dB	Sensitivity = -114 dBm
Max Interferer Level		Max Interferer Level
• (5% removed) = -23 dBm	32 dB	• (5% removed) = 9 dBm
• (10% removed) = -23 dBm	56 dB	• (10% removed) = 33 dBm

Cosite Analysis Software Overview

Ensure that your Command & Control (C2) Platform communications are not losing communications range from cosite interference. Our mission is to assist RF communications integrators in fielding first time successes.



Mitigation Equipment

Platform Information

Radio Information



Systems Architecture

ID	Date/Time	Description
1	08/08/08 0:00	Project Created
2	08/08/08 0:01	Attributes Saved
3	08/08/08 0:02	System Design Created
6	08/08/08 0:25	Project Saved
7	08/08/08 0:44	Analysis Started
8	08/08/08 12:04	Analysis Terminated
9	08/11/08 10:44	Project Saved
10	08/14/08 14:35	Analysis Completed
14	08/13/08 14:38	Project Saved

Undesired Signal Level Causing 3dB SINAD Degradation at Sensitivity in Military Transceivers

Pattern
 Show Far field Near field Compare Plot
 Total gain [dB] 105 100 90Y 75 60
 6.975 MHz
 Horizontal plane
 135 120 105 90 75 60 45 30 15 0
 240 255 270 285 300 315 330 345 360

Cosite Analysis Software

Output

System Block Diagram Equipment

List Performance Summary

- Table, graphs, charts, terrain coverage maps, etc.

Final Report

- List of assumptions and source data
- Description of interference mechanisms and mitigation techniques
- Recommendations and conclusions

Solutions

Operational Solutions

- Frequency management rules
- Operational restrictions

Off-the-shelf Mitigation Hardware

- Filters, cancelers, isolators, etc.
- Intermodulation improved power amplifiers, LNA's, etc.

Development Item Solutions

Scenario Predictions

Scenario Success Predictions

- Waveform and duty cycle mix
- Solution comparisons
- Range prediction

Channel Availability

- With cosite interference
- With solutions

Bit Error Rate Estimates

Coverage Area

- Combination of Longley-Rice model and IF77 model
- Predict coverage in specific geographical areas

Use Pole/Zero® Cosite Interference Analysis Results to Determine:

- Optimal communications hardware selection
- Minimal channel frequency separation determination
- Optimal platform antenna placement
- Link budget margins

Conclusions

- Multiple radios together = cosite environment
- With mitigation, critical communication links can be assured

Integrated Cosite Equipment (ICE)

Integrated Products That Perform

Often the cosite environment for a particular RF communications application will require enhanced performance beyond that achievable through the standard filter product lines described earlier in this catalog. This section highlights Pole/Zero®'s **Integrated Cosite Equipment (ICE)** product line, which was developed to resolve severe interference issues resulting from insufficient linear dynamic range. ICE directly interfaces with modern radio transceivers to enhance the transceiver's performance in cosite environments and incorporates tunable filter modules and low noise amplifiers in a cascade arrangement to provide excellent selectivity throughout the tuning range.

Integrated Cosite Equipment:

Part Number	Frequency Range	SATCOM ⁽¹⁾	Type ⁽²⁾	Selectivity ⁽³⁾	Output Power ⁽⁴⁾	Relative Price	Catalog Page Number
ICE2003-TR-30-512	30 to 512 MHz		T & R	∧∧	+43 dBm	\$\$	64
ICE2004-R-30-512	30 to 512 MHz		R	∨∨∨ (canceler)	N/A	\$\$\$\$	66
ICE3001-TR-243-318	243 to 318 MHz	X	T or R	∧∧∧	+18 dBm	\$\$	68
ICE3002-R-243-270	243 to 270 MHz	X	R	∧∧∧	N/A	\$\$\$	70
ICE3003-T-292-318	292 to 318 MHz	X	T	∧∧∧	+53 dBm	\$\$\$	72
ICE3005-TR-225-400	225 to 400 MHz		T & R	∧∧∧	+45 dBm	\$\$\$\$	74
ICE3006-TR-225-400	225 to 400 MHz	X	T & R	∧∧∧	+51 dBm	\$\$\$\$	76
ICE3007-T-292-318	292 to 318 MHz	X	T	∧∧∧	+43 dBm	\$\$\$	78
ICE3008-TR-30-174	30 to 174 MHz		T & R	∧∧∧	+47 dBm	\$\$\$\$	80
ICE3009-TR-108-400	108 to 400 MHz		T & R	∧∧∧	+47 dBm	\$\$\$	82
ICE3011-TR-30-400	30 to 400 MHz		T & R	∧∧∧	+45 dBm	\$\$\$	84
ICE4001-T-225-400	225 to 400 MHz		T	∧∧∧∧	+41 dBm	\$\$	86
ICE4002-T-225-400	225 to 400 MHz	X	T	∧∧∧∧	+52 dBm	\$\$	88
ICE4003-2TR-225-400	225 to 400 MHz		2T & 2R	∧∧∧∧	+44 dBm	\$\$\$\$\$	90
ICE4004-TR-118-400	108 to 400 MHz		T & R	∧∧∧∧	+43 dBm	\$\$\$	92
ICE4005-T-290-320	290 to 320 MHz	X	T	∧∧∧∧	+51 dBm	\$\$\$	94
ICE5001-TR-225-400	225 to 400 MHz	X	T & R	∧∧∧∧∧	+52 dBm	\$\$\$\$\$	96
ICE5002-TR-30-400	30 to 400 MHz		T & R	∧∧∧∧∧	+51 dBm	\$\$\$\$\$	98
ICE5002-TR-30-406	30 to 406 MHz		T & R	∧∧∧∧∧	+51 dBm	\$\$\$\$\$	98

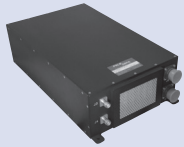
- Note(s):**
- (1) - "X" indicates SATCOM capability.
 - (2) - "T" indicates transmit filter capability and "R" indicates receive filter capability.
 - (3) - Selectivity is relative to all ICE products with ∧ representing the least selective and ∧∧∧∧∧ representing the most selective.
 - (4) - Output power is defined in dBm for transmit only. Receive filters have gain as defined in the detailed specifications.
 - (5) - Price is a relative factor of price per channel with "\$" being the lowest price and "\$\$\$\$\$" being the highest price.

Integrated Cosite Equipment (ICE) Overviews:

The following brief overviews are provided to further support your efforts to identify potential solutions to resolve interference aboard your platforms. These brief overviews are simply intended to provide a snapshot of the capabilities and intended applications for the associated **Integrated Cosite Equipment (ICE)**. Please refer to specific catalog pages identified in the previous summary table for detailed descriptions of ICE.

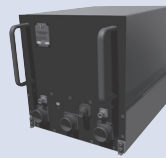
Pole/Zero® ICE2000 Series Products

The **ICE2000** Series provides unique solutions in moderate cosite environments across the broad tuning range of 30 to 512 MHz. This series includes both a filter/amplifier product as well as a canceler product for easy integration in your system. The ICE2003 product utilizes our proven filter/amplifier cascade approach to purify the RF transmit signal and to protect the narrowband receive signal in half duplex operation. The ICE2004 utilizes a referenceless approach to effectively cancel interferers in your receive path.



ICE2003

The ICE2003 is an agile filter/amplifier tunable across the 30 to 512 MHz range and is primarily intended for UAV applications. This light weight design provides a high level of performance and readily interfaces with modern frequency-hopping transceivers to support communication relay and remote vehicle control applications.



ICE2004

The ICE2004 will simultaneously cancel up to eight interferers in your 30 to 512 MHz receive path without the need for cumbersome reference signals from local transmitters. The product provides a low loss RF path with the capacity to quickly acquire and cancel up to eight on or off board cosite emitters, both fixed frequency and agile. A comprehensive user interface enables this unit to be completely tailored to your system needs, or it can also operate autonomously based on factory settings.



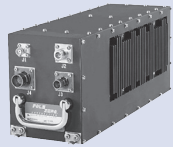
Pole/Zero® ICE3000 Series Products

The **ICE3000** Series provides excellent selectivity in high cosite environments primarily through the implementation of filter/amplifier cascades. **ICE3000** typically incorporates additional capabilities such as gain limiting for the receive path, low broadband noise/high power amplifiers in the transmit path or other enhancements for good cosite performance.



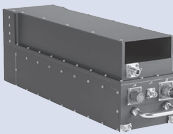
ICE3001

The ICE3001 is an agile transmit or receive filter for the SATCOM frequency bands, covering frequencies between 243 and 318 MHz. This unit has been qualified for military applications.



ICE3002

The ICE3002 is an agile receive filter for the SATCOM frequency band, covering frequencies between 243 and 270 MHz. This unit is JITC (Joint Interoperability Test Command) certified and has been qualified for military applications.



ICE3003

The ICE3003 is an agile transmit filter/amplifier for the SATCOM frequency band, covering frequencies between 292 and 318 MHz. This unit is JITC certified and has been qualified for military applications.



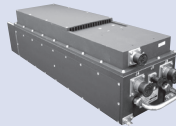
ICE3005

The ICE3005 is an agile transmit/receive filter/amplifier for the UHF frequency band with a VHF bypass mode, covering frequencies between 225 and 400 MHz. This unit is qualified for military applications and has been optimized for SWAP (size, weight and power).



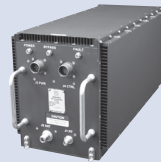
ICE3006

The ICE3006 is an agile transmit/receive filter/amplifier for the UHF frequency band with a VHF bypass mode, covering frequencies between 225 and 400 MHz. This unit is qualified for military applications and has been optimized for SWAP with increased transmit output power.



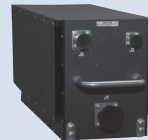
ICE3007

The ICE3007 is an agile transmit filter for the SATCOM band, covering frequencies between 292 and 318 MHz.



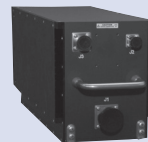
ICE3008

The ICE3008 is a half duplex transmit and receive filter amplifier, providing agile filtering across the 30 to 88 MHz and 108 to 174 MHz bands.



ICE3009

The ICE3009 is a half duplex transmit and receive filter amplifier, providing agile filtering across the 108 to 174 MHz and 225 to 400 MHz bands.

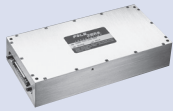


ICE3011

The ICE3011 is a half duplex transmit and receive filter amplifier, providing agile filtering across the 30 to 88 MHz, the 108 to 174 MHz and the 225 to 400 MHz bands.

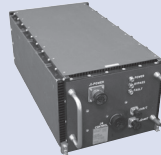
Pole/Zero® ICE4000 Series Products

The **ICE4000** Series achieves narrow band selectivity in high cosite environments typically through incorporation of TRAK-POLE™ technology. **ICE4000** provides narrowband transmit filter/amplification, and in several cases incorporates receive filtering to improve sensitivity performance.



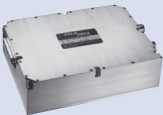
ICE4001

The ICE4001 is an agile transmit filter for the UHF frequency band, covering frequencies between 225 and 400 MHz. This unit is qualified for military applications.



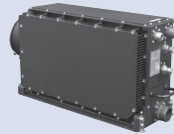
ICE4004

The ICE4004 is an agile transmit/receive filter/amplifier for both the UHF and VHF frequency bands, covering frequencies between 118 and 400 MHz.



ICE4002

The ICE4002 is an agile transmit filter for the UHF frequency band, covering frequencies between 225 and 400 MHz. The unit provides 20 Watts output power in LOS Mode and 150 Watts output power in SATCOM Mode. This unit is qualified for military applications.



ICE4005

The ICE4005 is a UHF SATCOM high power transmit filter amplifier designed to provide 125 Watts minimum RF output power in the 292 to 318 MHz frequency range.



ICE4003

The ICE4003 is a Dual Channel Filter that provides two independent UHF TX/RX channels in a single package, covering frequencies between 225 and 400 MHz. This unit is one of many Pole/Zero® subsystems that are qualified for military applications.

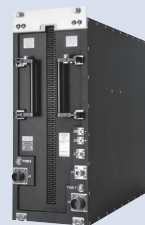
Pole/Zero® ICE5000 Series Products

The **ICE5000** Series incorporates several advanced technologies to achieve highly selective performance for extreme cosite environments. **ICE5000** provides narrowband preselection with gain and power limiting for receive protection against strong interferers. It also incorporates high power transmit amplification with low broadband noise performance for operation in dense cosite applications.



ICE5001

The ICE5001 is a highly integrated tunable UHF Cosite Filter/Amplifier providing state-of-the-art performance for cosite applications. This unit covers frequencies between 225 and 400 MHz and is another of Pole/Zero®'s military qualified systems.



ICE5002

The ICE5002 is a highly integrated tunable V/UHF Cosite Filter/Amplifier providing state-of-the-art performance for cosite applications and is an airborne qualified system. The ICE5002 is offered in two versatile models; one covering 30 to 88 MHz, 118 to 174 MHz and 225 to 400 MHz in receive; the other covering 30 to 88 MHz, 108 to 174 MHz and 225 to 406.25 MHz in receive. Additionally, both units provide a separate 121.5 MHz Guard Filter which provides selectivity of -50 dB at 4 MHz and a minimum gain of 3 dB with a maximum noise figure of only 9 dB.

ICE2003

Specifications:

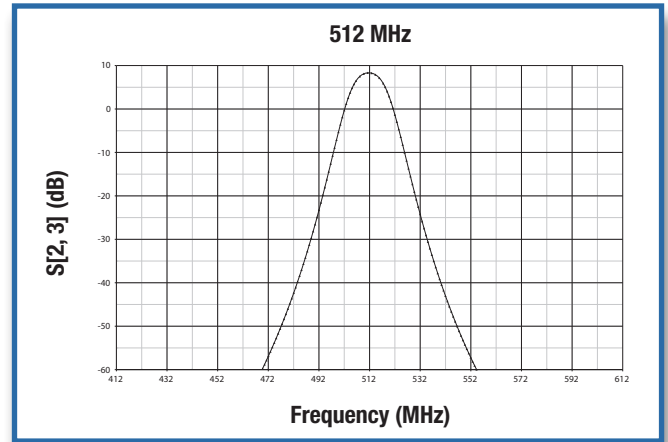
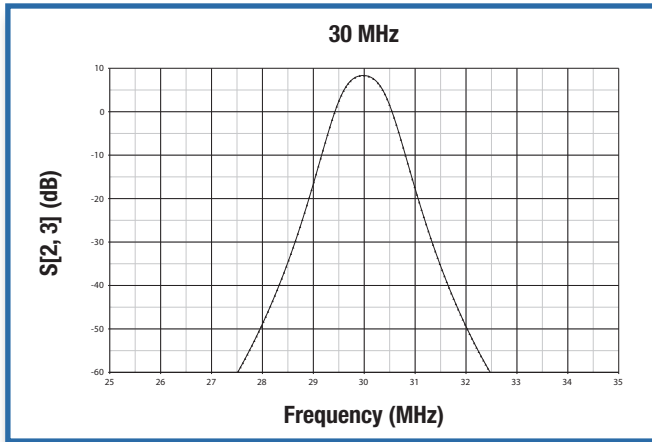
Part Number:	ICE2003-TR-30-512	
Operation:	Half duplex Tx & Rx filter/amplifier	
Frequency Coverage:	VHFL:	30 to 88 MHz
	VHFH:	108 to 174 MHz
	UHF:	225 to 512 MHz
	VHF Guard:	121.5 MHz*
	UHF Guard:	243 MHz*
Receive Gain (Typical):	5.0 to 9.0 dB	
Receive Noise Figure (Typical):	13.0 dB nominal (Main Channel)	
Transmit Noise Floor:	30 to 88 MHz	
	-130 dBm/Hz @ 10% removed	
	108 to 174, 225 to 512 MHz	
	-140 dBm/Hz @ 10% removed	
Transmit RF Output Power:	20 W FM, 10 W AM (carrier)	
Selectivity (Typical):	30 to 88 MHz	
	20 dB @ ± 5%	
	55 dB @ ± 10%	
	108 to 174, 225 to 512 MHz	
	35 dB @ ± 5%	
	55 dB @ ± 10%	
Harmonics (Typical):	Transmit:	
	Per MIL-STD-461F	
Tuning Speed:	200 μs	
Power:	+28 VDC Input @ 5.5 A	
Operating Temperature Range:	-40° to +55°C	
Size:	3/8 ATR Short	
	3.6 × 12.5 × 7.6 (in.) / 90.4 × 318 × 193.5 (mm.)	
Weight:	9 lbs. / 4.082 kg.	

* Optional

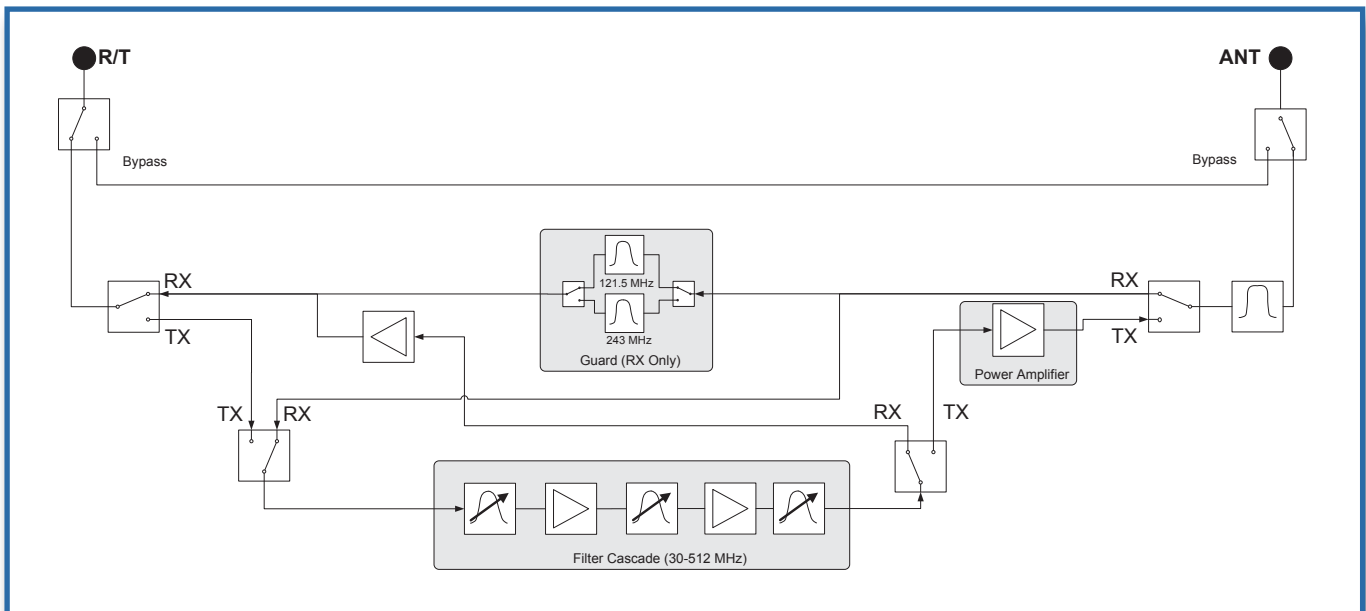


The **ICE2003** is a half duplex transmit and receive filter/amplifier designed for UAV applications. When used with modern, light weight transceivers, interference-free, full-range communications are realized for communications relay and vehicle control applications. The transceiver interface supports modern frequency hopping algorithms with guard channel monitoring and protection via internal filtering. The unit is cooled by an internal fan that draws ambient air. Cost-effective modifications are available on the **ICE2003**. Please contact your sales representative at 513-870-9060 for further details.

Performance:



Block Diagram:



ICE2004

Specifications:

Part Number:	ICE2004-R-30-512
Operation:	8-Channel RF Interference Canceler
Frequency Coverage:	30 to 512 MHz
Insertion Loss:	2 dB
Harmonics (Typical):	-70 dBc
Spurious:	-111 dBm
Tuning Speed:	200 μ S
	SINGGARS & Have Quick compatible
Power:	115 VAC / 400 Hz Single Phase, 450 W
Operating Temperature Range:	-15 to +55°C
Interference Suppression:	40 dB
Input Amplitude Range:	-40° to 10 dBm
Interfaces:	Ethernet, ARC-210, ARC-231
Size:	10.1 x 10.7 x 12.6 (in.) / 256.5 x 272 x 320 (mm.)
Weight:	40 lbs. / 18 kg.



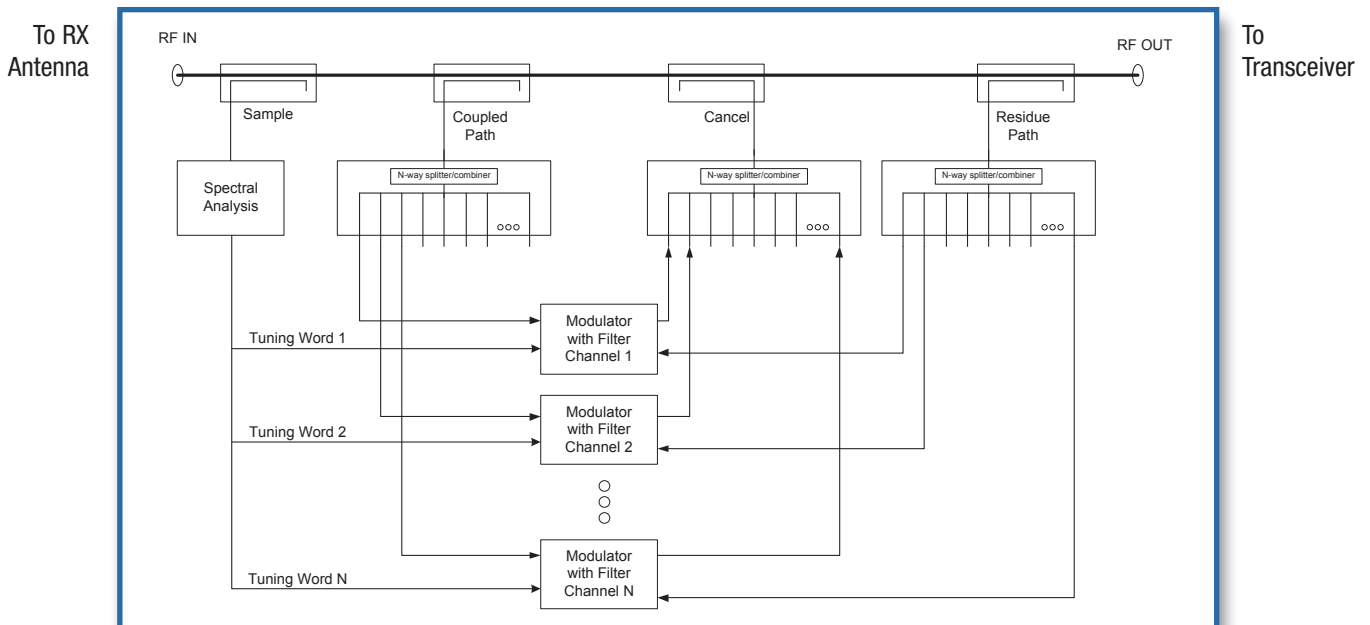
The **ICE2004** is an 8-channel RF interference canceler system that achieves 40 dB of attenuation without the need for cumbersome reference signals from local transmitters. It is a simple two-port RF assembly that covers the 30 to 512 MHz frequency range. The **ICE2004** enables the reception of low-level RF signals in the presence of up to 8 strong interferers as a result of its inherent low loss path for all non-canceled signals.

The **ICE2004** provides fast canceler acquisition and is compatible with SINGGARS and Have Quick hopping waveforms. The canceler system is also designed for minimal harmonics and spurious and is MIL-STD-461F compliant. The power is MIL-STD-704F compatible. The unit will mount with standard military trays.

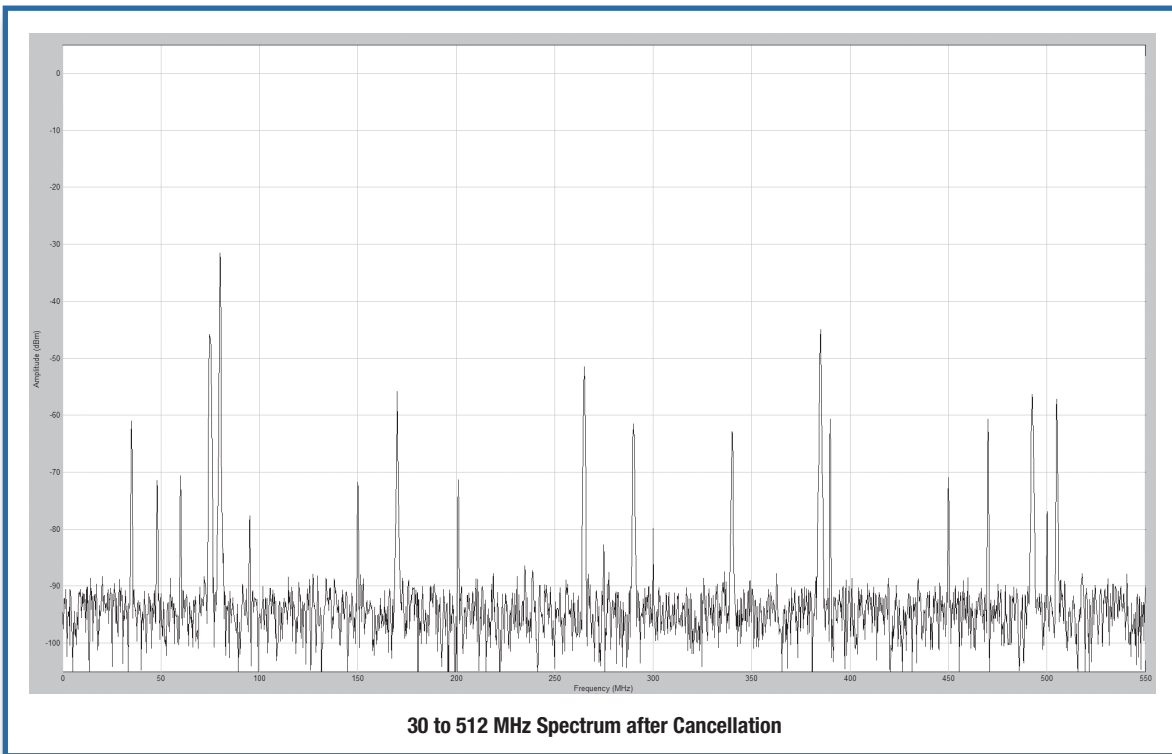
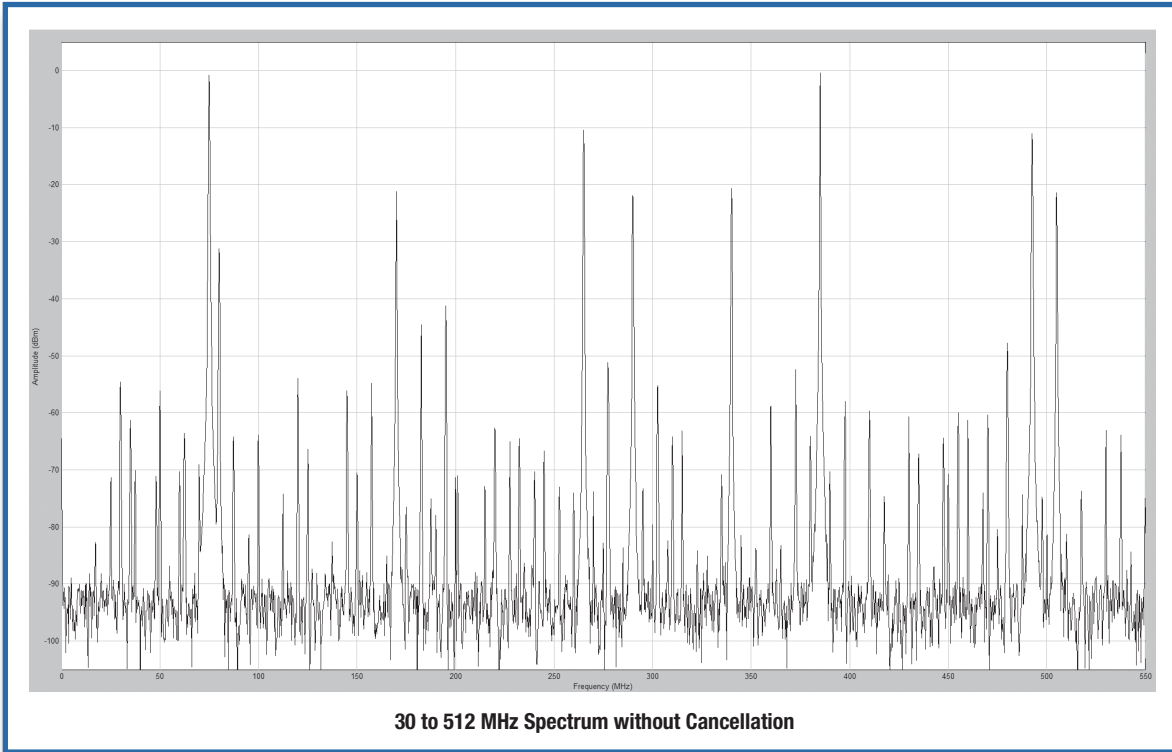
The **ICE2004** can auto-tune to on or off board cosite emitters and also support radio tuning. The canceler system supports IP addressable Ethernet for Built-In-Test (BIT) and system monitoring.

Cost-effective modifications are available on the **ICE2004**. Please contact your sales representative at 513-870-9060 for further details.

Block Diagram:



Performance:



Note: There are eight (8) large interfering signals that are now attenuated by at least 40 dB in this receive spectrum, which simultaneously reduces their associated products in the receiver. The remaining desired signals are now readily discernible and receivable as a result of improved sensitivity.

ICE3001

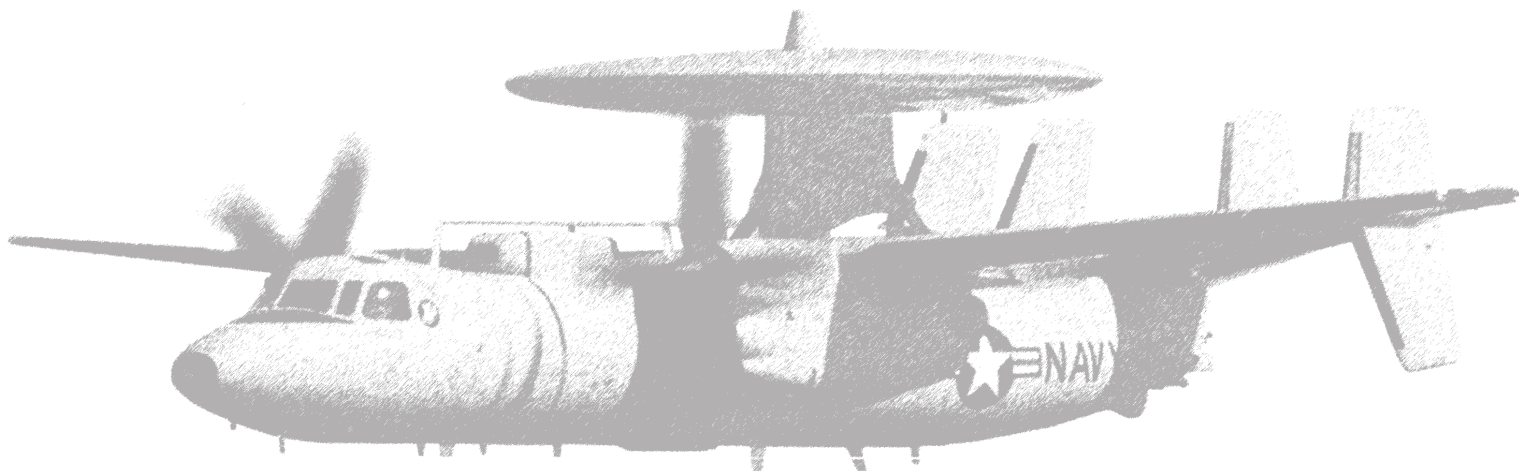
Specifications:

Part Number:	ICE3001-TR-243-318	
Operation:	Tx or Rx	
Frequency Coverage:	Receive: 243 to 270 MHz	Transmit: 292 to 318 MHz
Receive Gain (Typical):	Receive: 5.0 dB	Transmit: 11.0 dB
Receive Noise Figure (Typical):	10.5 dB	
Receive Input IP3:	65 dBm @ 12 & 24 MHz offset	
Transmit RF Output Power:	+18 dBm	
Selectivity (Typical):	Receive Band:	Transmit Band:
	-30 dB @ ± 0.75%	-25 dB @ ± 0.75%
	-45 dB @ ± 1.0%	-42 dB @ ± 1.0%
	-65 dB @ ± 1.5%	-65 dB @ ± 1.5%
	-80 dB @ > 6.0 MHz	-80 dB @ > 6.0 MHz
Spurious:	-126 dBm (< 300 kHz) -70 dB (> 300 kHz)	
Tuning Speed:	100 µS	
Power:	+28 VDC @ 2.2 A	
Operating Temperature Range:	-20° to +55°C	
Size:	3 × 5.5 × 13 (in.) / 75 × 139 × 337 (mm.)	
Weight:	9 lbs. / 4.08 kg.	

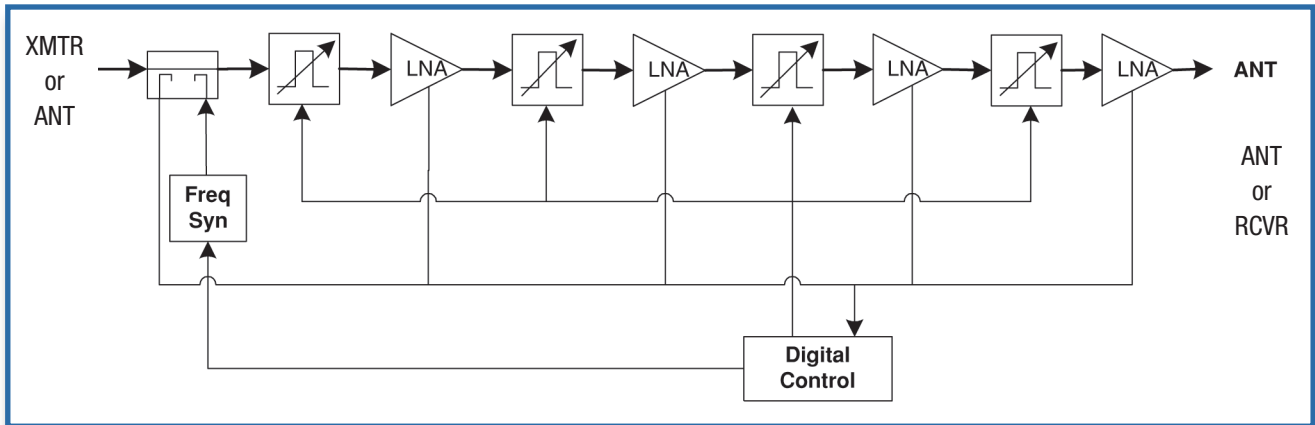


This subsystem is an agile filter for the SATCOM frequency band, capable of acting as either a receive or a transmit filter. It enables simultaneous operation of multiple transceivers in extreme cosite environments. The **ICE3001** provides multiple poles of RF selectivity to reduce broadband noise, harmonics, and spurious signals for either receive or transmit applications. This filter is a highly integrated design incorporating complete Built-in-Test (BIT) capability. The design has been qualified for military applications. A dual-mount tray is also available as an option for easy incorporation on your platform.

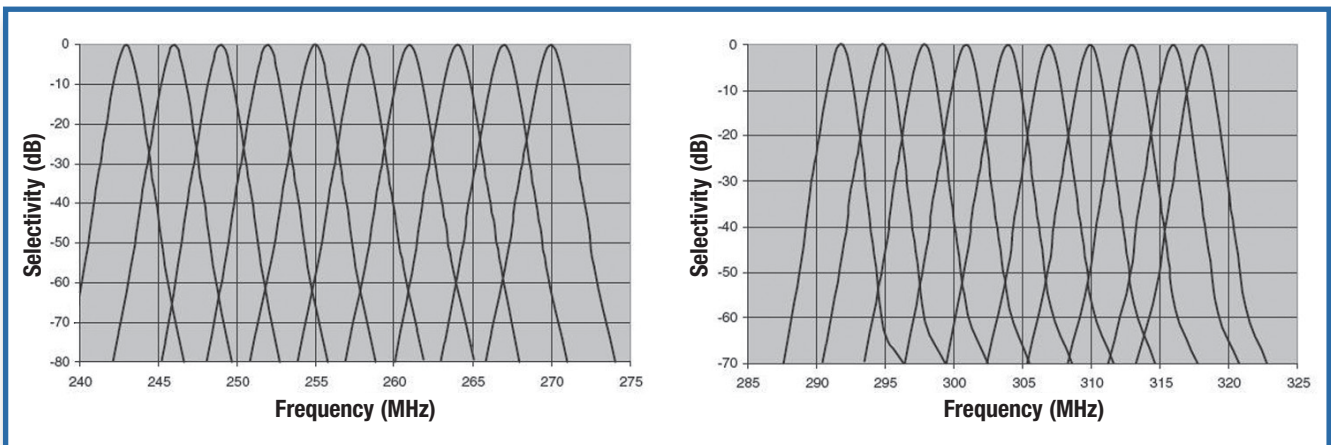
Cost-effective modifications are available on the **ICE3001**. Please contact your sales representative at 513-870-9060 for further details.



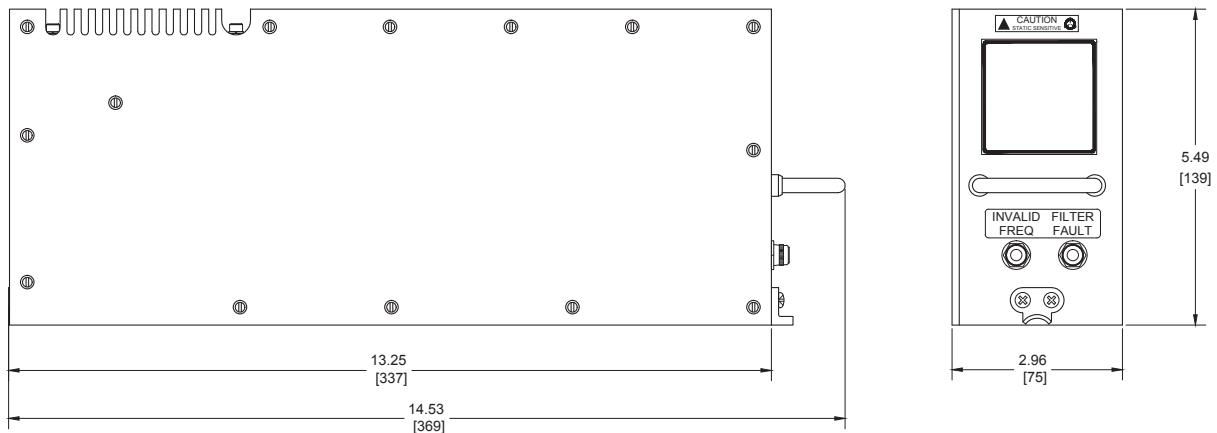
Block Diagram:



Performance:



Chassis Outline:

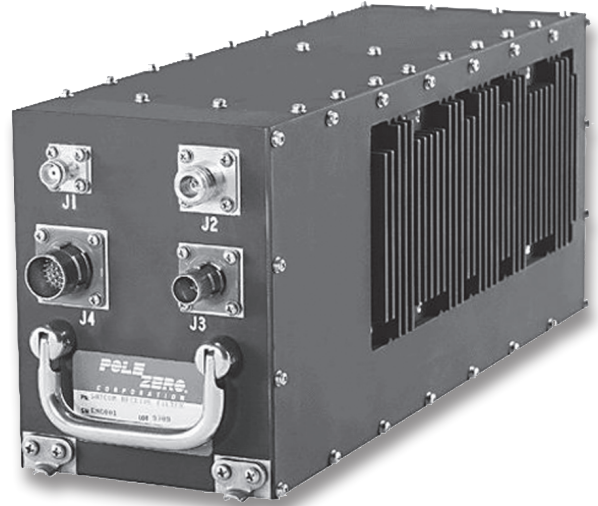


Data is believed to be accurate. All data is subject to change without notice.

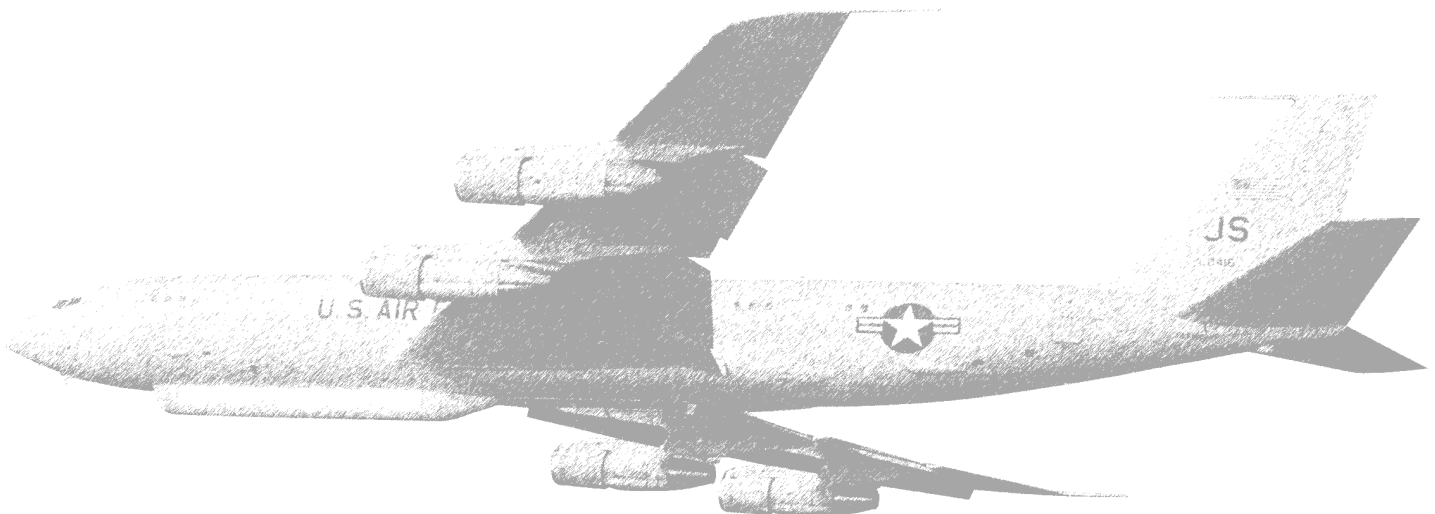
ICE3002

Specifications:

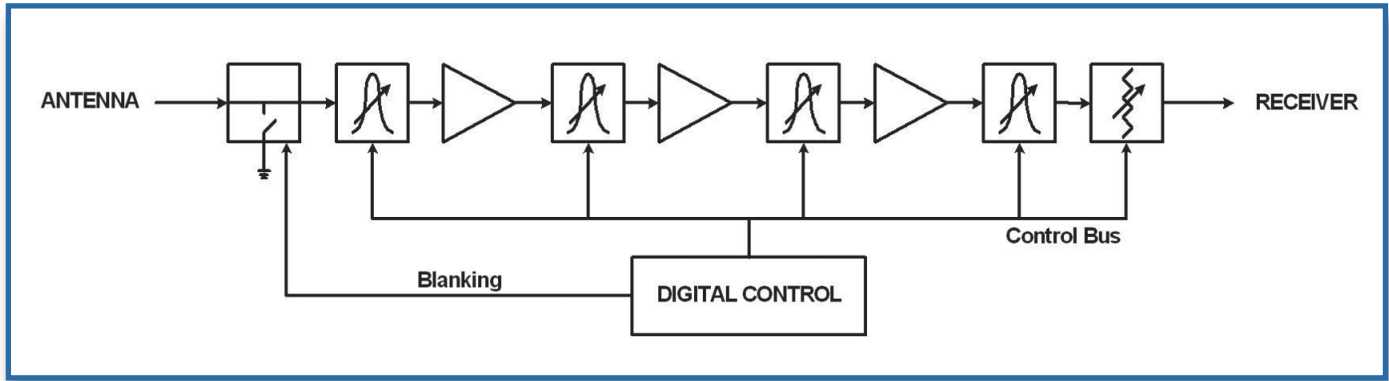
Part Number:	ICE3002-R-243-270
Operation:	Rx
Frequency Coverage:	243 to 270 MHz
Receive Gain (Typical):	11.0 to 14.0 dB
Receive Input IP3:	+55 dBm @ 4 & 8 MHz offset
Selectivity (Typical):	-65 dB @ ± 4.0 MHz
	-80 dB @ > 5.0 MHz
Spurious:	-110 dBm (< 300 kHz)
	-70 dB (> 300 kHz)
Tuning Speed:	100 µS
DC Power:	+28 VDC @ 2.3 A
Operating Temperature Range:	0° to +40°C
Size:	5 × 6.1 × 14.3 (in.) / 128 × 155 × 364 (mm.)
Weight:	16 lbs. / 7.26 kg.



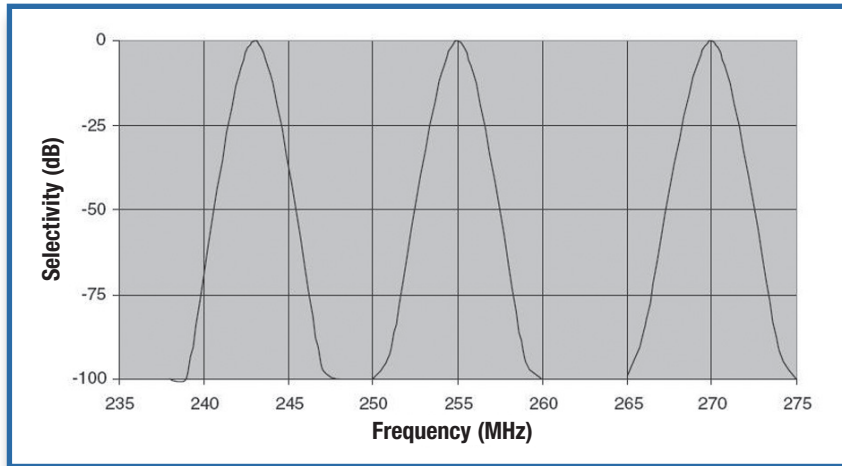
The **ICE3002** is an agile filter for the SATCOM receive frequency band and is factory configured for an ARC-231 interface. It enables simultaneous operation of multiple transceivers in extreme cosite environments. The **ICE3002** provides multiple poles of selectivity to mitigate interference from collocated transmitters and other spurious signals present at the receive antenna. This SATCOM receive filter is a highly integrated design incorporating complete Built-in-Test (BIT) capability and is qualified for use in military applications. Cost-effective modifications are available on the **ICE3002**. Please contact your sales representative at 513-870-9060 for further details.



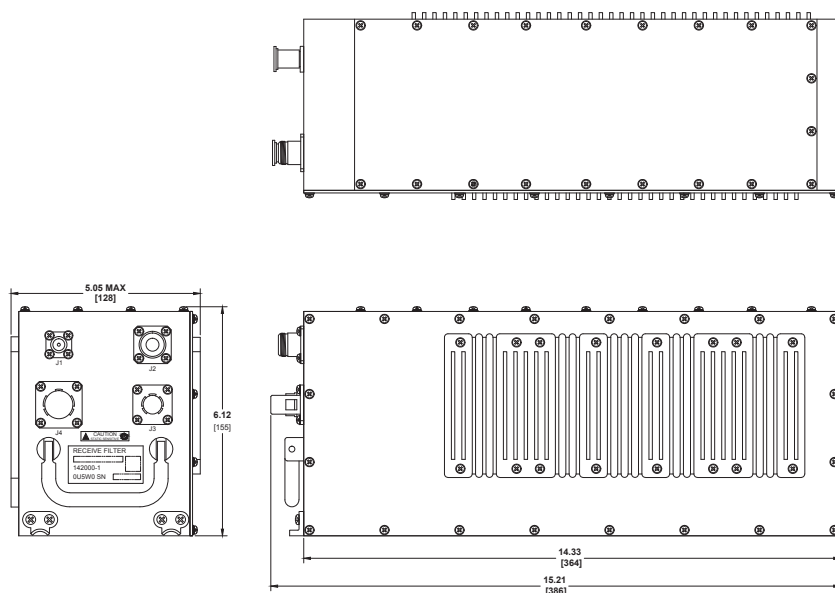
Block Diagram:



Performance:



Chassis Outline:



Integrated Cosite Equipment (ICE)

ICE3003

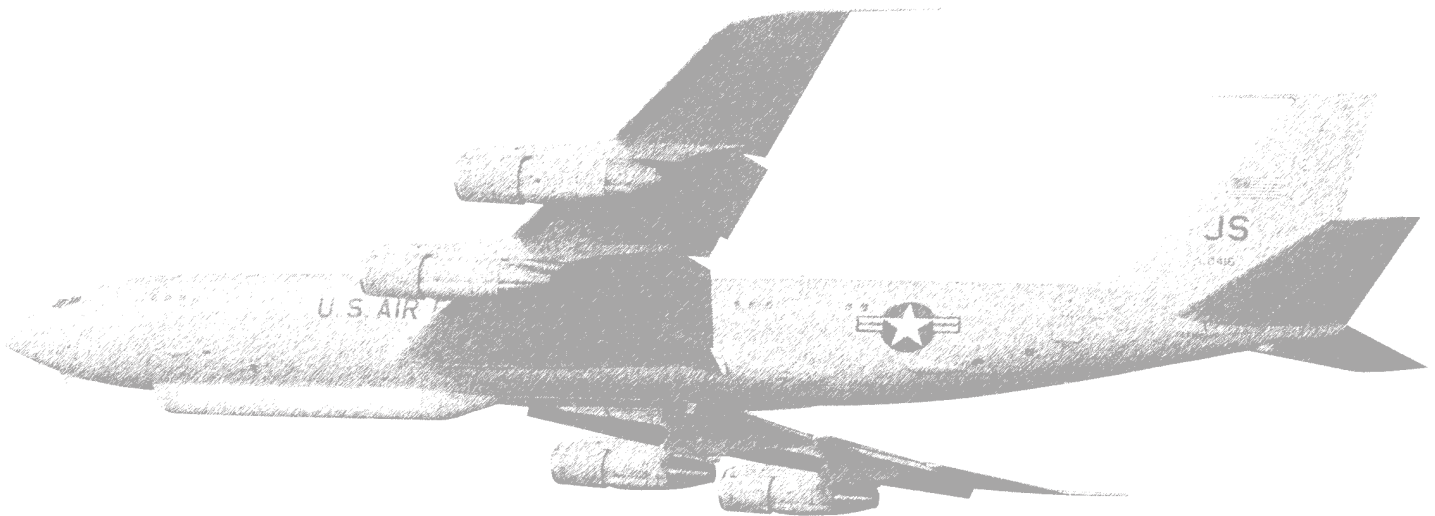
Specifications:

Part Number:	ICE3003-T-292-318
Operation:	Tx
Frequency Coverage:	292-318 MHz
Transmit RF Output Power:	1 to 200 W in 2 dB steps (FM)
Selectivity (Typical):	-65 dB @ ± 4.0 MHz -75 dB @ > ± 5.0 MHz
Harmonics (Typical):	-70 dBc (2 nd harmonic) -80 dBc (all others)
Tuning Speed:	100 μS
DC Power:	+28 VDC @ 22 A
Operating Temperature Range:	0° to +40°C
Size:	5.5 × 7.1 × 20 (in.) / 140 × 180 × 508 (mm.)
Weight:	26 lbs. / 11.79 kg.

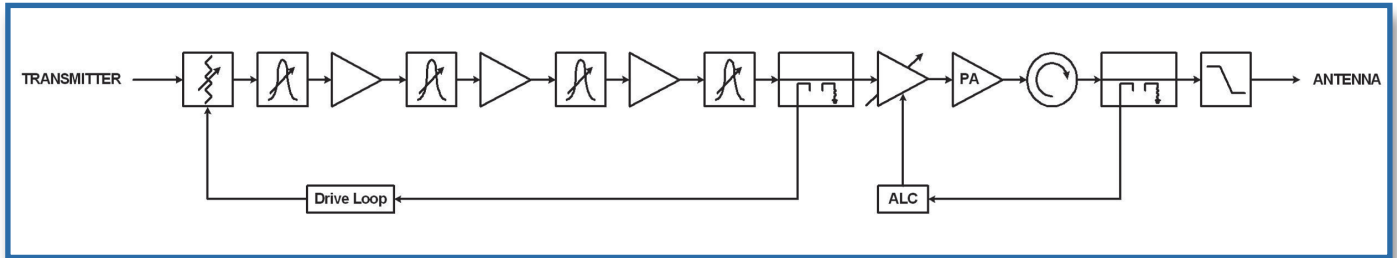


The **ICE3003** is an agile filter for the SATCOM transmit frequency band and is factory configured for an ARC-231 interface. It enables simultaneous operation of multiple transmitters and receivers in extreme cosite environments. The **ICE3003** provides multiple poles of selectivity to reduce broadband noise, harmonics, and spurious signals from propagating to the antenna. This SATCOM transmit filter is a highly integrated design incorporating complete Built-in-Test (BIT) capability and is qualified for use in military applications.

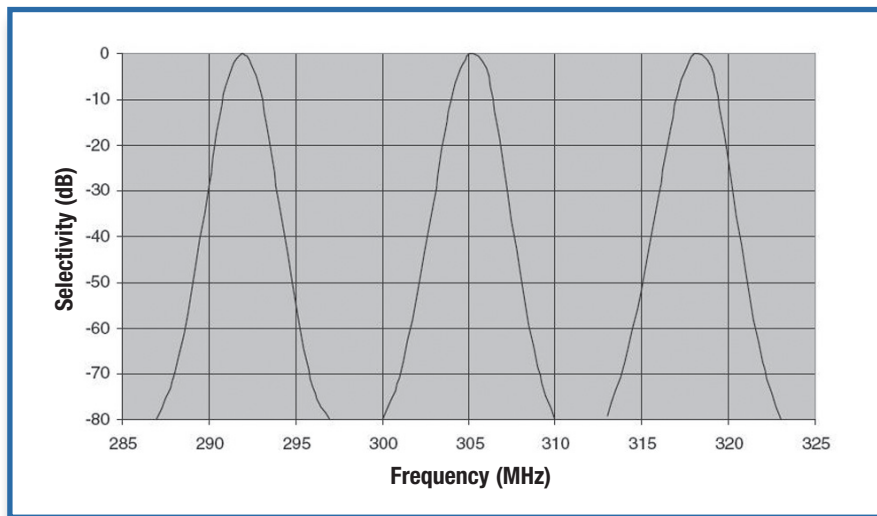
Cost-effective modifications are available on the **ICE3003**. Please contact your sales representative at 513-870-9060 for further details.



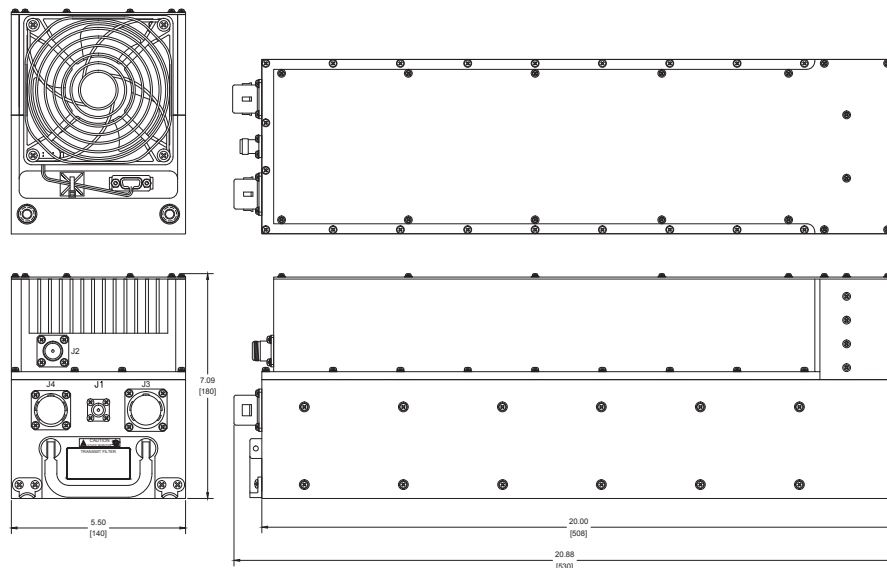
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

ICE3005

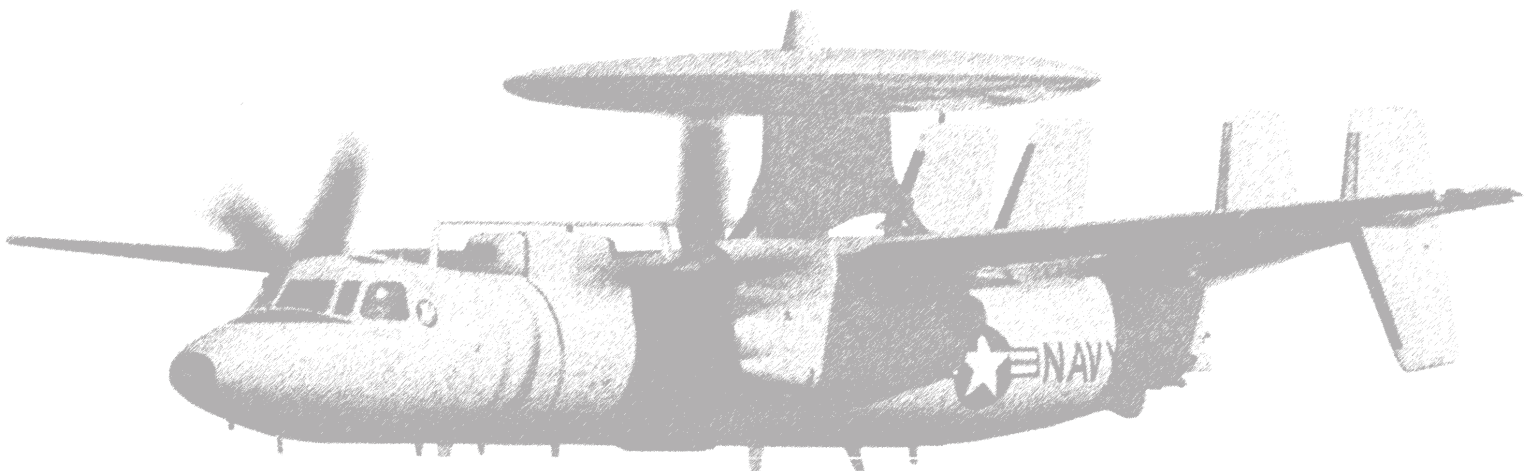
Specifications:

Part Number:	ICE3005-TR-225-400	
Operation:	Tx & Rx filter/amplifier with bypass	
Frequency Coverage:	30 to 174 MHz filtered bypass 225 to 400 MHz AM/FM Rx/Tx Have Quick (HQ)/HQ II 30 to 512 MHz bypass	
Receive Gain (Typical):	7.0 to 11.0 dB	
Receive Noise Figure (Typical):	9.5 dB	
Receive Input IP3:	+60 dBm @ 5 & 10% offset	
Transmit RF Output Power:	30 W AM/FM	
Selectivity (Typical):	UHF Transmit:	UHF Receive:
	-10 dB @ ± 1.0%	-10 dB @ ± 1.0%
	-30 dB @ ± 2.0%	-35 dB @ ± 2.0%
	-40 dB @ ± 3.0%	-50 dB @ ± 3.0%
	-47 dB @ ± 4.0%	-57 dB @ ± 4.0%
	-55 dB @ ± 5.0%	-65 dB @ ± 5.0%
Broadband Noise:	-142 dBm/Hz @ ± 10 MHz -145 dBm/Hz @ ± 5.0%	
Harmonics (Typical):	< -80 dBc	
Spurious:	-135 dBc @ > 3%	
Tuning Speed:	200 µS	
Power:	+28 VDC @ 13 A	
Operating Temperature Range:	-20° to +55°C	
Size:	7.8 × 6 × 19.4 (in.) / 198 × 152 × 493 (mm.)	
Weight:	24.5 lbs. / 11.1 kg.	

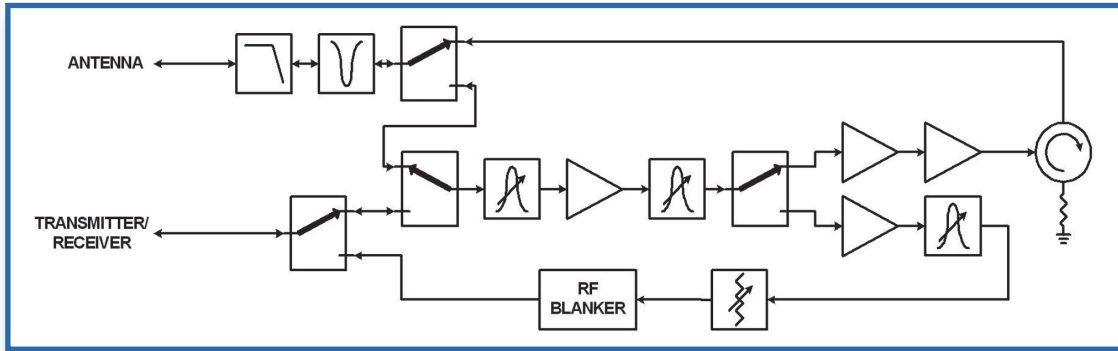


The **ICE3005** is an agile filter/amplifier cascade for the UHF frequency band with a VHF bypass. It enables simultaneous operation of multiple transceivers in a cosite environment and is factory configured for an ARC-210 interface. This filter/amplifier provides multiple poles of RF selectivity to reduce broadband noise, harmonics, and spurious signals while still providing full output power in transmit mode and excellent selectivity to interfering signals at the transceiver's RF input in receive mode. All transmit, receive, and bypass switching is incorporated into the two-port design. The **ICE3005** also includes a separate audio processor circuit that mitigates popping and drop-outs in the R/T audio that are common in hopping or blanked waveforms. The **ICE3005** incorporates extensive Built-in-Test (BIT) capability and is qualified for military applications. A mounting tray is also available as an option for easy incorporation on your platform.

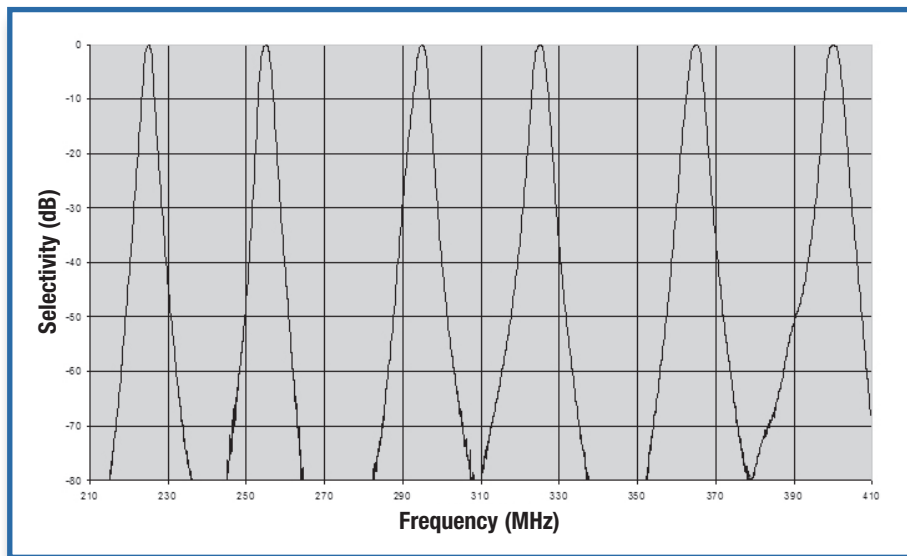
Cost-effective modifications are available on the **ICE3005**. Please contact your sales representative at 513-870-9060 for further details.



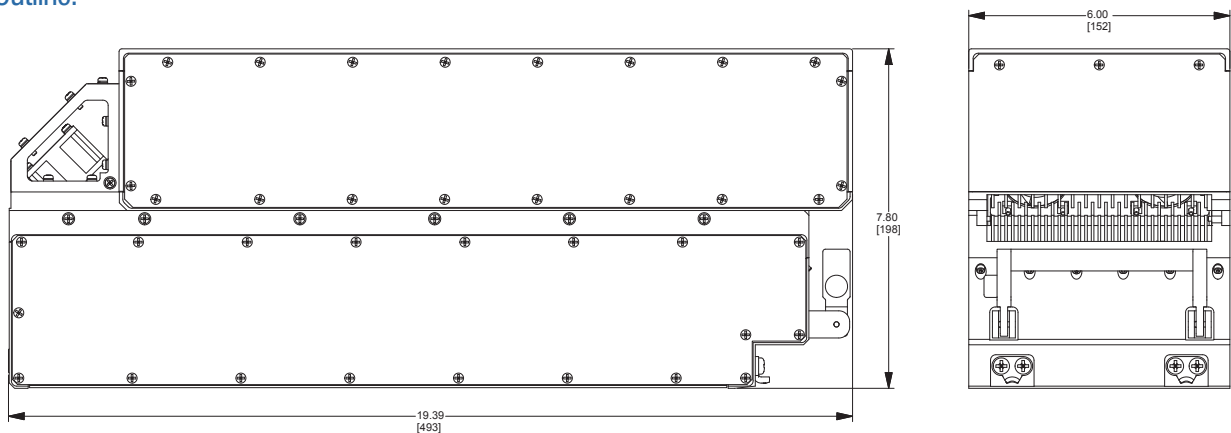
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

Integrated Cosite Equipment (ICE)

ICE3006

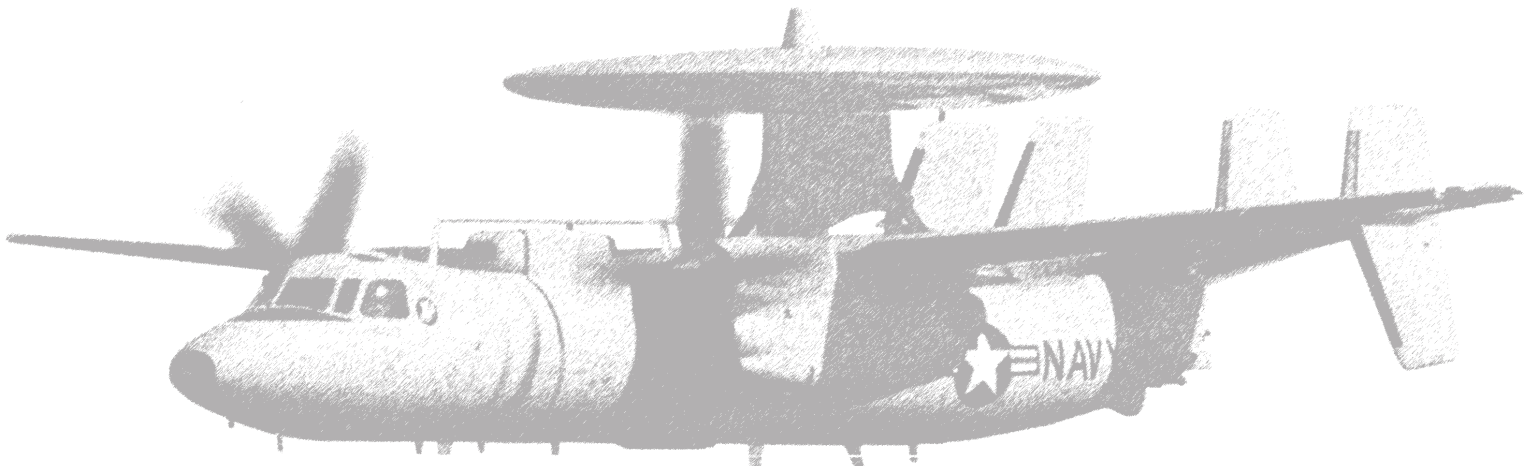
Specifications:

Part Number:	ICE3006-TR-225-400	
Operation:	Tx & Rx filter/amplifier with bypass	
Frequency Coverage:	30 to 174 MHz bypass 225 to 400 MHz AM/FM Rx/Tx Have Quick (HQ)/HQ II, SATCOM 400 to 406.025 MHz AM/FM Receive only and automatic bypass	
Receive Gain (Typical):	7.0 to 11.0 dB	
Receive Noise Figure (Typical):	9.5 dB max. @ 225 to 395 MHz 10.0 dB max. @ 395 to 397.5 MHz 10.5 dB max. @ 397.5 to 400 MHz	
Receive Input IP3:	+60 dBm @ 5 & 10% offset	
Transmit RF Output Power:	30 W (AM) 110 W (FM/FSK 225 to 400 MHz) 125 W (FM/PSK 292 to 318 MHz)	
Selectivity (Typical):	UHF Transmit:	UHF Receive:
	-10 dB @ ± 1.0%	-10 dB @ ± 1.0%
	-30 dB @ ± 2.0%	-35 dB @ ± 2.0%
	-40 dB @ ± 3.0%	-50 dB @ ± 3.0%
	-47 dB @ ± 4.0%	-57 dB @ ± 4.0%
	-55 dB @ ± 5.0%	-65 dB @ ± 5.0%
Broadband Noise:	-142 dBm/Hz @ ± 10 MHz -145 dBm/Hz @ ± 5.0%	
Harmonics (Typical):	< -90 dBc	
Spurious:	-150 dBc @ > 4%	
Tuning Speed:	200 µS	
Power:	115 VAC, 400 Hz @ 861 VA	
Operating Temperature Range:	-20° to +55°C	
Size:	9 × 6 × 19.3 (in.) / 228 × 152 × 491 (mm.)	
Weight:	26.2 lbs. / 11.88 kg.	

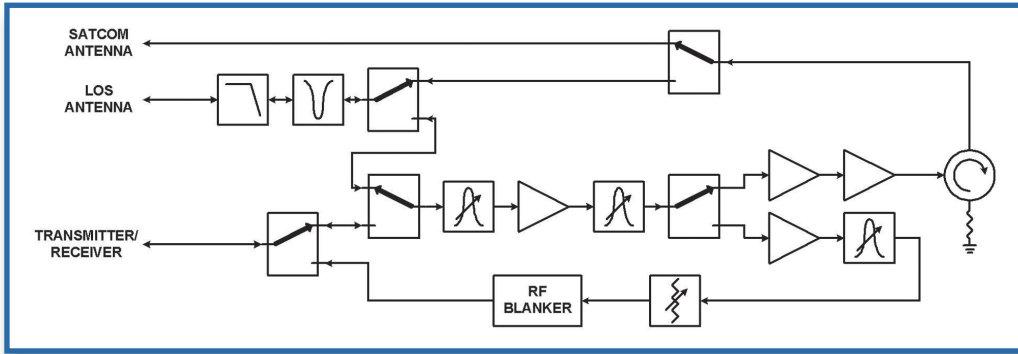


The **ICE3006** is an agile filter/amplifier cascade for the UHF frequency band with a VHF bypass. It enables simultaneous operation of multiple transceivers in the cosite environment. This filter/amplifier provides multiple poles of RF selectivity to reduce broadband noise, harmonics and spurious signals while still providing full output power in transmit mode and excellent selectivity to interfering signals at the transceiver's RF input in receive mode. All transmit, receive and bypass switching is incorporated into the three-port design (LOS and SATCOM). The **ICE3006** also includes a separate audio processor circuit that mitigates popping and dropouts in the R/T audio that are common in hopping or blanked waveforms. The **ICE3006** incorporates extensive Built-in-Test (BIT) capability and is qualified for airborne applications. A mounting tray is also available as an option for easy incorporation on your platform.

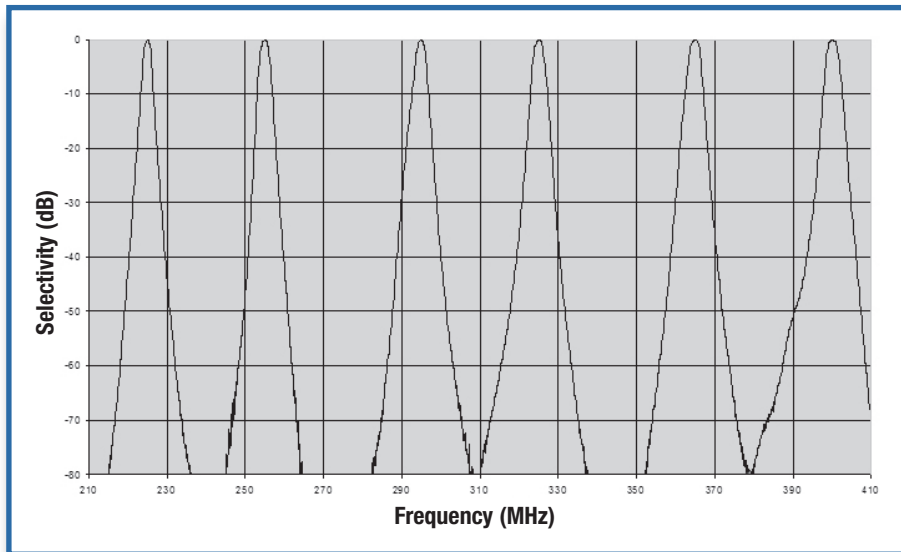
Cost-effective modifications are available on the **ICE3006**. Please contact your sales representative at 513-870-9060 for further details.



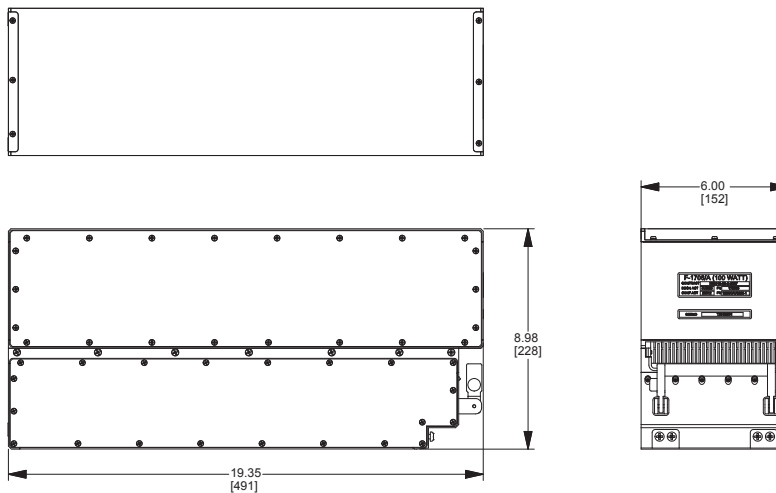
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

Integrated Cosite Equipment (ICE)

ICE3007

Specifications:

Part Number:	ICE3007-T-292-318
Operation:	Tx filter/amplifier
Frequency Coverage:	292 to 318 MHz
Transmit Noise Floor:	-140 dBm/Hz @ ± 4 MHz
Transmit RF Output Power:	30 to 42 dBm in 2 dB steps, 43.6 dBm max.
Selectivity (Typical):	-65 dB @ ± 4.0 MHz -75 dB @ > ± 5.0 MHz
Harmonics (Typical):	-60 dBc (2 nd , 3 rd harmonic)
Tuning speed:	100 μs
Power:	+28 VDC Input, 8 A max.
Operating Temperature Range:	-20° to +55°C
Size:	5.5 × 5.5 × 20 (in.) / 140 × 140 × 508 (mm.)
Weight:	18.5 lbs. / 8.3 kg.

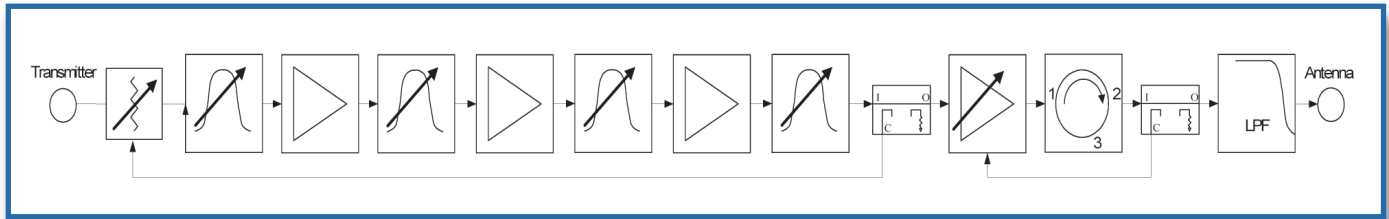


The **ICE3007** is an agile filter for the SATCOM frequency band and is factory configured for an ARC-210 interface. The **ICE3007** provides multiple poles of selectivity to reduce broadband noise and spurious signals from propagating to the antenna. The **ICE3007** is cooled by an internal fan that draws ambient air.

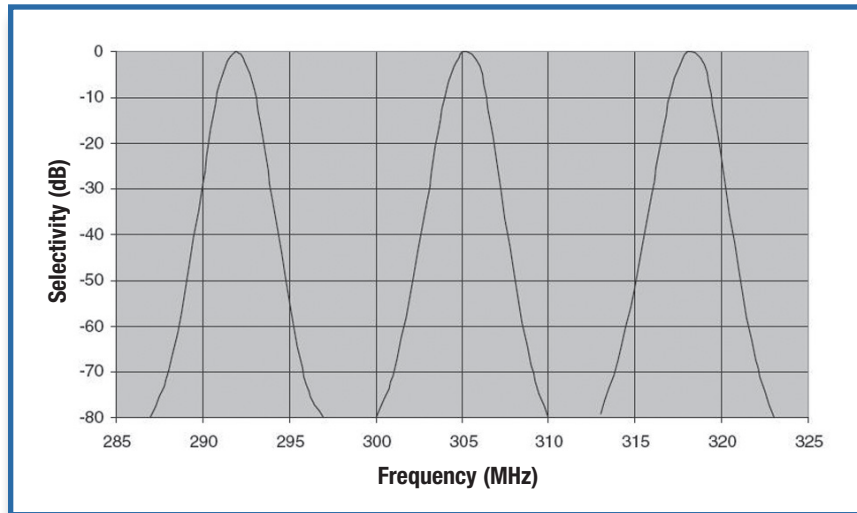
Cost-effective modifications are available on the **ICE3007**. Please contact your sales representative at 513-870-9060 for further details.



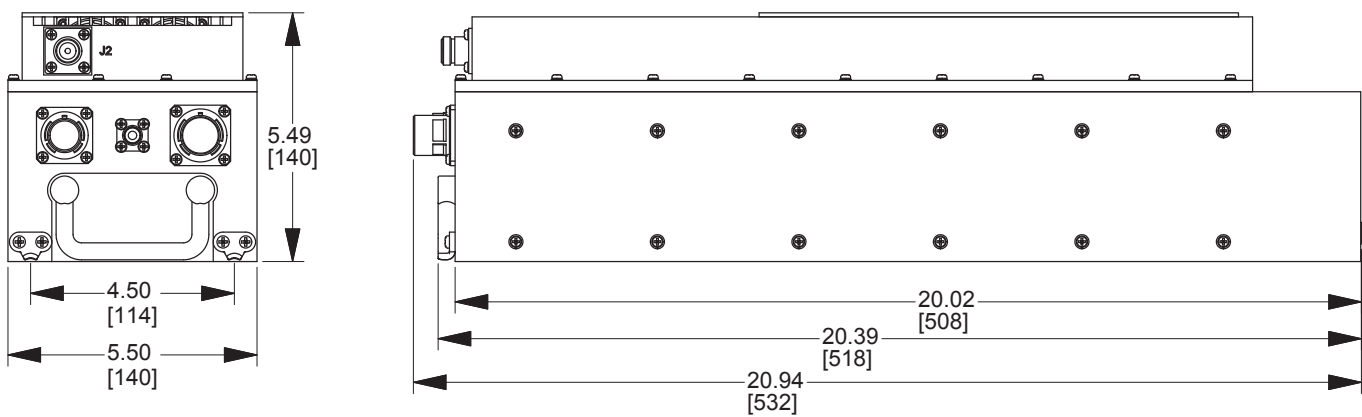
Block Diagram:



Performance:



Chassis Outline:



ICE3008

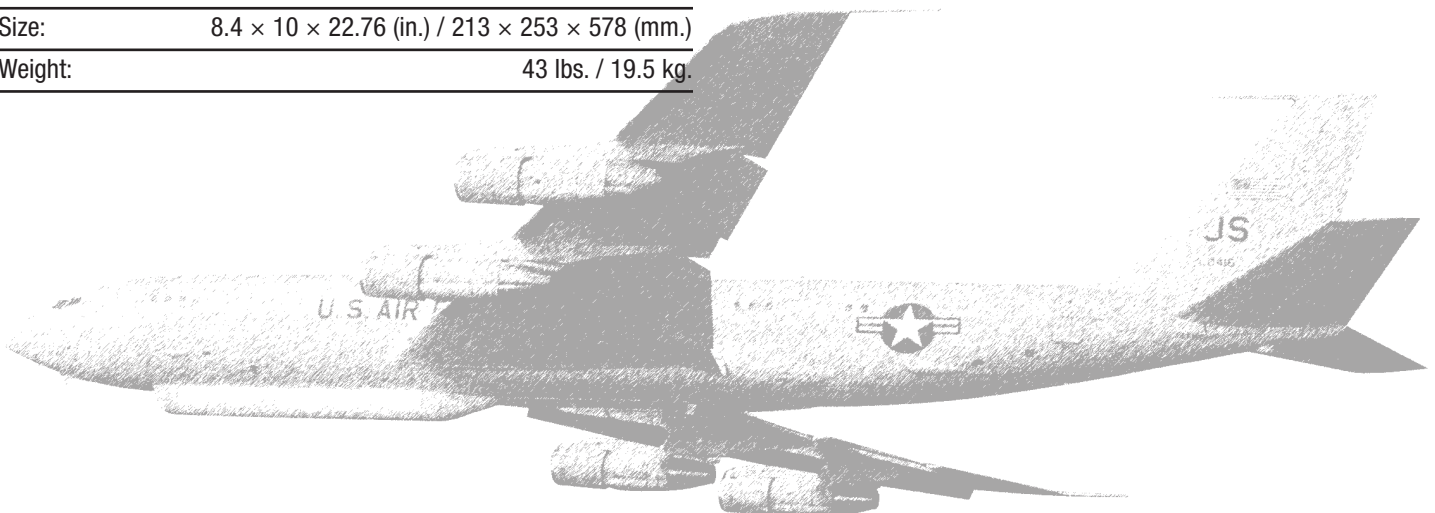
Specifications:

Part Number:	ICE3008-TR-30-174		
Operation:	Half duplex Tx & Rx filter/amplifier		
Frequency coverage:	VHFL:	30 to 88 MHz	
	VHFH:	108 to 174 MHz	
	Bypass:	30 to 512 MHz	
Receive Gain (Typical):	7.0 to 11.0 dB		
Receive Noise Figure (Typical):	10.0 dB		
Transmit Noise Floor:	VHFL:	-135 dBm/Hz @ ± 4 MHz	
	VHFH:	-140 dBm/Hz @ ± 4 MHz	
Receive Input IP3:	+54 dBm @ 4 & 8 MHz offset		
Transmit Output Power:	VHFL:	16, 25, 50 W FM (selectable)	
	VHFH:	18 W FM, 12 W AM (carrier)	
Selectivity (Typical):	VHFL RX/TX:	-25 dB @ ± 2.0 MHz	
		-52 dB @ ± 4.0 MHz	
	VHFH RX/TX:	-14 dB @ ± 2.0 MHz (-17 dB typ.)	
		-36 dBc @ ± 4.0 MHz	
		-50 dBc @ ± 6.0 MHz	
Harmonics (Typical):		-70 dBc (2 nd , 3 rd harmonic)	
		-80 dBc (others)	
Spurious:	Receive:	-112 dBm (< 300 kHz)	
		-80 dBm (elsewhere)	
	Transmit:	-80 dBm (2 to 4 MHz)	
		-100 dBm (4 to 10 MHz)	
		-110 dBm (elsewhere in-band)	
		-130 dBm (elsewhere out-of-band)	
Tuning Speed:	200 µs		
Power:		+28 VDC Input	
	VHFL:	350 W	
	VHFH:	250 W	
Operating Temperature Range:	0° to +50°C		
Size:	8.4 × 10 × 22.76 (in.) / 213 × 253 × 578 (mm.)		
Weight:	43 lbs. / 19.5 kg.		

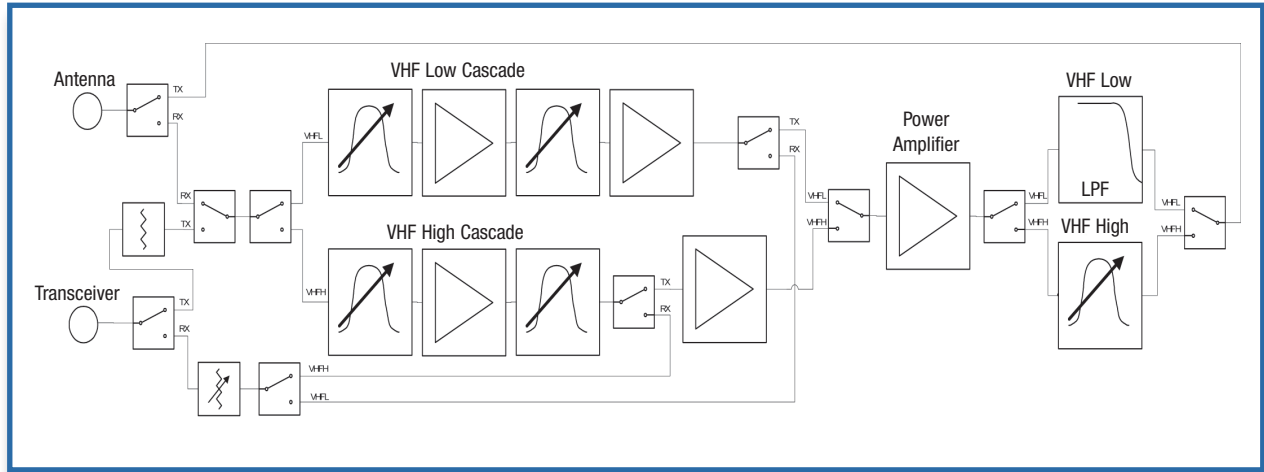


The **ICE3008** is a half duplex transmit and receive filter amplifier that provides cosite mitigation throughout the VHF band. The design incorporates a flexible control interface that can be configured at the factory for various radios (ARC-201D, ARC-210, ARC-231, etc.) and supports operation in fast hopping modes, such as SINGGARS. In addition, our MEGA-POLE® technology is utilized as an output stage to further enhance the performance of the filter amplifier. An optional mounting tray is available for easy integration onto your platform.

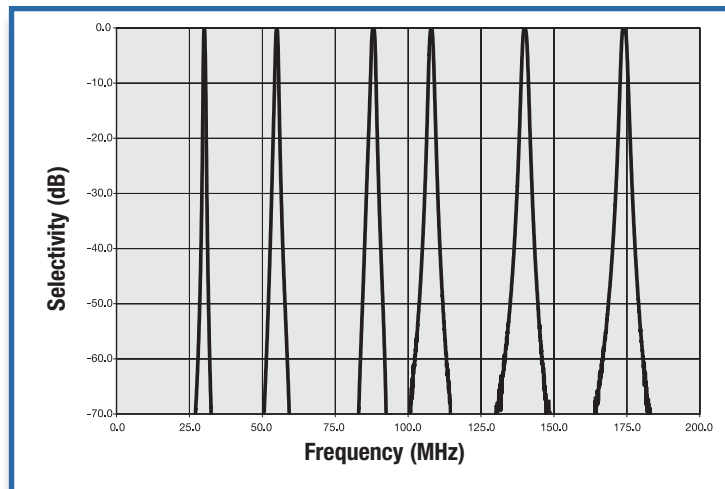
Cost-effective modifications are available on the **ICE3008**. Please contact your sales representative at 513-870-9060 for further details.



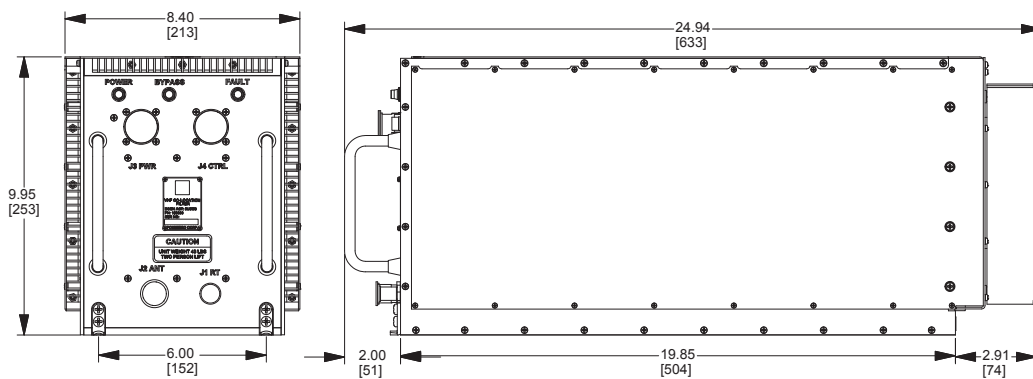
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

ICE3009

Specifications:

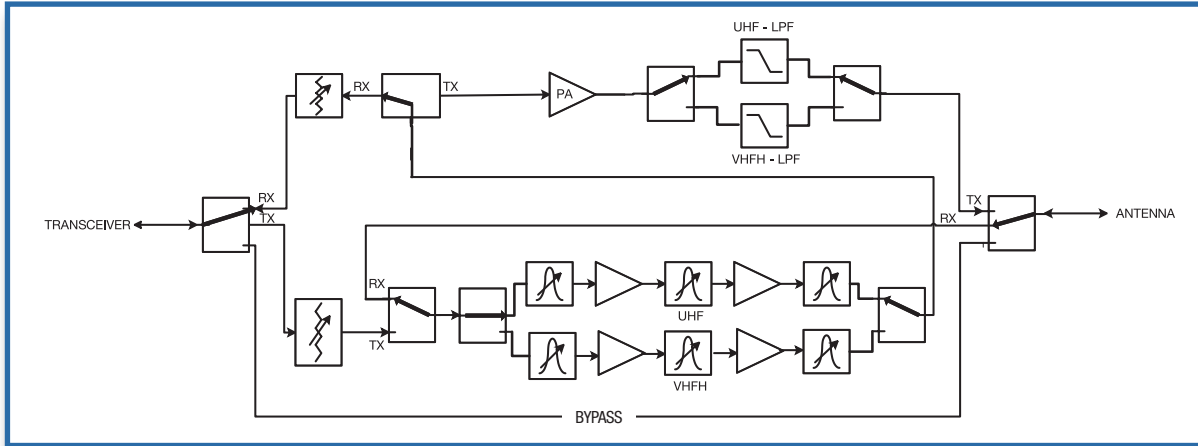
Part Number:	ICE3009-TR-108-400		
Operation:	Half duplex transmit and receive		
Frequency Coverage:	VHFL: 108 to 174 MHz UHF: 225 to 400 MHz		
Receive Gain (Typical):	5.0 to 10.0 dB		
Receive Noise Figure (Typical):	9.0 dB		
Receive Input IP3:	52 dBm @ 5 & 10% offset		
Transmit RF Output Power:	50 W (FM) 25 W (AM)		
Selectivity (Typical):	-35 dB @ > ± 3.0% -55 dB @ > ± 5.0%		
Broadband Noise:	-140 dBm/Hz @ > 5%		
Harmonics (Typical):	-70 dBc (2 nd , 3 rd harmonic) -80 dBc (others)		
Spurious:	Receive:	< -90 dBm (> 3%)	
	Transmit:	-80 dBc min. per MIL-STD 461E	
Tuning Speed:	UHF:	< 50 μs	
	VHFH:	< 100 μs	
Power:	+28 VDC	Tx:	386 W
		Rx:	125 W
		Bypass:	80 W
Operating Temperature Range:	-20° to +55°C		
Size:	6 × 7 × 15.7 (in.) / 152 × 178 × 398 (mm.)		
Weight:	20 lbs. / 9.07 kg.		



This subsystem is an agile filter for both the VHFH and UHF frequency bands. It allows operation of a number of transceivers in a cosite environment. The VHFH/UHF Filter provides multiple poles of RF selectivity to reduce broadband noise in transmit mode of operation and to reduce interfering signals at the transceiver's RF input in receive mode at Have Quick II/IIa and SATURN tuning speeds. This design incorporates a flexible control scheme that can be configured at the factory for various radio interfaces (ARC-210, ARC-231, ARINC 429, etc.) The design is highly integrated and includes all filters, amplifiers, power supply, transmit and receive switching (including a bypass mode) and Built-in-Test (BIT). A mounting tray is available as an option for easy incorporation on your platform. This system is qualified for military applications. Cost-effective modifications are available on the **ICE3009**. Please contact your sales representative at 513-870-9060 for further details.



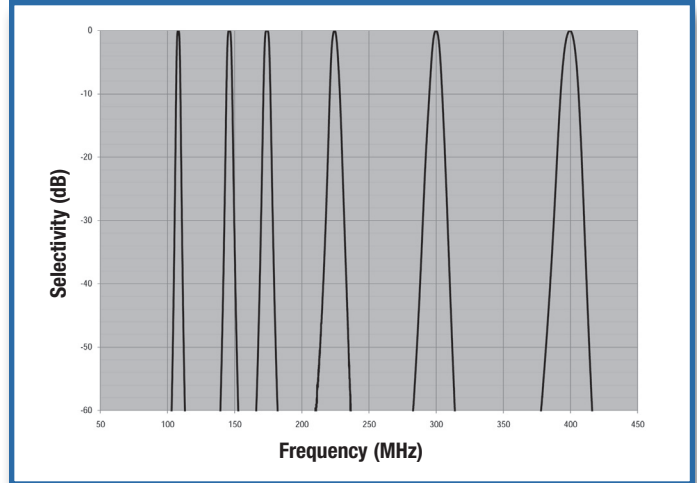
Block Diagram:



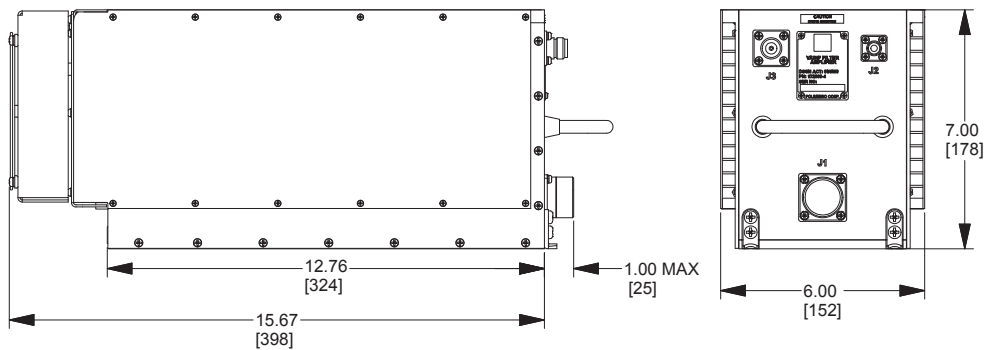
Configuration Selection Chart:

Band 1	<ul style="list-style-type: none"> 30-88 MHz, 108-174 MHz, 225-400 MHz, 225-450 MHz, 225-512 MHz, Custom
Band 2 (optional)	<ul style="list-style-type: none"> 30-88 MHz, 108-174 MHz, 225-400 MHz, 225-450 MHz, 225-512 MHz, Custom
Output RF Power	<ul style="list-style-type: none"> FM: 100 W, AM: 40 W (Single Band Option) FM: 50 W, AM: 25 W (Dual Band Option)
Input RF Power	<ul style="list-style-type: none"> 0 dBm, 20 dBm, 10-23 W (Transceiver) Output Level
Interface	<ul style="list-style-type: none"> ARC-210, ARC-231, PRC-117F, G, TRA 2030, Custom
Options	<ul style="list-style-type: none"> Guard Band (121.5 MHz, 243 MHz) Modified Bandwidths

Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

ICE3011

Specifications:

Part Number:	ICE3011-TR-30-400		
Operation:	Half duplex Tx & Rx		
Frequency Coverage:	30 to 88 MHz 108 to 174 MHz 225 to 400 MHz 30 to 512 MHz bypass		
Receive Gain (Typical):	5.0 to 10.0 dB		
Receive Noise Figure (Typical):	VHFL:	10.0 dB	
	VHFH/UHF:	9.0 dB	
Receive Input IP3:	VHFL:	+47 dBm @ 4 & 8 MHz	
	VHFH/UHF:	+47 dBm @ 5 & 10%	
Transmit RF Output Power:	30 W (FM) 20 W (AM)		
Selectivity (Typical):	VHFL:	-30 dBc @ ± 4.0 MHz -45 dBc @ ± 8.0 MHz	
	VHFH:	-30 dBc @ ± 5.0% -60 dBc @ ± 10.0%	
Broadband Noise:	VHFL:	-135 dBm/Hz @ ± 8 MHz	
	VHFH/UHF:	-135 dBm/Hz @ ± 10%	
Harmonics (Typical):	-60 dBc		
Spurious:	-80 dBc per MIL-STD -461E		
Tuning Speed:	VHFL:	< 200 µs and SINGGARS	
	VHFH:	< 100 µs	
	UHF:	< 50 µs and HQ/HQII/SATURN	
Power:	+28 VDC	Tx:	300 W
		Rx:	112 W
		Bypass:	28 W
Operating Temperature Range:	-40° to +55°C		
Size:	6 × 7 × 16.7 (in.) / 152.4 × 177.8 × 419.1 (mm.)		
Weight:	20 lbs. / 9 kg.		

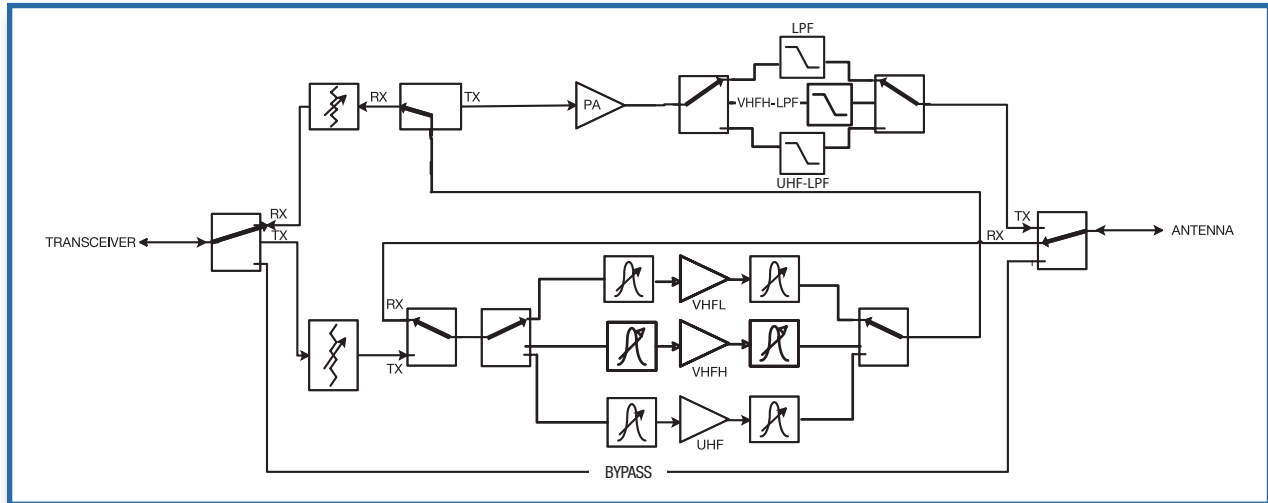


This subsystem is a multi-band agile filter for the VHFL, VHFH and UHF frequency bands. It allows operation of a number of wideband transceivers in a cosite environment. The V/UHF filter/amplifier provides multiple poles of selectivity to reduce broadband noise and spurs in transmit mode and to reduce the impact of interfering signals and the transceiver's input in receive mode. Fast tuning speeds accommodate a variety of frequency hopping waveforms including SINGGARS, HQ/HQ II and SATURN. This design incorporates a flexible control scheme that can be factory configured for various radio interfaces including the ARC-210, ARC-231 and ARINC 429. The design is highly integrated and includes all filters, amplifiers, a power supply, T/R and band switching (including a failsafe bypass mode) and Built-In-Test (BIT). A mounting tray is also available as an option for easy incorporation on your platform. This system is designed for military applications.

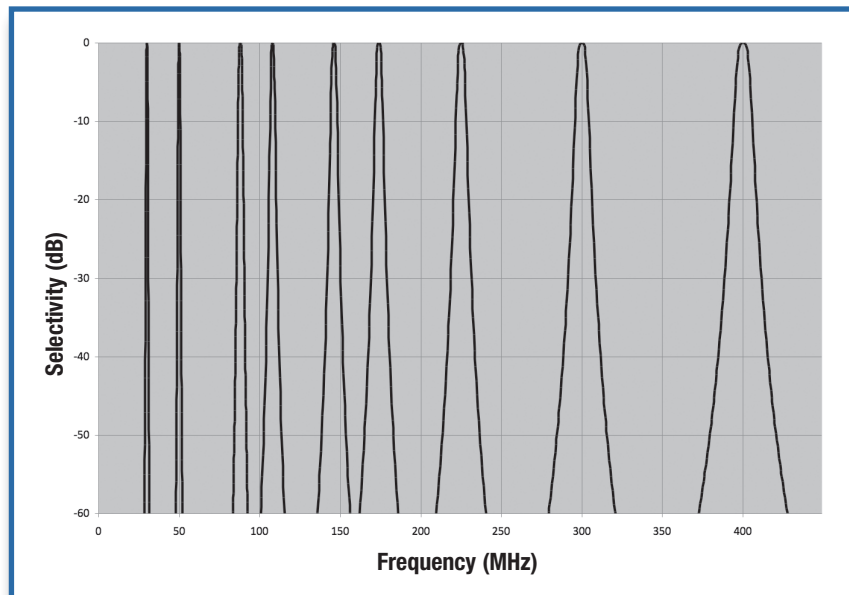
Cost-effective modifications are available on the **ICE3011**. Please contact your sales representative at 513-870-9060 for further details.



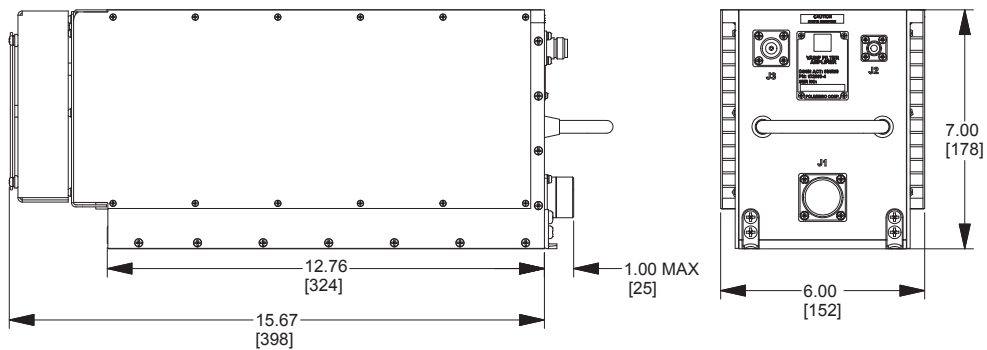
Block Diagram:



Performance:



Chassis Outline:

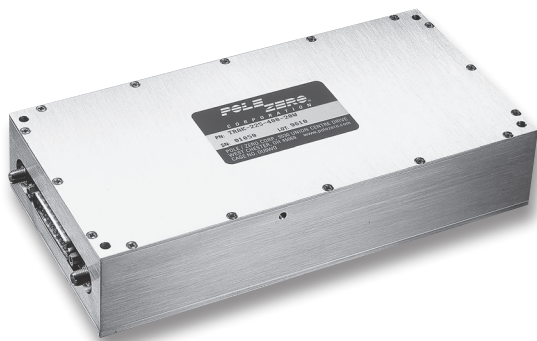


Data is believed to be accurate. All data is subject to change without notice.

ICE4001

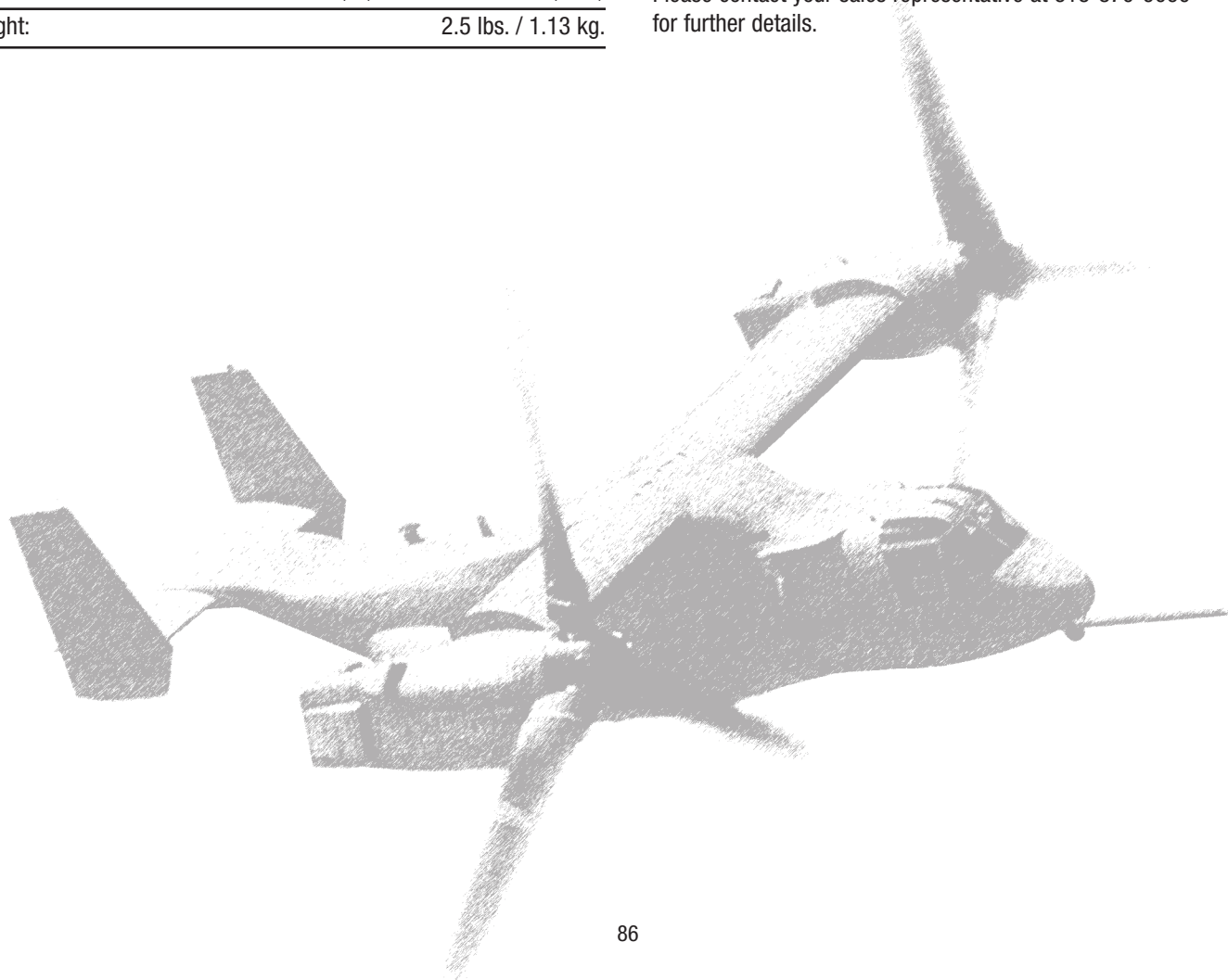
Specifications:

Part Number:	ICE4001-T-225-400	
Operation:	Tx filter/amplifier	
Frequency Coverage:	Transmit:	225 to 400 MHz
	Bypass:	30 to 400 MHz
Gain (Typical):	3.3 dB @ 225 MHz 4.0 dB @ 400 MHz	
Input IP3:	+48 dBm	
Transmit RF Output Power:	10 W (AM) 12 W (FM)	
Selectivity (Typical):	-60 dB @ > ± 4.0 MHz	
Broadband Noise:	-150 dBm/Hz @ ± 10 MHz	
Harmonics (Typical):	-40 dBc (2 nd harmonic) -60 dBc (others)	
Tuning Speed:	150 μS	
Power:	+28 VDC @ 4 A	
Operating Temperature Range:	-40° to +70°C	
Size:	1.6 × 4 × 8 (in.) / 41 × 102 × 203 (mm.)	
Weight:	2.5 lbs. / 1.13 kg.	

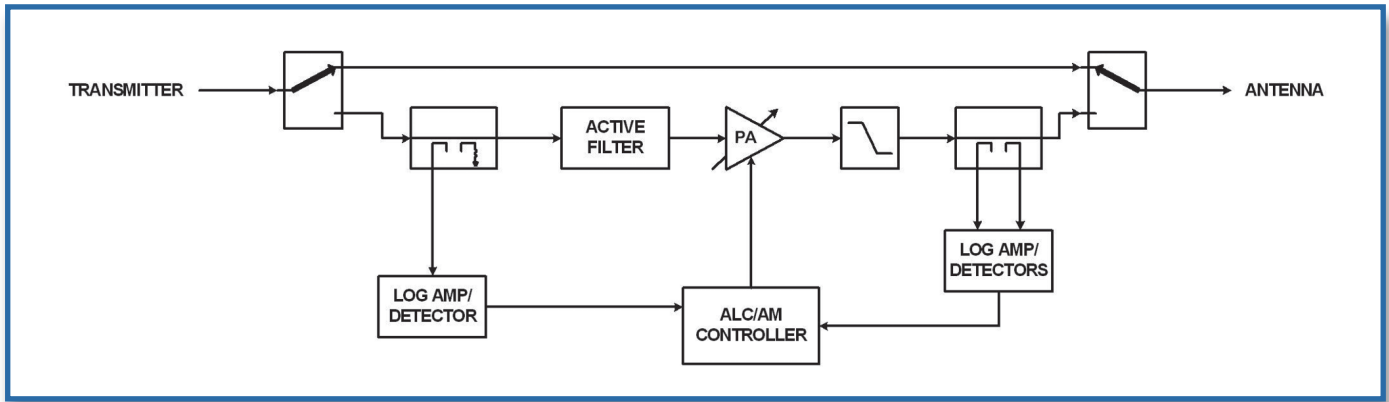


This subsystem is an extremely high-Q agile transmit filter for the UHF frequency band. It enables clear channel operation of multiple transceivers in extreme cosite environments. The **ICE4001** utilizes Trak-Pole™ technology to provide excellent selectivity and broadband noise performance in a chassis that is a fraction of the volume and weight of a conventional filter approach. The **ICE4001** is designed to mount directly to your system's cold plate or heat sink surface. It comes factory configured with a 16 bit serial interface. This filter/amplifier incorporates Built-in-Test (BIT) capability and is qualified for helicopter applications.

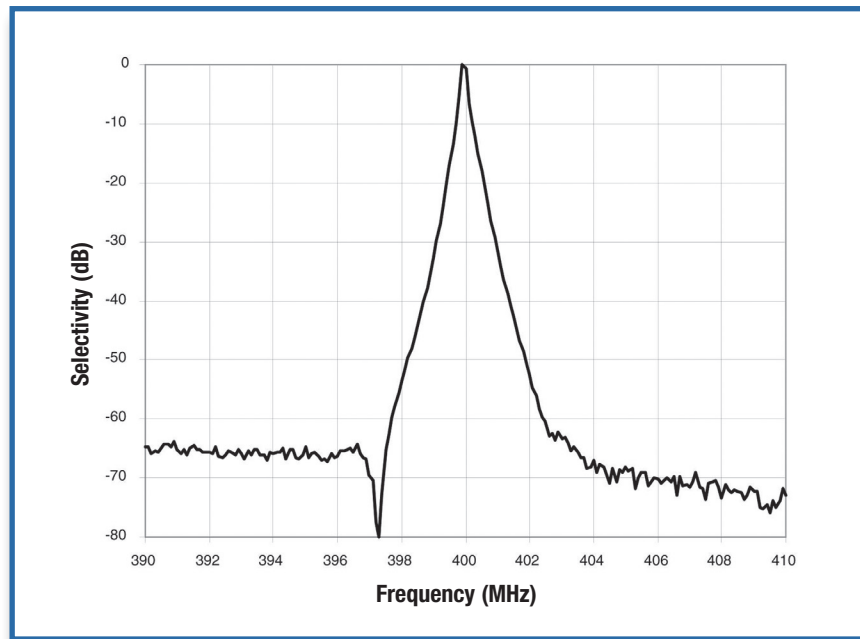
Cost-effective modifications are available on the **ICE4001**. Please contact your sales representative at 513-870-9060 for further details.



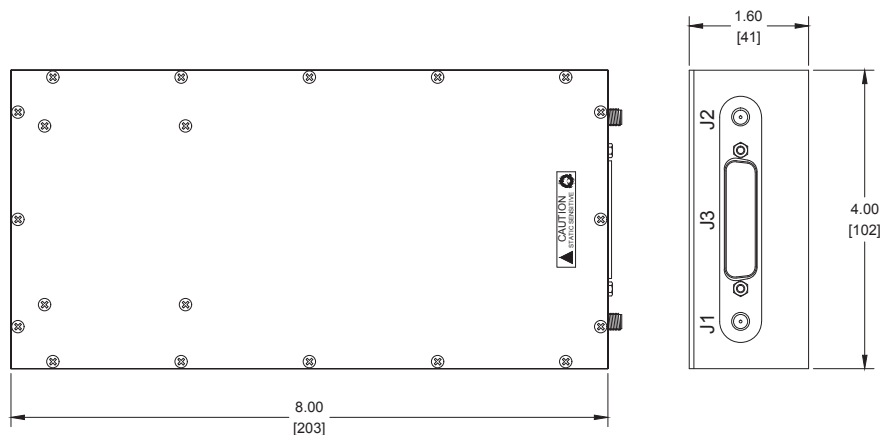
Block Diagram:



Performance:



Chassis Outline:



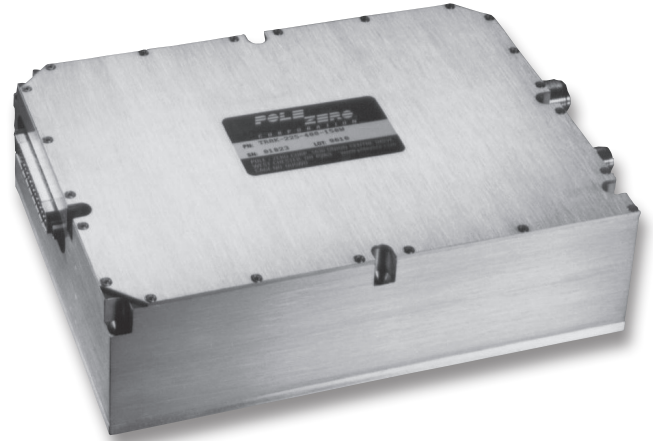
Data is believed to be accurate. All data is subject to change without notice.

Integrated Cosite Equipment (ICE)

ICE4002

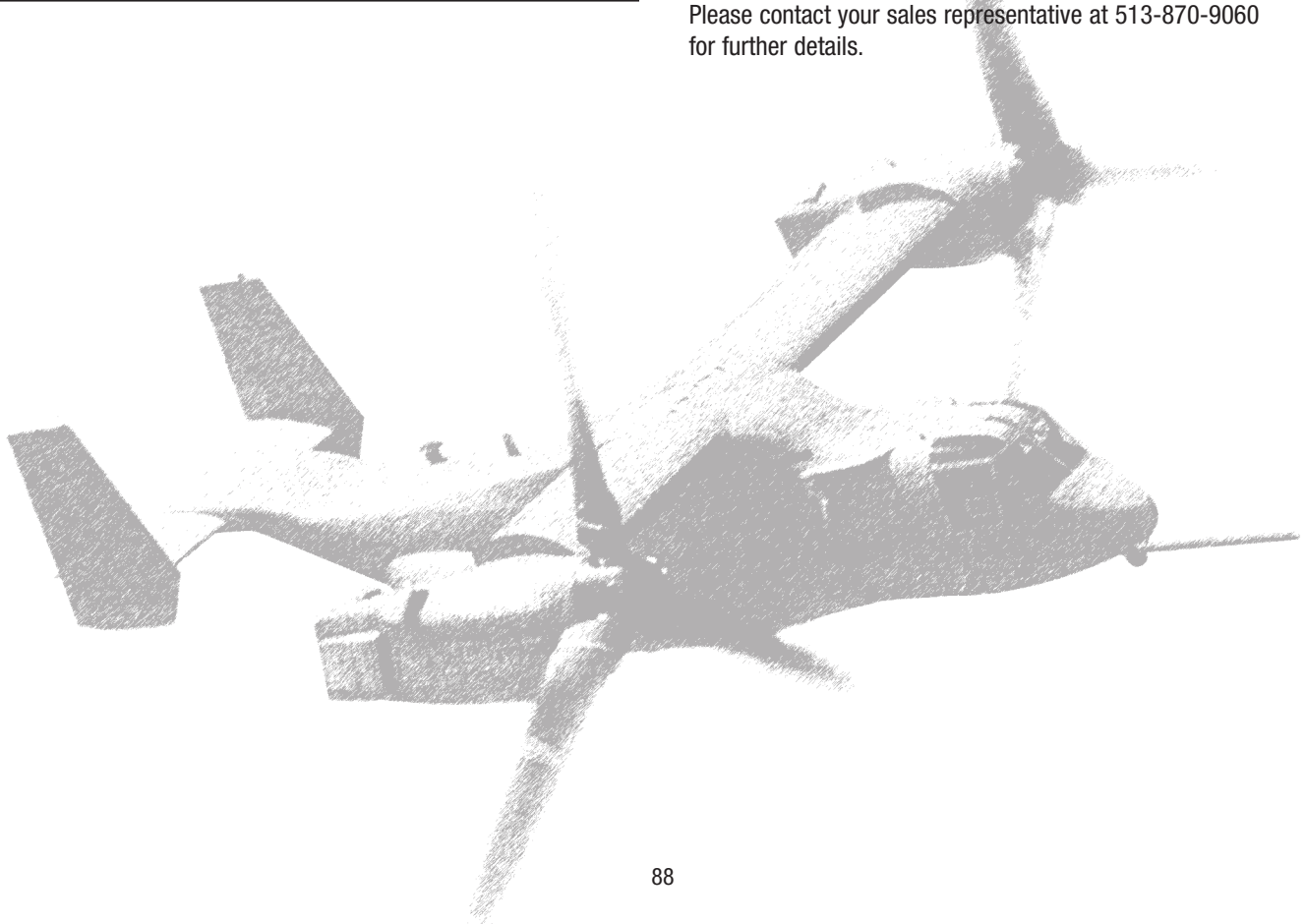
Specifications:

Part Number:	ICE4002-T-225-400	
Operation:	Tx filter/amplifier	
Frequency Coverage:	Low Power:	225 to 400 MHz
	High Power:	290 to 320 MHz
	Bypass:	30 to 400 MHz
Gain (Typical):	3.8 dB @ 225 to 400 MHz	
	13.8 dB @ 290 to 320 MHz	
Input IP3:	+55 dBm	
Transmit RF Output Power:	Low Power:	10 W (AM) 12 W (FM)
	High Power:	150 W (FM)
Selectivity (Typical):	-60 dBc @ > ± 4.0 MHz	
Broadband Noise:	-150 dBm/Hz @ ± 10 MHz in Low Power	
Harmonics (Typical):	-30 dBc (2 nd harmonic) -60 dBc (others)	
Tuning Speed:	150 μS	
Power:	+28 VDC @ 20 A	
Operating Temperature Range (baseplate):	-40° to +70°C	
Size:	2.3 × 6 × 8 (in.) / 57 × 152 × 203 (mm.)	
Weight:	3.75 lbs. / 1.70 kg.	

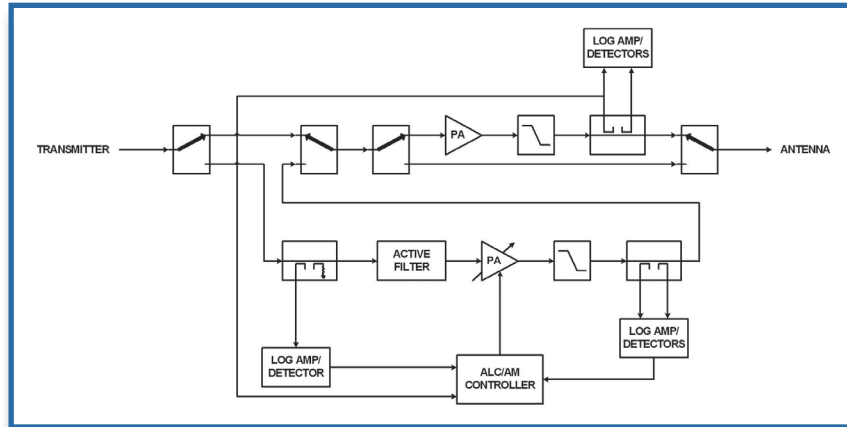


This subsystem is an agile transmit filter/amplifier for the UHF frequency band, providing 20 Watts output power in LOS Mode and 150 Watts output power in SATCOM Mode. It enables clear channel operation of multiple transceivers in extreme cosite environments. The **ICE4002** utilizes Trak-Pole™ technology to provide excellent selectivity and broadband noise performance in a chassis that is a fraction of the volume and weight of a conventional filter approach. This filter/amplifier incorporates Built-in-Test (BIT) capability and is qualified for military applications. This unit is designed to mount directly to your system's cold plate or heat sink surface and comes factory configured with a 16 bit serial interface.

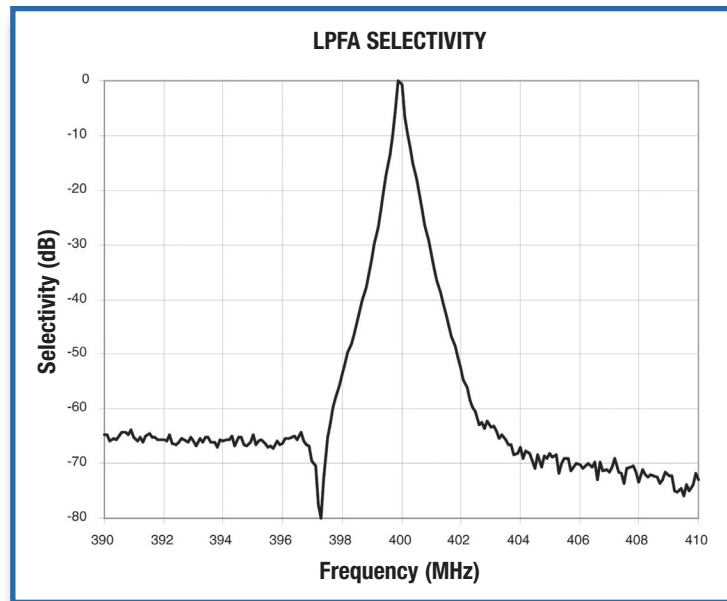
Cost-effective modifications are available on the **ICE4002**. Please contact your sales representative at 513-870-9060 for further details.



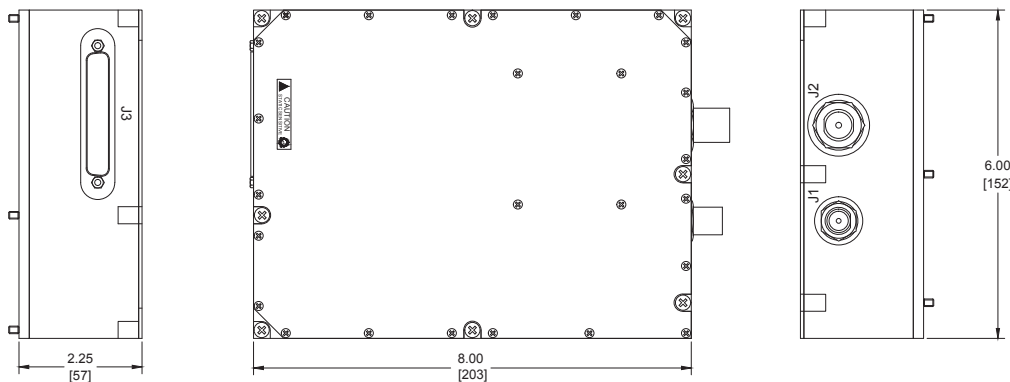
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

ICE4003

Specifications:

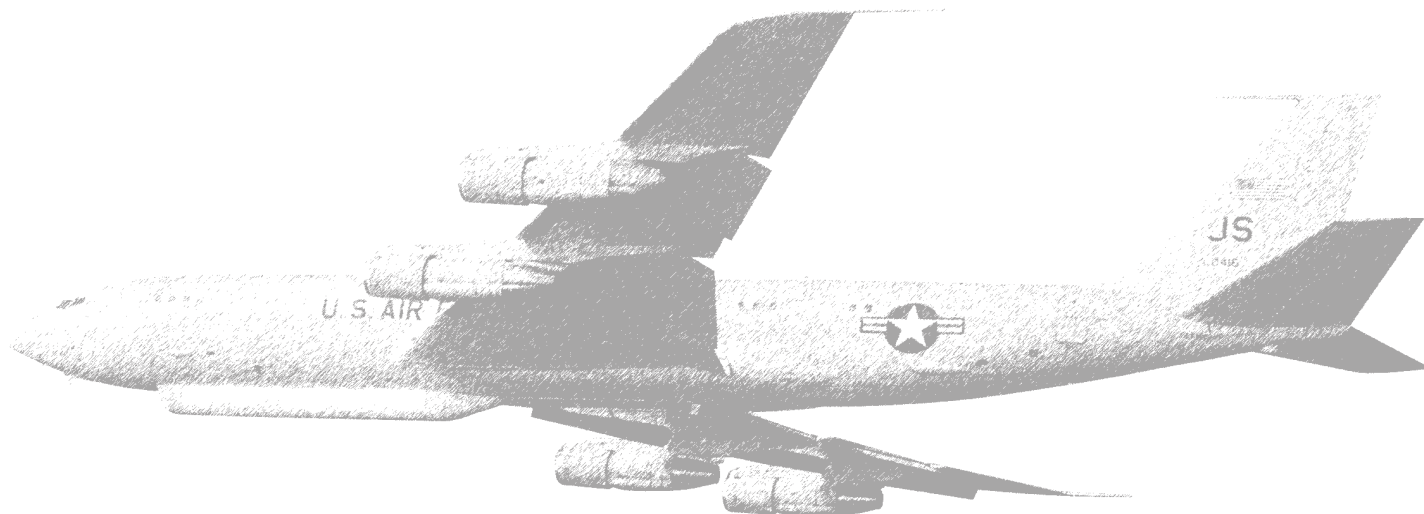
Part Number:	ICE4003-2TR-225-400
Operation:	Dual channel Tx & Rx filter/amplifier
Frequency Coverage:	225 to 400 MHz (2 channels)
Receive Gain (Typical):	1.0 to 5.0 dB
Receive Noise Figure (Typical):	10 dB*
Receive Input IP3:	+55 dBm @ 4 & 8 MHz offset
Transmit RF Output Power:	25 W per channel
Selectivity (Typical):	Transmit or Receive: -8 dBc @ ± 1.0 MHz -40 dBc @ ± 2.0 MHz -60 dBc @ ± 3.0 MHz
Harmonics (Typical):	-70 dBc (2 nd harmonic) -105 dBc (3 rd harmonic) -90 dBc (others)
Spurious:	-85 dBm/Hz @ ± 4 MHz -75 dBm/Hz @ ± 25 MHz
Tuning Speed:	200 μS
Power:	115 VAC, 400 Hz @ 6.3 A
Operating Temperature Range:	0° to +40°C
Size:	8.3 × 11.3 × 20 (in.) / 211 × 287 × 505 (mm.)
Weight:	71 lbs. / 32.2 kg.

* Performance varies around guard band (243 MHz).

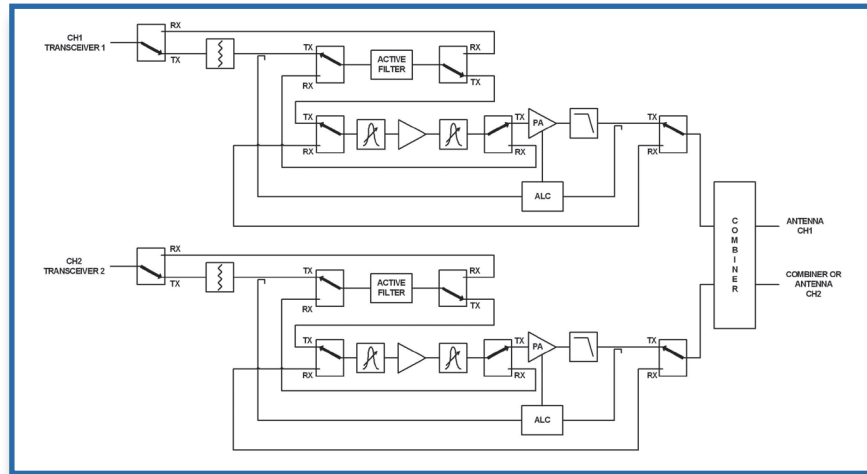


The **ICE4003** is a Dual Channel Filter that provides two independent UHF TX/RX channels in a single package. Each channel can operate autonomously into a dedicated antenna or both channels can be combined into a single antenna. Furthermore, the combiner used in the **ICE4003** is capable of combining any combination of TX/RX signals while minimizing path loss. Currently, supported radios include the ARC-225 and ARC-210. The **ICE4003** is also designed with a flexible interface to support future radio requirements, such as JTRS. A mounting tray is also available as an option for easy incorporation on your platform.

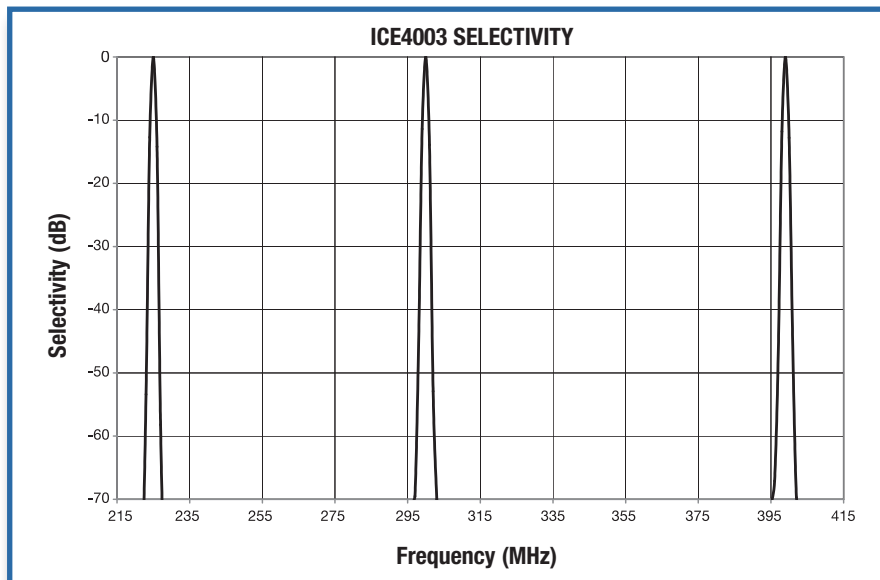
Cost-effective modifications are available on the **ICE4003**. Please contact your sales representative at 513-870-9060 for further details.



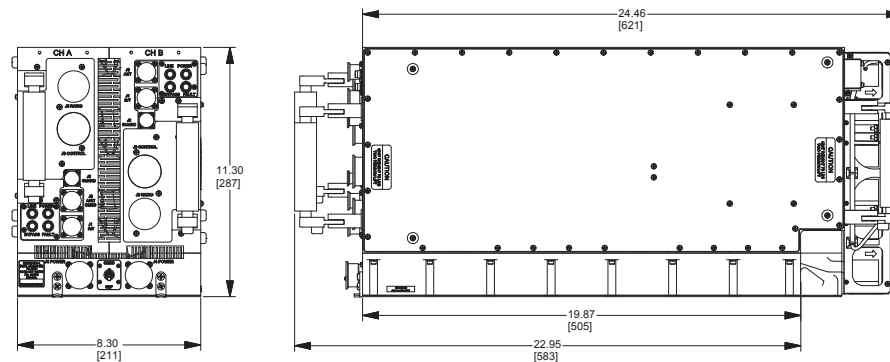
Block Diagram:



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

ICE4004

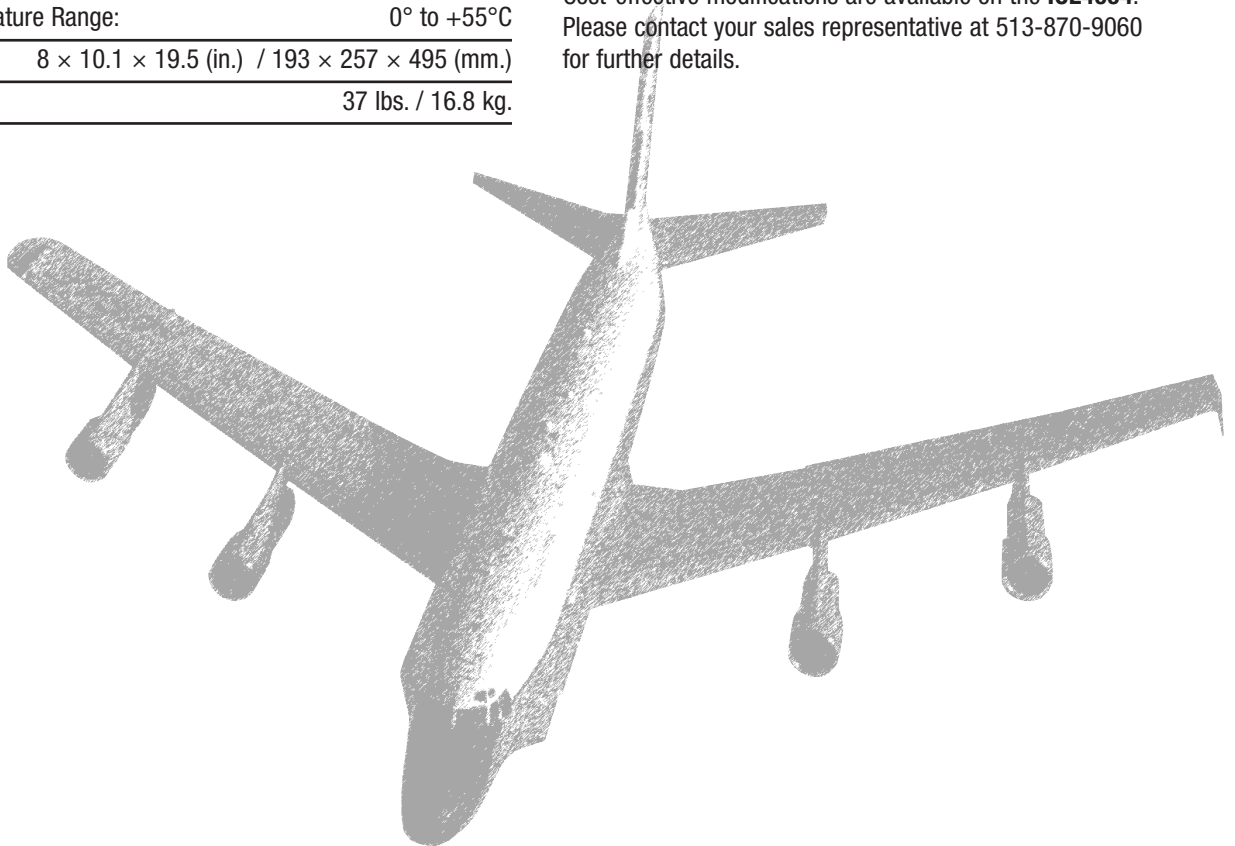
Specifications:

Part Number:	ICE4004-TR-118-400	
Operation:	VHF/UHF frequency agile filter/amplifier	
Frequency Coverage:	118 to 174 MHz 225 to 400 MHz 30 to 512 MHz Automatic bypass	
Receive Gain (Typical):	4.0 to 15.0 dB	
Receive Noise Figure (Typical):	9.0 dB	
Receive Input IP3:	+40 dBm	
Transmit RF Output Power:	10 W, 15 W, 20 W (selectable)	
Selectivity (Typical):	Receive:	Transmit:
	-30 dBc @ ± 4.0 MHz (VHF)	-60 dBc @ (> 4 MHz)
	-55 dBc @ ± 8.0 MHz (VHF)	
	-14 dBc @ ± 4.0 MHz (UHF)	
	-36 dBc @ ± 8.0 MHz (UHF)	
Broadband Noise:	-140 dBm/Hz @ 10 MHz	
Harmonics (Typical):	-60 dBc	
Spurious:	-80 dBc	
Tuning Speed:	300 μS	
Power:	+28 VDC @ 23 A	
Operating Temperature Range:	0° to +55°C	
Size:	8 × 10.1 × 19.5 (in.) / 193 × 257 × 495 (mm.)	
Weight:	37 lbs. / 16.8 kg.	

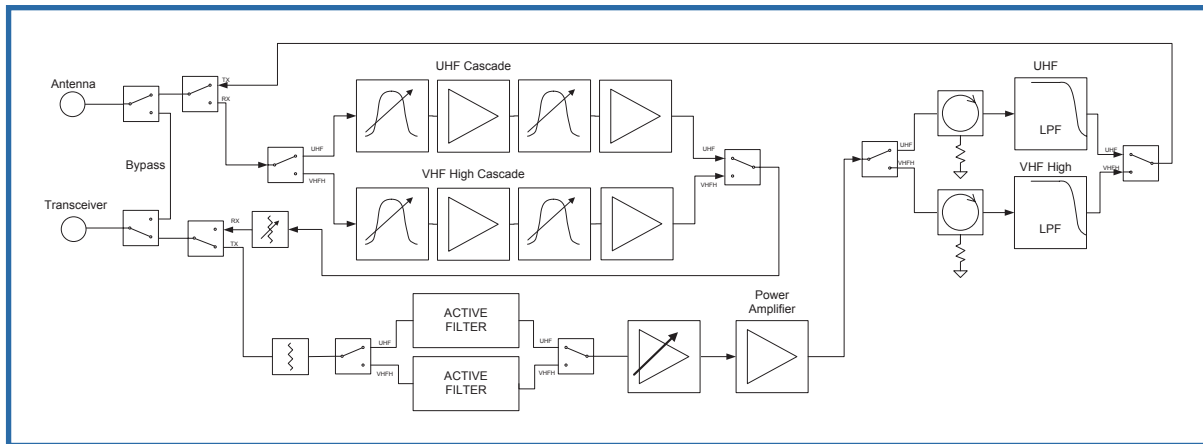


The **ICE4004** is an agile filter for both the VHF and UHF frequency bands. It allows simultaneous operation of a number of transceivers in the cosite environment. The VHF/UHF Filter provides significant RF selectivity to reduce broadband noise in transmit mode of operation and to reduce interfering signals at the transceiver's RF input in receive mode. The design is highly integrated, including Built-in-Test (BIT), a failsafe bypass mode and an ARC-210 interface. The **ICE4004** fits the standard ATR-1 Long mounting tray.

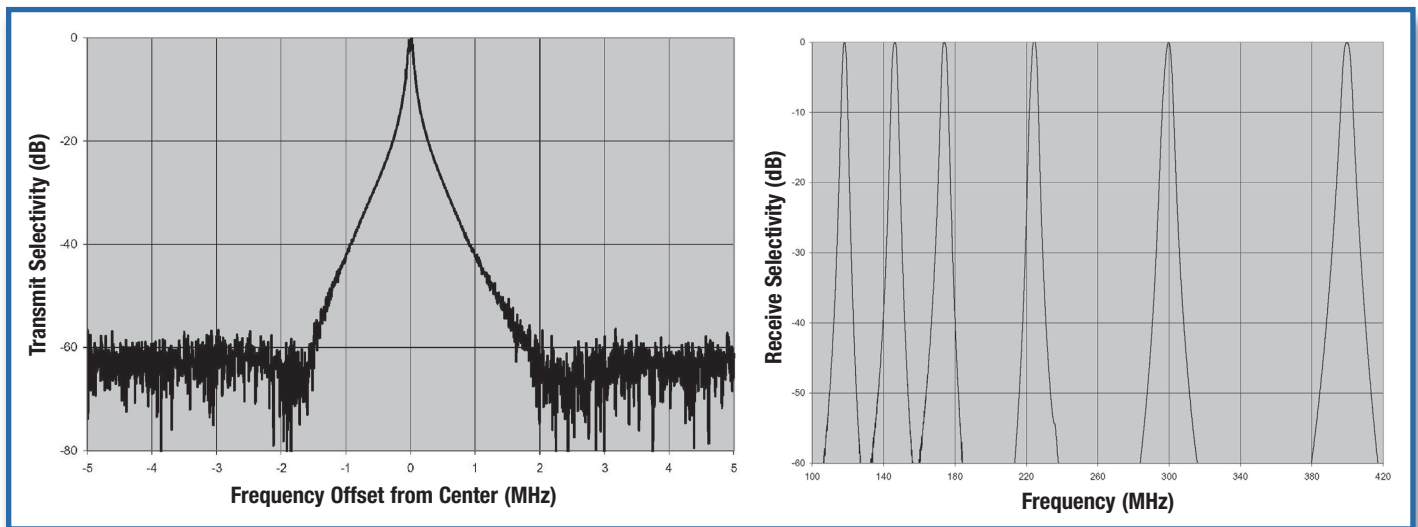
Cost-effective modifications are available on the **ICE4004**. Please contact your sales representative at 513-870-9060 for further details.



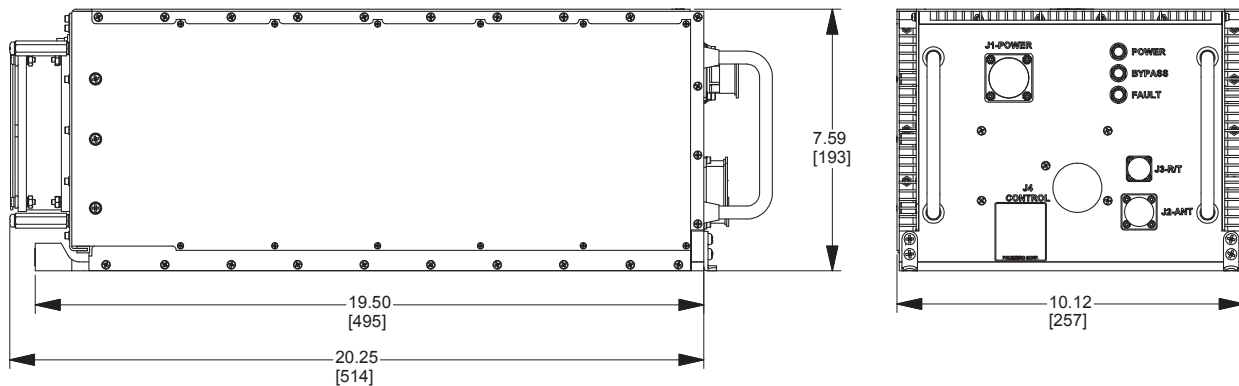
Block Diagram:



Performance:



Chassis Outline:

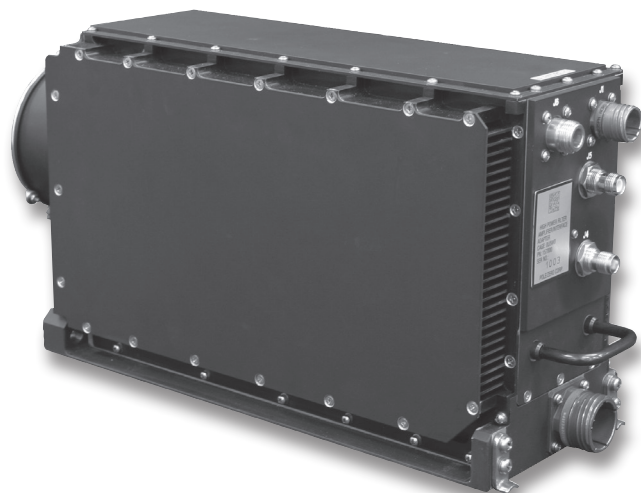


Data is believed to be accurate. All data is subject to change without notice.

ICE4005

Specifications:

Part Number:	ICE4005-T-290-320
Operation:	Selectable dual-radio Tx filter amplifier
Frequency coverage:	UHF SATCOM Transmit 290 to 320 MHz
Transmit Noise Floor:	≤ -139 dBm/Hz @ ≥ ± 10 MHz removed
Transmit RF Output Power:	51.0 to 37.0 dBm (adjustable with 1 dB steps)
Selectivity (Typical):	-45 dBc min. @ ± 2.5 MHz -50 dBc typical @ ± 2.5 MHz
Harmonics (Typical):	-80 dBc max. (2 nd harmonic) -90 dBc typical (2 nd harmonic) -90 dBc max. (3 rd harmonic) -100 dBc typical (3 rd harmonic)
Tuning Speed:	750 μs max.
Power:	18 to 32V @ ≤ 22.5 A MIL-STD-704F compliant
DC Output:	+28V @ 100 mA for external LNA
Operating Temperature Range:	-40° to +45°C @ 100% duty cycle -45° to +70°C @ 20% duty cycle
Size:	Modified ½ ATR Short 4.9 × 7.7 × 12.5 (in.) / 124 × 195 × 318 (mm.)
Weight:	16 lbs. / 7 kg.
Software:	DO-178B Level D compliant

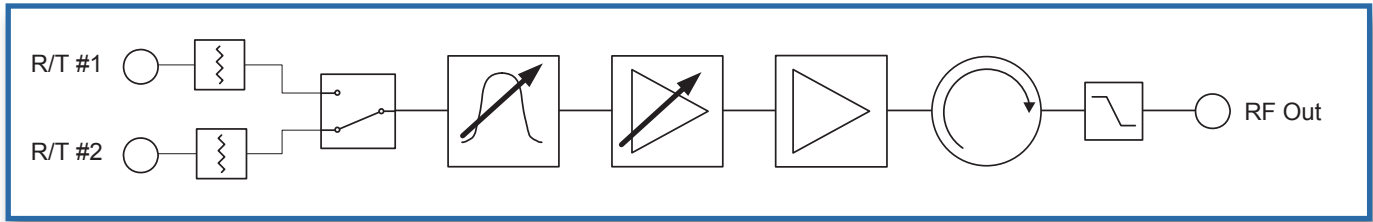


The **ICE4005** is a UHF SATCOM High Power Transmit Filter/Amplifier (HPTF/A) designed to provide 125 Watts minimum RF output power in the 290 to 320 MHz frequency range. This system provides excellent selectivity and broadband noise performance. It enables simultaneous operation of multiple transceivers in a cosite environment. This filter incorporates extensive Built-In-Test (BIT) capability, has been qualified for airborne platforms and has applications on ground-mobile and shipboard communication systems. This unit is qualified for use in military applications. A mounting tray is also available for easy incorporation on your platform.

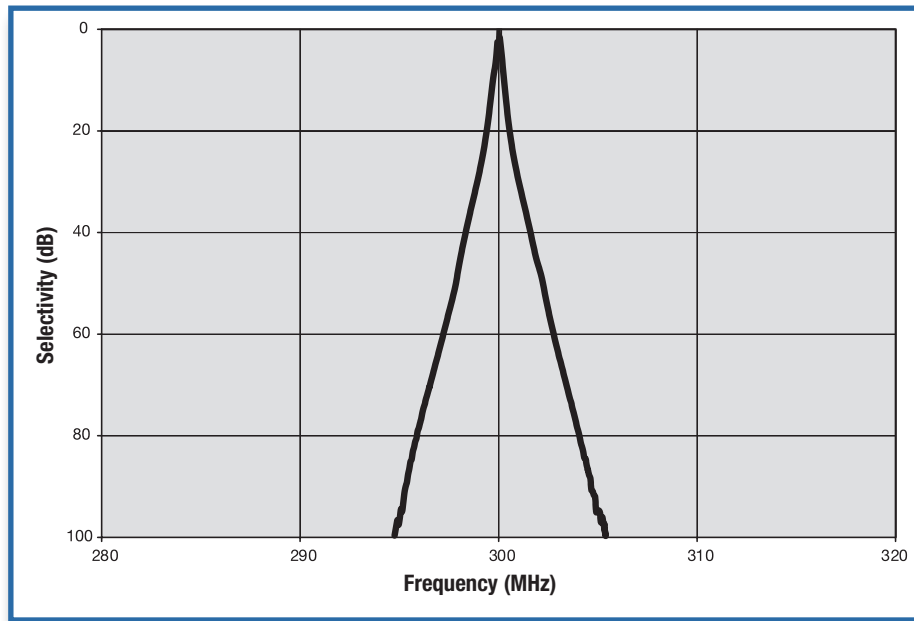
Cost-effective modifications are available on the **ICE4005**. Please contact your sales representative at 513-870-9060 for further details.



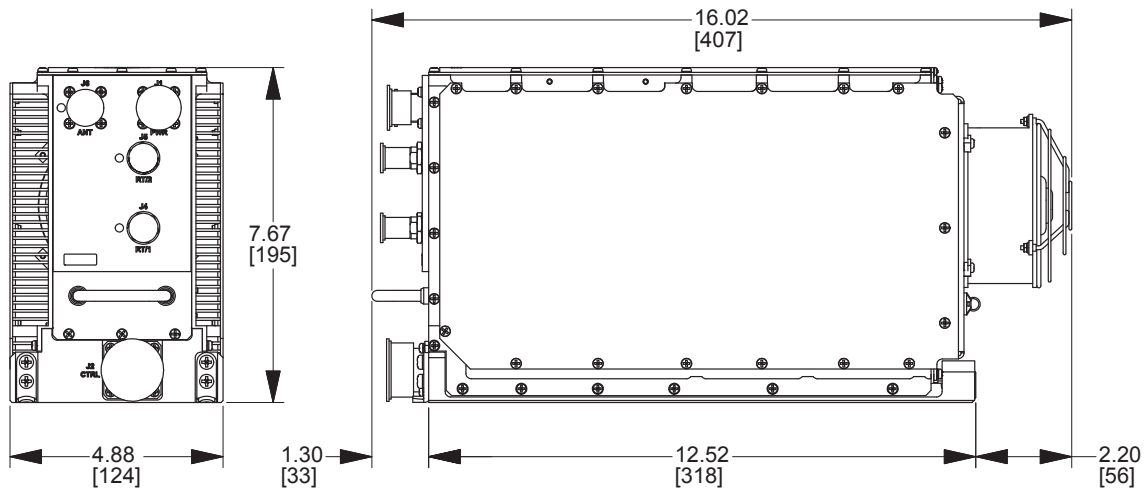
Block Diagram:



Performance:



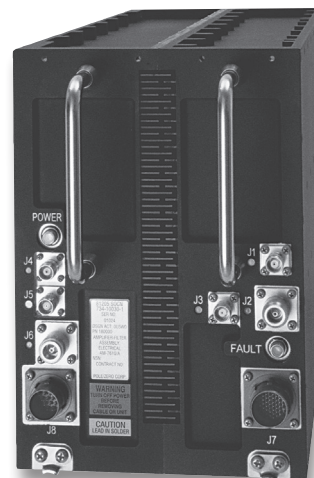
Chassis Outline:



ICE5001

Specifications:

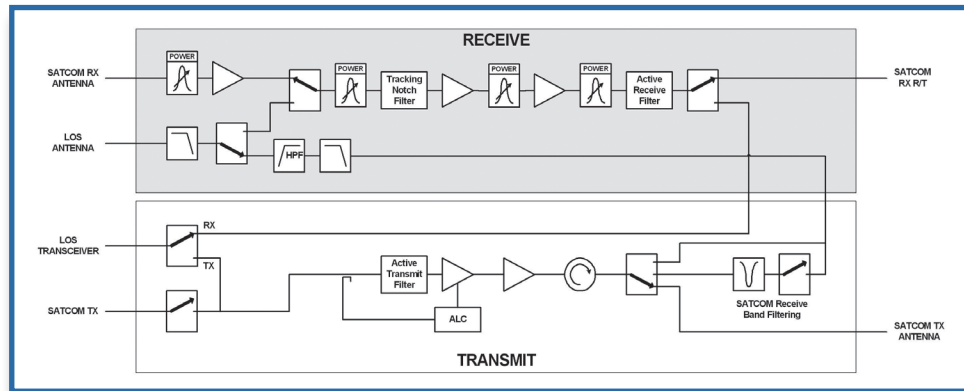
Part Number:	ICE5001-TR-225-400
Operation:	Full duplex (SATCOM) Half duplex (LOS) Tx & Rx filter/amplifier
Frequency Coverage:	243 to 318 MHz (SATCOM) 225 to 400 MHz (LOS)
Receive Gain (Typical):	14.0 dB (SATCOM) 12.0 dB (LOS)
Receive Noise Figure (Typical):	8.0 dB < 9.5 dB
Receive Input IP3:	+73.5 dBm @ 4 & 7.5 MHz offset (500 kHz off channel product)
Transmit RF Output Power:	158 W (SATCOM) 40 W (LOS)
Selectivity (Typical):	Receive: -60 dBc @ ± 2.0 MHz -75 dBc @ ± 4.0 MHz -80 dBc @ ± 6.0 MHz Transmit: -45 dBc @ ± 2.0 MHz -70 dBc @ ± 4.0 MHz -80 dBc @ ± 6.0 MHz
Broadband Noise:	-143 dBm/Hz @ ± 4.0 MHz
Harmonics (Typical):	-70 dBc (2 nd harmonic) -80 dBc (others)
Spurious:	Receive: -110 dBm (< 300 kHz) -80 dBm (elsewhere) Transmit: -80 dBm (2-4 MHz) -100 dBm (< 10 MHz) -110 dBm (elsewhere in-band) -130 dBm (elsewhere out-of-band)
Tuning Speed:	100 μS
Power:	115 VAC, 3 Phase, 400 Hz @ 3 A
Operating Temperature Range:	0° to +50°C
Size:	7.0 × 10 × 19.3 (in.) / 178 × 256 × 491 (mm.)
Weight:	48 lbs. / 21.8 kg.



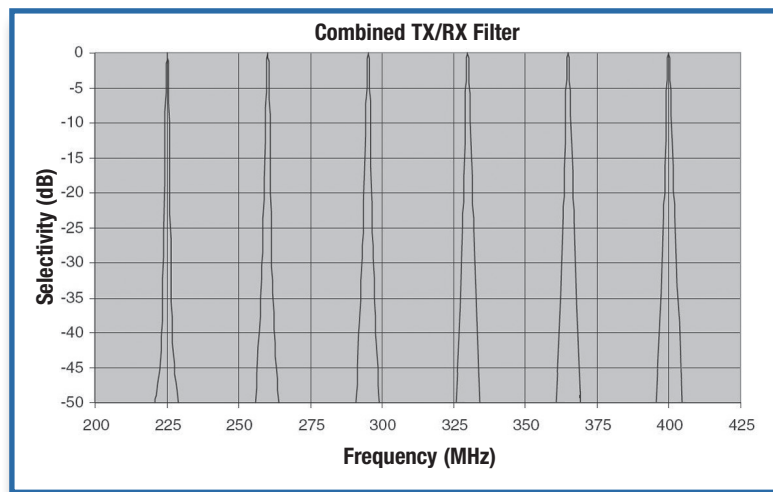
The **ICE5001** is a highly integrated tunable UHF Cosite Filter/Amplifier providing state-of-the-art performance for cosite applications. We have incorporated several of our cutting-edge technologies into this design, and it represents our highest performance subsystem. Currently, supported radios include the ARC-210, ARC-232 and ARC-234. The **ICE5001** is designed with a flexible interface to support future radio requirements, such as JTRS. This unit is qualified for use in military applications. A mounting tray is also available for easy incorporation on your platform. Cost-effective modifications are available on the **ICE5001**. Please contact your sales representative at 513-870-9060 for further details.

Block Diagram:

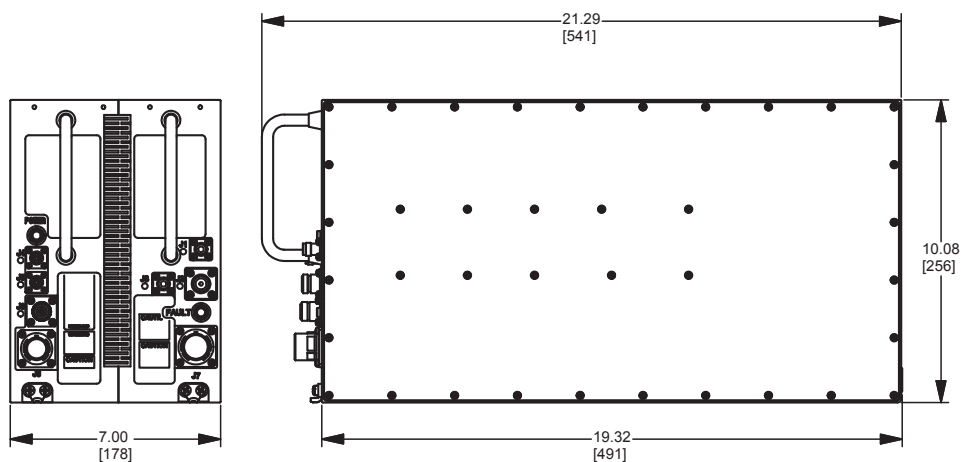
The **ICE5001** is comprised of 17 separate modules including an input switching module, filter/LNAs, power amplifiers and power supply modules. The block diagram below is provided to convey the basic function of the **ICE5001**. Please contact Pole/Zero® for additional details.



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

Integrated Cosite Equipment (ICE)

ICE5002

Specifications:

Part Numbers: ICE5002-TR-30-400 / ICE5002-TR-30-406

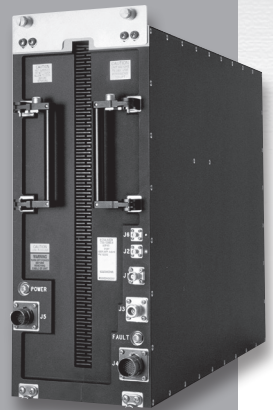
Operation: Half duplex (LOS) Tx & Rx; UHF, VHF high and low band filter amplifier

	VHFL	VHFH	UHF LOS
Frequency Coverage:	30-88 MHz	118 to 174 MHz	225 to 400 MHz
Receive Gain (Typical):	11.0 dB	9.0 dB	12.0 dB
Receive Noise Figure (Typical):	10.0 dB	10.0 dB	11.0 dB
Receive Input IP3:	+60 dBm @ 4 & 8 MHz	+60 dBm @ 4 & 8 MHz	+73.5 dBm @ 4 & 7.5 MHz (500 kHz off channel product)
Transmit RF Output Power:	95 W (FM)	95 W (FM) 30 W (AM)	125 W (FM) 40 W (AM)
Selectivity (Typical):	RX & TX: -25 dBc @ ± 2.0 MHz -40 dBc @ ± 3.0 MHz -55 dBc @ ± 4.0 MHz -60 dBc @ ± 6.0 MHz	RX & TX: -22 dBc @ ± 2.0 MHz -45 dBc @ ± 3.0 MHz -62 dBc @ ± 4.0 MHz -65 dBc @ ± 6.0 MHz	RX: -60 dBc @ ± 2.0 MHz -75 dBc @ ± 4.0 MHz -80 dBc @ ± 6.0 MHz TX: -45 dBc @ ± 2.0 MHz -70 dBc @ ± 3.0 MHz -80 dBc @ ± 4.0 MHz
Broadband Noise:	-135 dBm/Hz @ ± 4.0 MHz	-140 dBm/Hz @ ± 4.0 MHz	-140 dBm/Hz @ ± 4.0 MHz
Harmonics (Typical):	-70 dBc (2 nd , 3 rd harmonic) -80 dBc (others)		
Spurious:	Receive: -112 dBm (< 300 kHz) -80 dBm (elsewhere) Transmit: -80 dBm (2 to 4 MHz) -100 dBm (4 to 10 MHz) -110 dBm (elsewhere in-band) -130 dBm (elsewhere out-of-band)		
Tuning Speed:	300 μS (UHF LOS) 200 μS (VHF)		
Power:	115 VAC, 3-Phase, 400 Hz, 900 VA		
Operating Temperature Range:	0° to +50°C		
Size:	7.0 × 18 × 20.0 (in.) 178 × 457 × 509 (mm.)		
Weight:	69 lbs. / 31.30 kg.		

The **ICE5002** is a highly integrated tunable V/UHF Cosite Filter/Amplifier providing state-of-the-art performance for cosite applications. We have incorporated several of our cutting-edge technologies into this design, and it represents our highest performance subsystem.

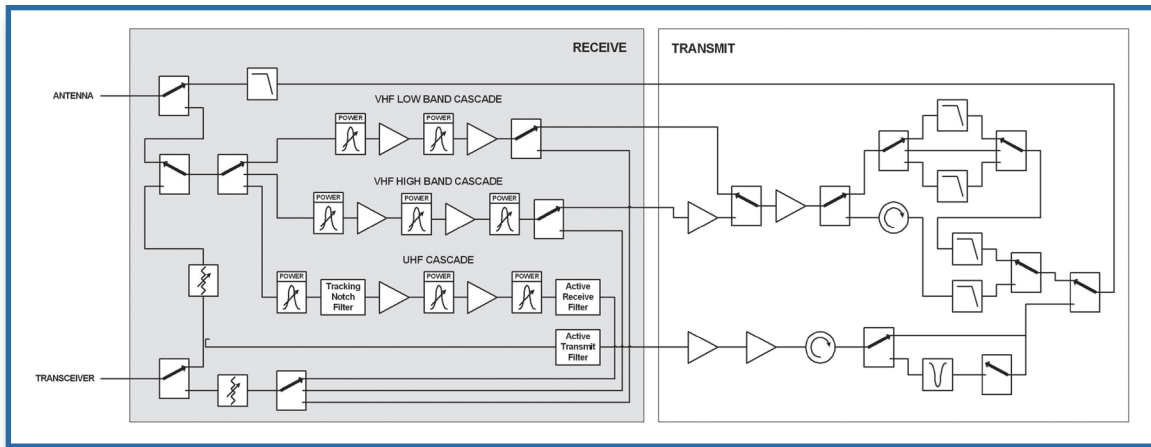
In addition to the specifications above, the **ICE5002** also provides a separate 121.5 MHz Guard Filter which provides selectivity of -50 dB at 4 MHz and a minimum gain of 3 dB with a maximum noise figure of only 9 dB. The **ICE5002** is offered in two versatile models; one covering 30 to 88 MHz, 118 to 174 MHz and 225 to 400 MHz in receive; the other covering 30 to 88 MHz, 108 to 174 MHz and 225 to 406.25 MHz in receive. The design incorporates a flexible control scheme that can be configured at the factory for various radio interfaces including the ARC-210 and ARC-232. A mounting tray is available as an option for easy incorporation on your platform.

Cost-effective modifications are available on the **ICE5002**. Please contact your sales representative at 513-870-9060 for further details.

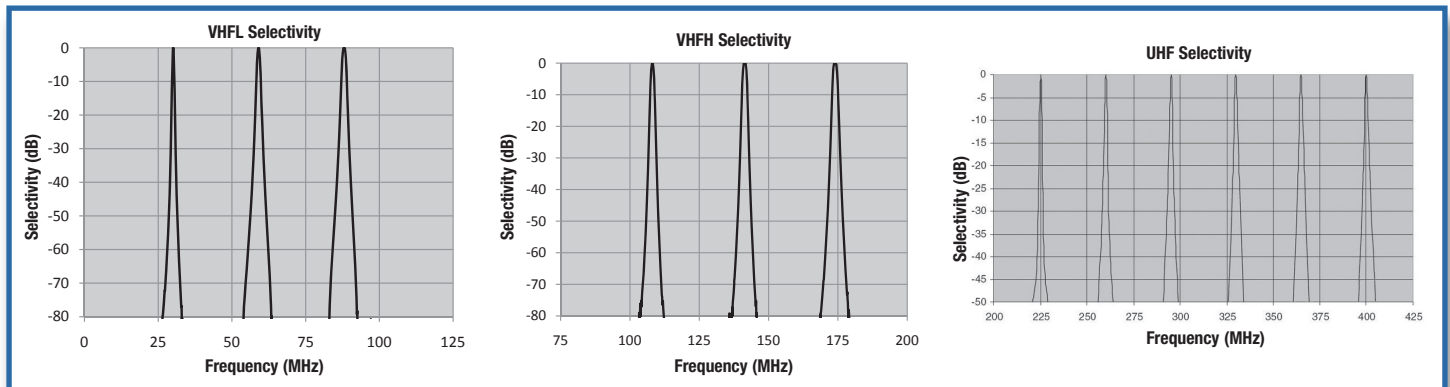


Block Diagram:

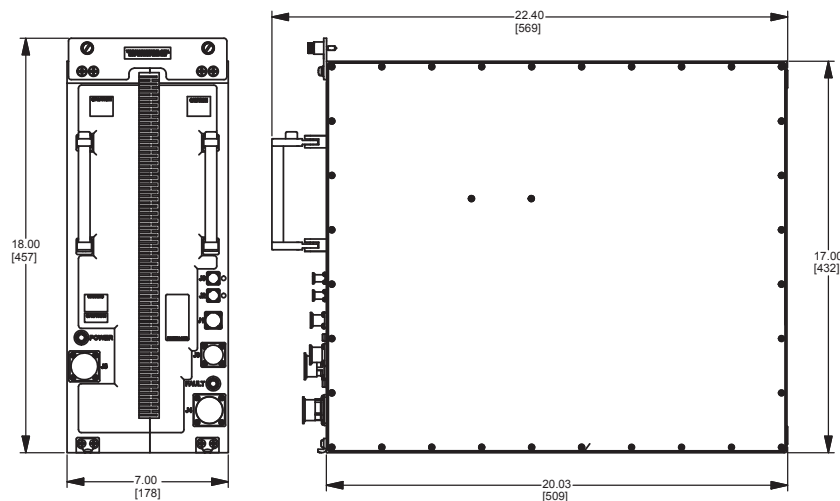
The ICE5002 is comprised of 24 separate modules including an input switching module, filter/LNAs, power amplifiers and power supply modules. The block diagram below is provided to convey the basic function of the ICE5002. Please contact Pole/Zero® for additional details.



Performance:



Chassis Outline:



Data is believed to be accurate. All data is subject to change without notice.

SATCOM LNA

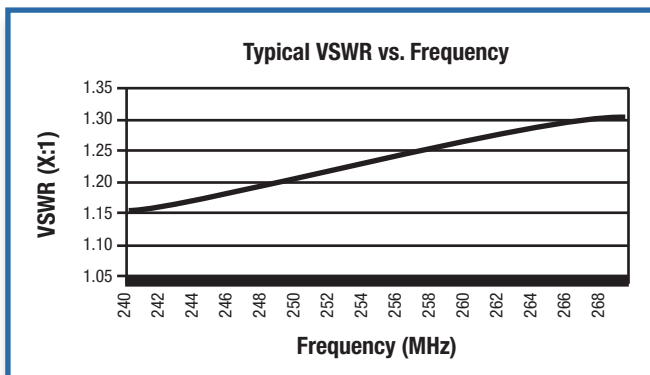
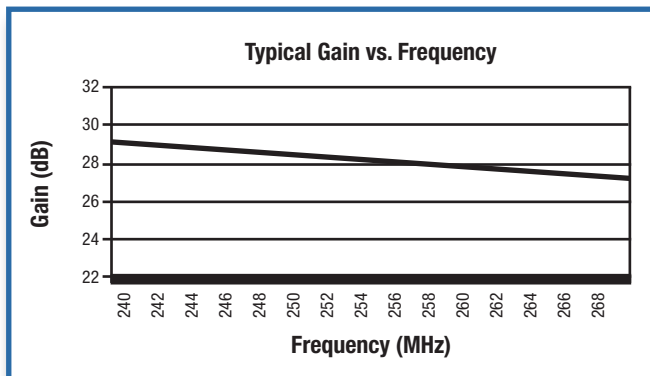
Specifications:

Part Number:	138750
Frequency coverage:	243 to 270 MHz
Noise Figure:	2.0 dB max.
VSWR:	1.35:1 max.
OIP3:	+50 dBm (two tone test)
RF Connectors:	RF In: SMA Female (J1) RF Out: SMA Female (J2)
DC Power Connector:	9-pin Male D-subminiature (P1) (P1 pin1 GND, P1 pin5 +24 VDC ± 5%)

Note: P1 includes Amp locking posts

Typical Performance:

The plots below are provided in order to demonstrate typical performance available from the Low Noise Amplifier (LNA) (illustrated performance is typical, not guaranteed).

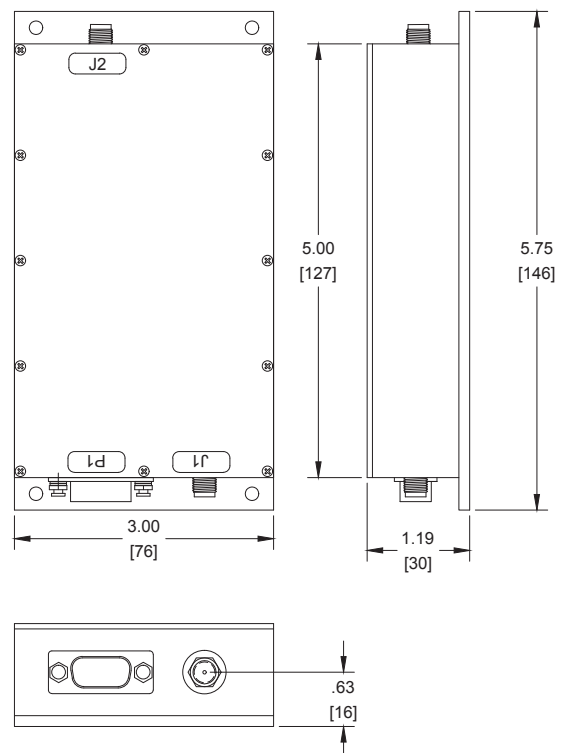


Pole/Zero® designs and manufactures low noise amplifiers (LNAs) for applications throughout the RF spectrum, from HF to above 1 GHz. These LNAs are utilized extensively as additional building blocks within our Integrated Cosite Equipment (ICE). They are also available as individual elements to support your RF system. The products on the following pages are offered as a sampling of our LNA capabilities. Please call the factory with your specific needs.

RF Power Handling Capability:

The amplifier is designed to provide highly linear, low noise performance for SATCOM applications. The high gain and strong signal handling capability makes it an ideal choice for significantly increasing SATCOM link margins in an environment with potential cosite interference issues.

Chassis Outline:



SATCOM LIMITER AMPLIFIER

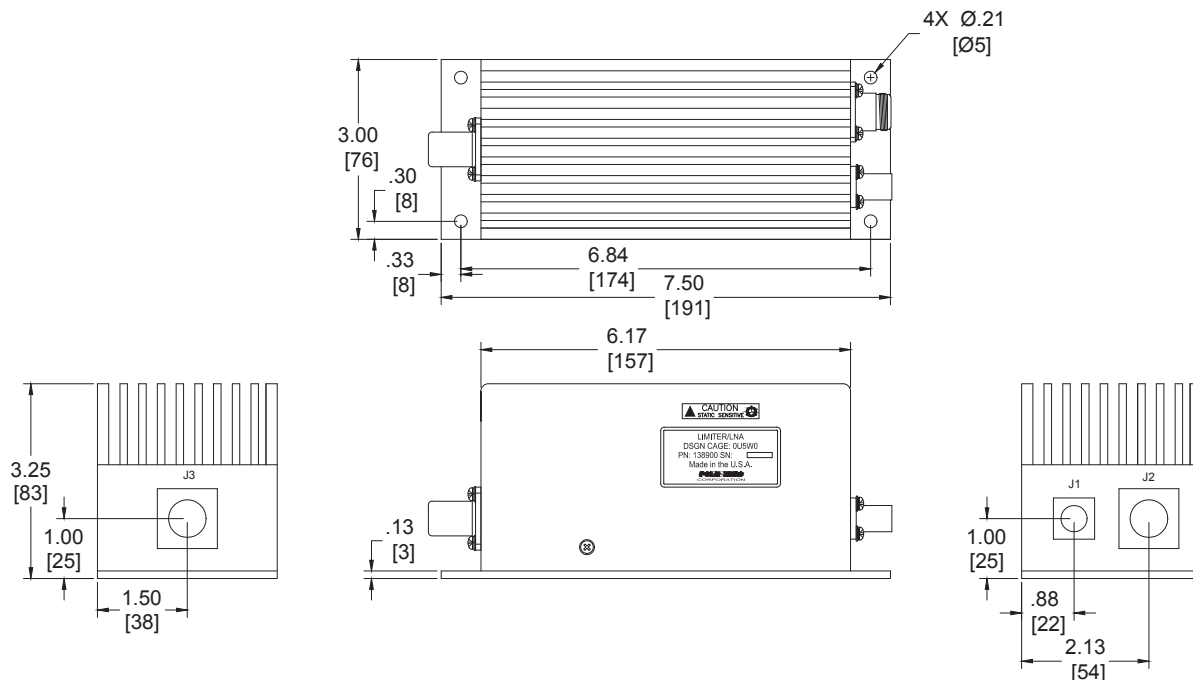
Specifications:

Part Number:	138900
Frequency Coverage:	243 to 270 MHz
Gain:	19.5 ± 1 dB
Noise Figure:	1.8 dB
RF Output Power Limiting:	< 35 dBm (< 45 dBm for initial 20 us)
Input/Output Impedance:	50Ω
Modulation Types:	FM, FSK, PSK
DC Power:	+28 VDC @ 1800 mA max.
Operating Temperature Range:	0° to +50°C
RF Connectors:	RF In: TNC Female (J1) RF Out: N Female (J2)
DC Power Connector:	M38999/42WB99PN (J3) (7-pin Circular)



The **SATCOM LIMITER AMPLIFIER** provides exceptional receive sensitivity and system overload protection in the presence of large interfering signals. Operating over the 243 to 270 MHz SATCOM receive band, the Limiter/Amp provides less than 1.8 dB noise figure, greater than 14 dB return loss, 19.5 ± 1 dB gain and 48 dBm OIP3, while limiting output power under extreme conditions to +35 dBm. Various frequency ranges and limiting levels are also available as a factory set option.

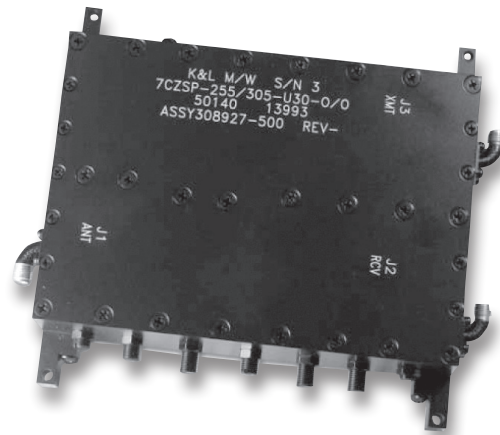
Chassis Outline:



Diplexer 7 Section

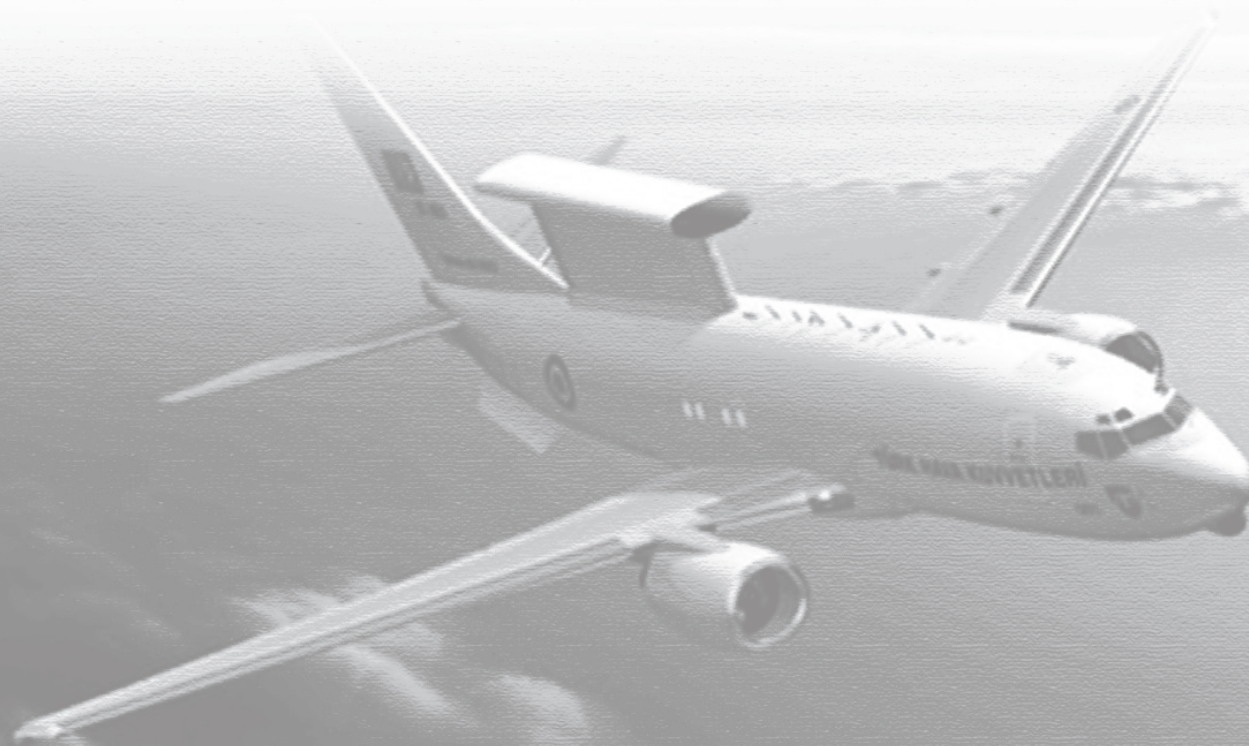
Specifications:

Part Number:	7CZSP-255/305-30-0
Center Frequency:	Rx: 256.5 MHz nominal Tx: 305.5 MHz nominal
Passband:	Rx: 243 to 270 MHz Tx: 292 to 318 MHz
Insertion Loss:	1.0 dB over Rx/Tx Passbands
VSWR:	Rx: 1.5:1 Over Passband Tx: 1.4:1 Over Passband
Stopband Rx:	-50 dB over 0 to 130 MHz -40 dB over 130 to 190 MHz -65 dB over 292 to 300 MHz -73 dB over 300 to 675 MHz
Tx:	-50 dB over 0 to 270 MHz -50 dB over 360 to 900 MHz
Isolation:	-80 dB over 2 to 228 MHz -50 dB over 243 to 270 MHz -50 dB over 292 to 400 MHz
Power Handling:	100 Watts
Weight:	2 lbs. / .91 kg.
Operating Temperature:	40° to +65°C
Size:	1.54 × 3.73 × 5.55 (in.) / 39.12 × 94.74 × 140.97 (mm.)
Environmental Testing:	As Required

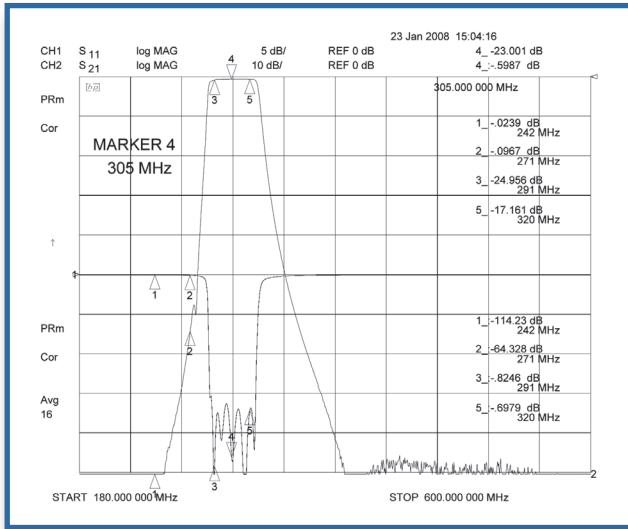


Qualification Information:

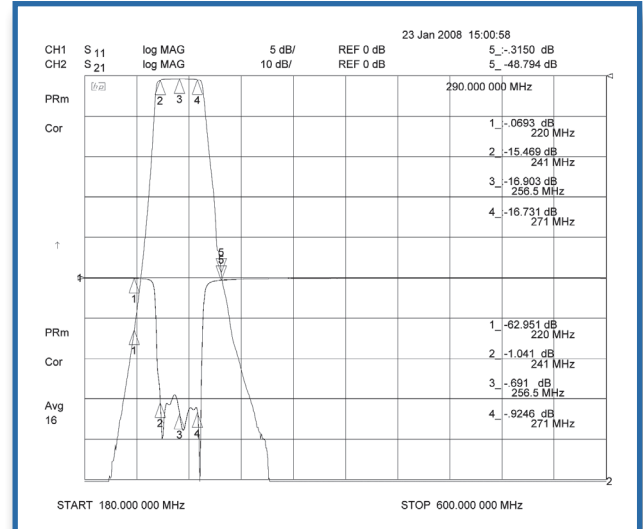
- Vibration per MIL-STD-810E; 6000 miles and vibration levels per Table 514.4-AXIX of MIL-STD-810E
- Shock
 - 18 saw tooth shock pulses of 40 +/- 4 G's, duration 11 milliseconds applied in both directions of each of three axes. MIL-STD 810E Method 516.3 procedure I
 - Ballistic Shock per MIL-S-901D



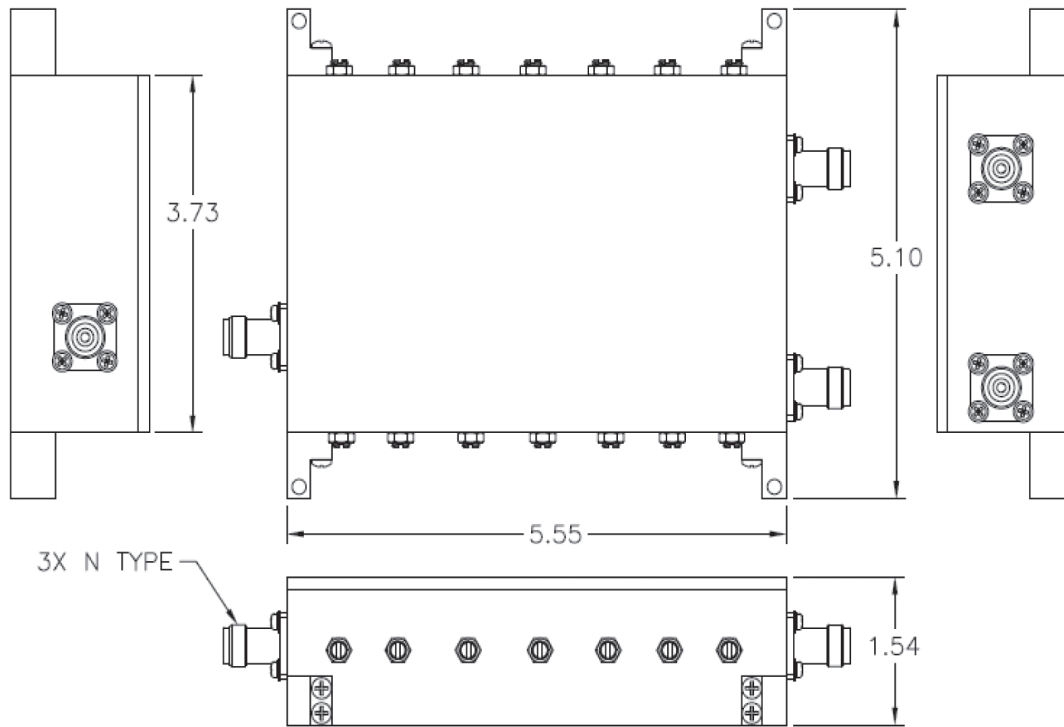
TX Path & Rejection:



RX Path & Rejection:



Chassis Outline:



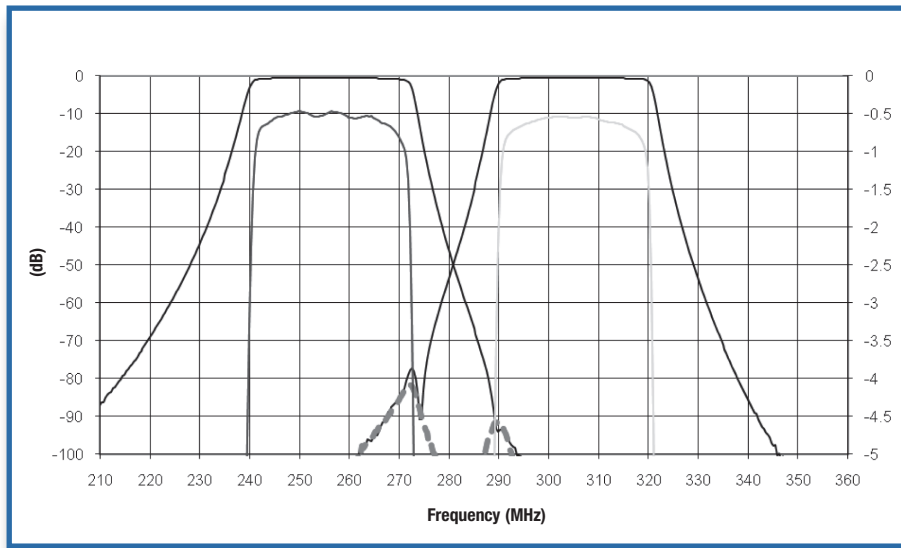
Diplexer 9 Section

Specifications:

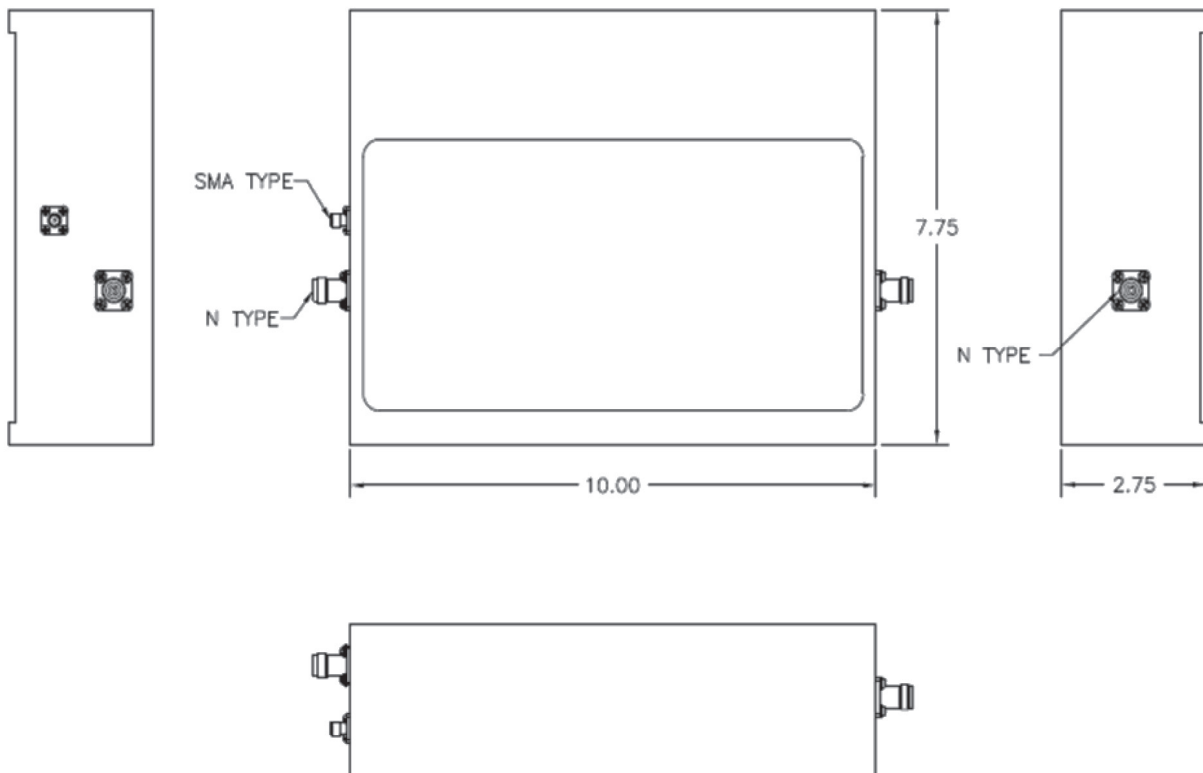
Part Number:	9FZSP-243/318	
Operation:	Transmit or Receive	
Frequency Coverage:	Rx: 256.5 MHz	Tx: 304.65 MHz
Insertion Loss:	Rx: 1.0 dB over 243 to 270 MHz	Tx: 1.0 dB over 291 to 318.3 MHz
VSWR:	Rx: 1.5:1 max. 243 to 270 MHz	Tx: 1.5:1 max. 291 to 318.3 MHz
Rejection:	Rx: 50 dB over 30 to 225 MHz 85 dB over 290 to 400 MHz	Tx: 75 dB over 30 to 270 MHz 80 dB over 340 to 400 MHz
Power Handling:	200 Watts	
Weight:	10 lbs. max. / 4.54 kg.	
Operating Temperature Range:	0° to +65° C	
Size:	2.75 × 7.75 × 10 (in.) / 69.85 × 196.85 × 254 (mm.)	



Performance:



Chassis Outline:



Cross Band Cosite Filtering

Specifications:

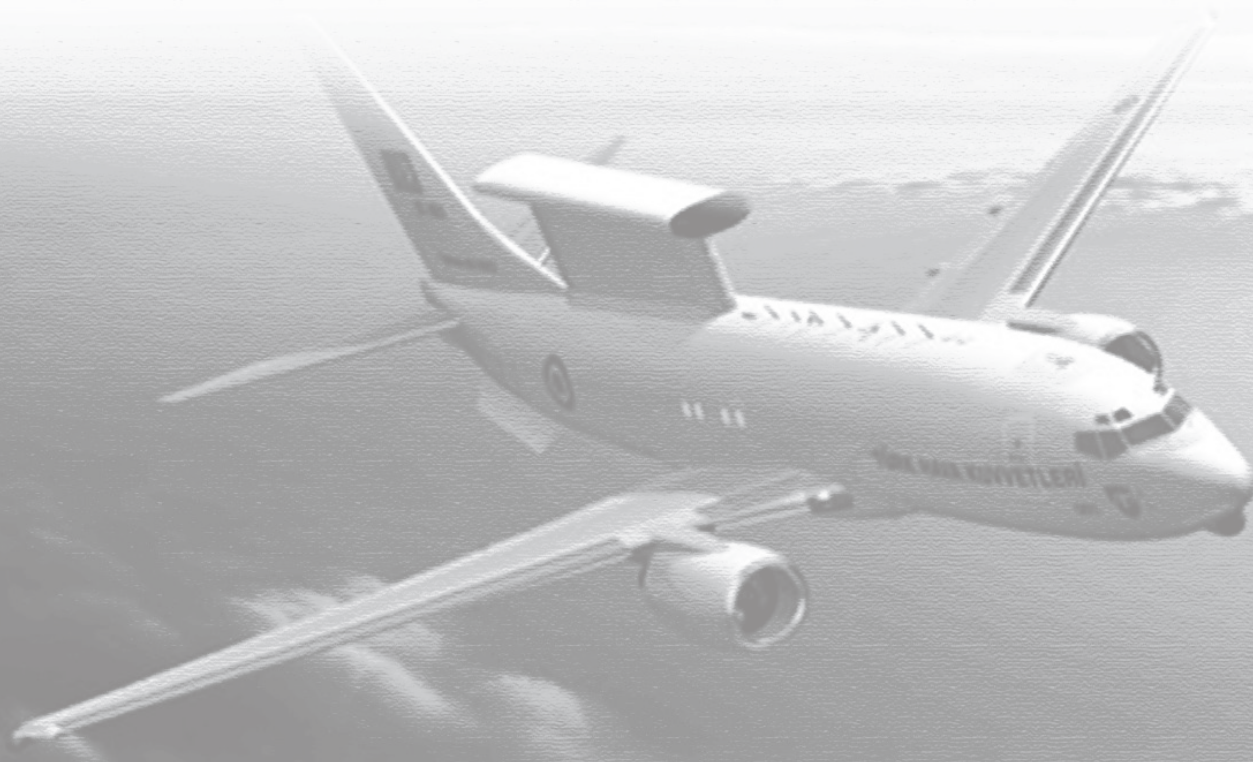
Part Number:	5LL50-88/400-N
Filter Passband:	30 to 88 MHz
Filter Form:	LPF
Passband Loss:	.5 dB max.
Rejection:	30 dB @ 108 MHz 40 dB @ 118 to 174 MHz 40 dB @ 225 to 400 MHz
Power Handling:	100 Watts
Operating Temperature Range:	-40° to +85°C
Size:	4.50 × 1.25 × 1.0 (in.) / 114.3 × 31.75 × 25.4 (mm.)

Part Number:	5LB50-132/48-N
Filter Passband:	108 to 156 MHz
Filter Form:	BPF
Passband Loss:	.5 dB max.
Rejection:	30 dB @ 30 to 88 MHz 30 dB @ 225 to 400 MHz
Power Handling:	100 Watts
Operating Temperature Range:	-40° to +85°C
Size:	4.50 × 1.25 × 1.0 (in.) / 114.3 × 31.75 × 25.4 (mm.)

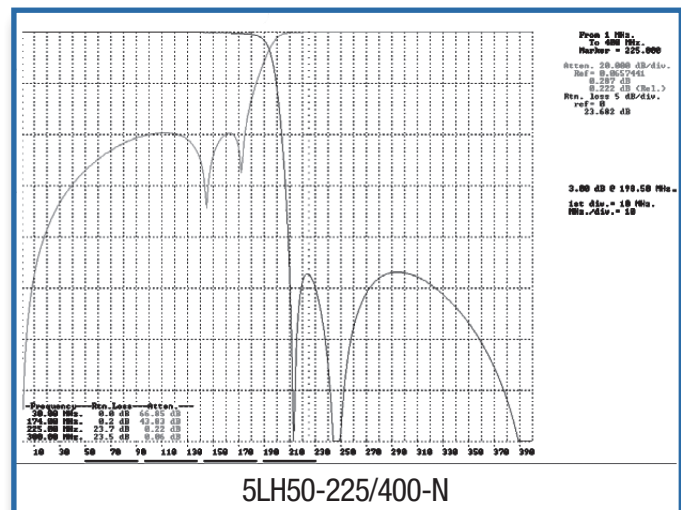
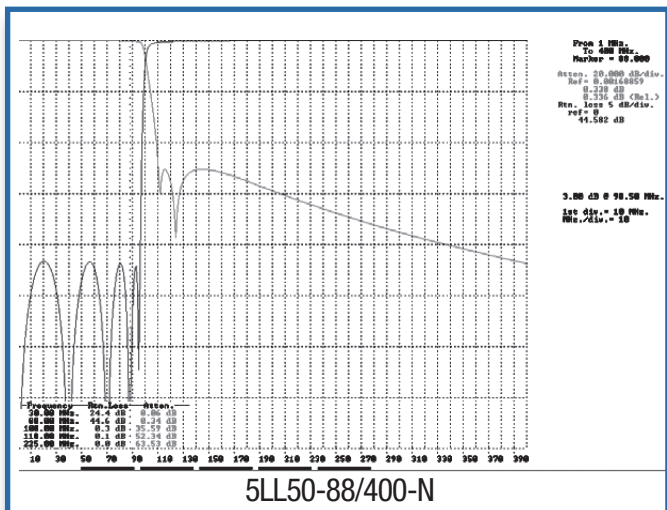
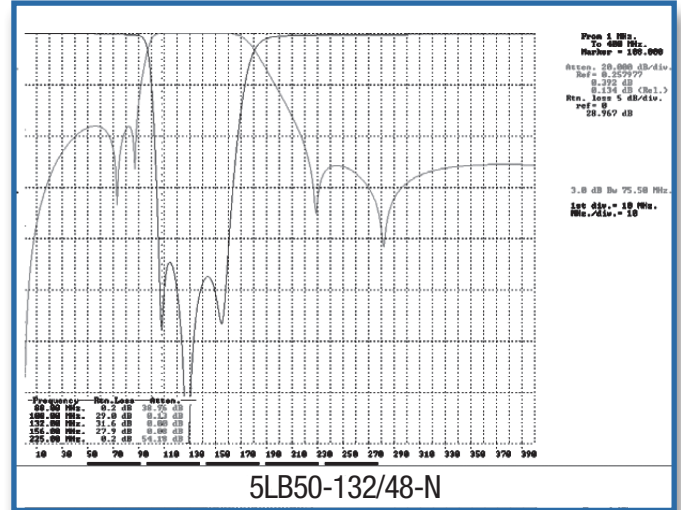
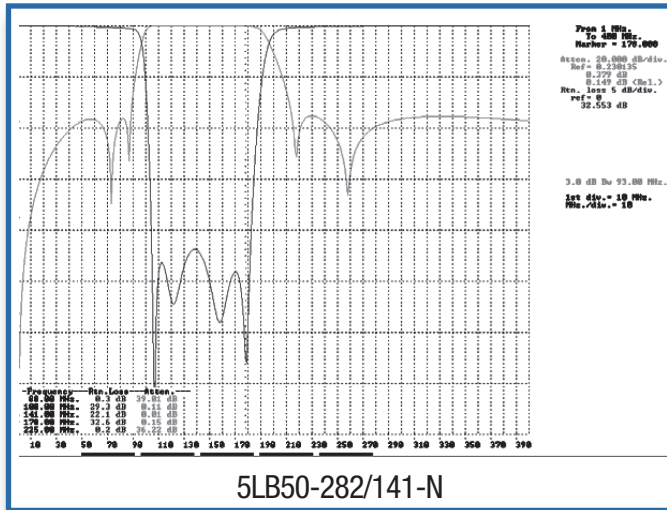
Part Number:	5LB50-282/141-N
Filter Passband:	108 to 174 MHz
Filter Form:	BPF
Passband Loss:	.5 dB max.
Rejection:	30 dB @ 30 to 88 MHz 30 dB @ 225 to 400 MHz
Power Handling:	100 Watts
Operating Temperature Range:	-40° to +85°C
Size:	4.50 × 1.25 × 1.0 (in.) / 114.3 × 31.75 × 25.4 (mm.)

Part Number:	5LH50-225/400-N
Filter Passband:	225 to 400 MHz
Filter Form:	HPF
Passband Loss:	.5 dB max.
Rejection:	30 dB @ 30 to 174 MHz
Power Handling:	100 Watts
Operating Temperature Range:	-40° to +85°C
Size:	1.5 × 1.0 × 1.0 (in.) / 38.1 × 25.4 × 25.4 (mm.)

MIL-STD 810 vibration and shock

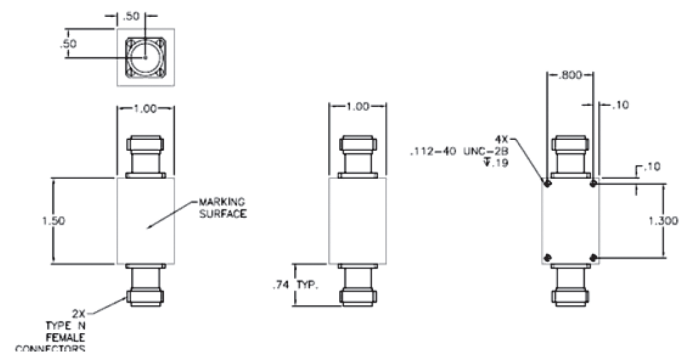
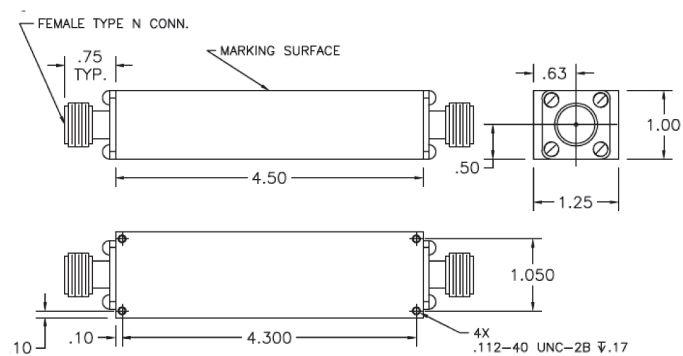


Performance:



Chassis Outline: 5LL50-88/400-N
 5LB50-132/48-N
 5LB50-282/141-N

5LH50-225/400-N

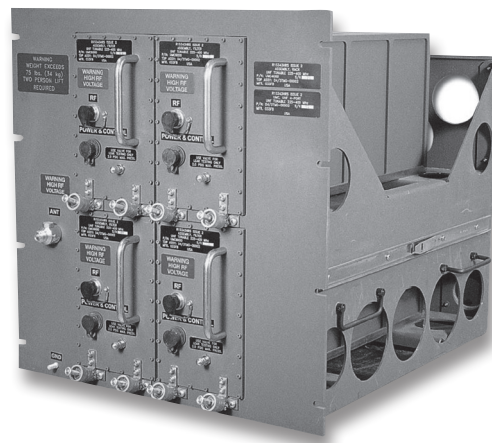


VHF & UHF Four Port Digitally Controlled Tunable Multicouplers

Specifications:

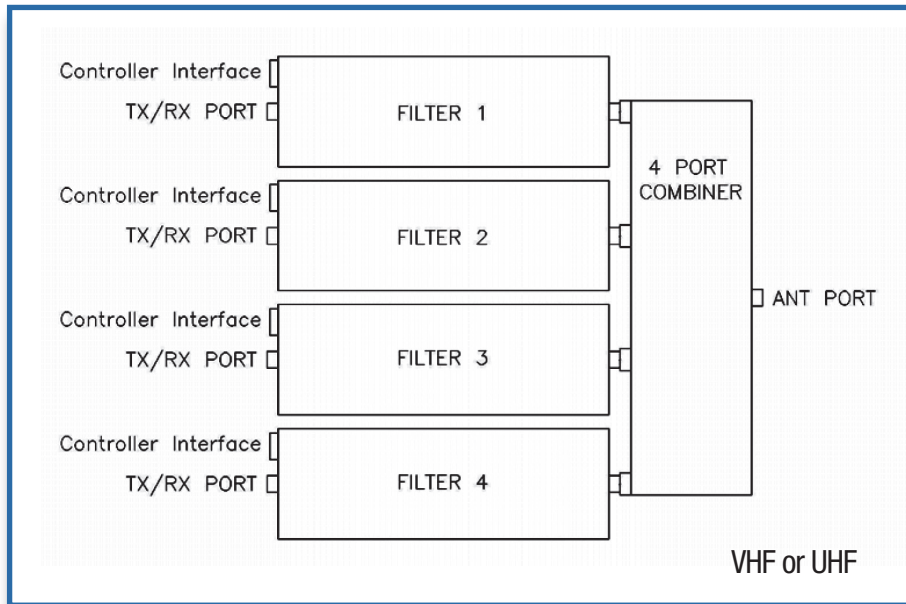
Part Number:	TMC-100/160
Operation:	Half duplex, transmit & receive, four-port multicoupler
Frequency Coverage:	100 to 160 MHz
Bandwidth:	0.7, 1.0 or 2.0% of Fc, nominal, -3 dB
Insertion Loss:	2.5, 2.0 or 1.5 dB, respectively, max. @ min. Co-channel separation
Co-channel Separation for 50 dB isolation:	+ 3.0, 4.0 or 8.0%, respectively, min.
Power Handling:	60 Watts avg., 160 Watts pk. per channel
Minimum Channel Separation:	4 MHz
Shape Factor (30 dB / 3 dB):	3.1 nominal
Ultimate Isolation:	80 dB, min.
Tuning Speed:	10 sec. max.
Power:	24 VDC Input
Standby:	24 Watts
Peak:	200 Watts
Weight:	145 lbs. nominal / 65.78 kg.
Operating Temperature Range:	0° to +50°C
Size:	20 × 20 × 25 (in.) / 508 × 508 × 635 (mm.)

Part Number:	TMC-225/400
Operation:	Half duplex, transmit & receive, four-port multicoupler
Frequency Coverage:	225 to 400 MHz
Bandwidth:	0.3, 1.0 or 2.0% of Fc, nominal, -3 dB
Insertion Loss:	2.5, 2.0 or 1.5 dB, respectively, max. @ min. Co-channel separation
Co-channel Separation for 50 dB isolation:	+ 2.0, 4.0 or 8.0%, respectively, min.
Power Handling:	100 Watts pk. per channel
Min. Channel Separation:	5 MHz
Shape Factor (30 dB / 3 dB):	3.5:1 nominal, 4.5:1 max.
Ultimate Isolation:	80 dB, min.
Tuning Speed:	10 sec. max.
Power:	24 VDC Input
Standby:	24 Watts
Peak:	200 Watts
Weight:	145 lbs. nominal / 65.78 kg.
Operating Temperature Range:	0° to +50°C
Size:	20 × 20 × 25 (in.) / 508 × 508 × 635 (mm.)

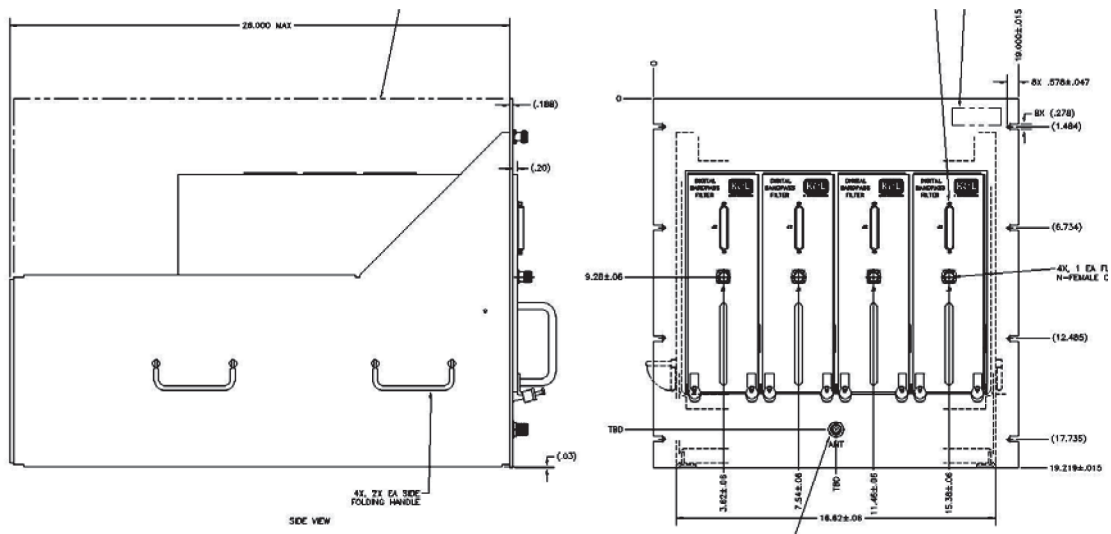


The TMC-100/160 are **TUNABLE MULTICOUPLERS** enabling up to four transceivers to operate simultaneously in transmission and reception mode using a common antenna. The four digitally controlled bandpass filters within the **MULTICOUPLERS** cover the VHF or UHF communication band. Each filter is a three pole design to provide high selectivity with a nominal 3 dB bandwidth of 0.7 (VHF), 0.3 (UHF), 1.0 or 2.0%. Each filter is controlled remotely through an independent digital interface. When a frequency command is received control circuitry drives a stepper motor to properly position the filter shaft. The **MULTICOUPLERS** may be optimized for custom interface, mechanical and performance requirements.

Block Diagram:



Chassis Outline:



ATTENUATION – The reduction in amplitude, measured in dB, of a signal passing through a dissipative network or other medium.

BANDWIDTH – The width in frequency of a filter's response, typically measured between the 3 dB points.

BANDPASS FILTER – A filter that passes one band of frequencies, while rejecting both higher and lower frequencies.

BUTTERWORTH FILTER – A filter with a maximally flat (minimum ripple) amplitude response in the passband.

CENTER FREQUENCY (f_0) – A measure of the central frequency, between the upper and lower cutoff frequencies. It can be defined as either the arithmetic mean or geometric mean.

$$\text{Arithmetically: } f_0 = (f_1 + f_2) / 2$$

$$\text{Geometrically: } f_0 = \sqrt{f_1 \times f_2}$$

COSITE INTERFERENCE – Interference, typically self-generated, in communication systems caused by transceivers located within close proximity to one another without appropriate isolation.

DECIBEL – A logarithmic unit of measurement expressing signal magnitude relative to a specified or implied reference level.

FALL TIME – The time required for a signal to change from a specified high value to a specified low value, typically defined as 90% and 10% of the steady state value.

FILTER Q – The Q Factor (Quality Factor) is a dimensionless parameter giving an indication of the 'quality' of a filter.

$$Q = f_0 / 3 \text{ dB bandwidth}$$

INSERTION LOSS – The decrease in transmitted signal power resulting from the insertion of a device. It is usually expressed relative to the signal power delivered to that same part before insertion, and is usually expressed in decibels (dB).

NOTCH FILTER – A filter that rejects one band of frequencies, while passing both higher and lower frequencies. Also known as a band reject filter.

PASSBAND – The range of frequencies that can be passed through a filter, bounded by limits often specified as the half-power points (i.e. 3 dB below the nominal).

PERCENT BANDWIDTH – The width of a filter's response between the 3 dB points, based on a percentage of the center frequency.

RESPONSE – A description of how a filter reacts to input signals versus frequency, and is defined as the ratio of the input signal compared to the output signal.

RISE TIME – The time required for a signal to change from a specified low value to a specified high value, typically defined as 10% and 90% of the steady state value.

SELECTIVITY – A measure of the attenuation provided at frequencies removed from the center frequency relative to the center frequency response.

SHAPE FACTOR – A dimensionless parameter giving an indication of the amount of selectivity provided by a given filter. Typically calculated as the ratio between the 30 dB bandwidth and 3 dB bandwidth.

The Effect of VSWR on Transmitted Power											
VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt Refl. Coeff.	Power Trans. (%)	Power Refl. (%)	VSWR	Return Loss (dB)	Trans. Loss (dB)	Volt Refl. Coeff.	Power Trans. (%)	Power Refl. (%)
1.00	∞	.000	.00	100.0	.0	1.60	12.7	.238	.23	94.7	5.3
1.01	46.1	.000	.00	100.0	.0	1.62	12.5	.250	.24	94.4	5.6
1.02	40.1	.000	.01	100.0	.0	1.64	12.3	.263	.24	94.1	5.9
1.03	36.6	.001	.01	100.0	.0	1.66	12.1	.276	.25	93.8	6.2
1.04	34.2	.002	.02	100.0	.0	1.68	11.9	.289	.25	93.6	6.4
1.05	32.3	.003	.02	99.9	.1	1.70	11.7	.302	.26	93.3	6.7
1.06	30.4	.004	.03	99.9	.1	1.72	11.5	.315	.26	93.0	7.0
1.07	29.4	.005	.03	99.9	.1	1.74	11.4	.329	.27	92.7	7.3
1.08	28.3	.006	.04	99.9	.1	1.76	11.2	.342	.28	92.4	7.6
1.09	27.3	.008	.04	99.8	.2	1.78	11.0	.356	.28	92.1	7.9
1.10	26.4	.010	.05	99.8	.2	1.80	10.9	.370	.29	91.8	8.2
1.11	25.7	.012	.05	99.7	.3	1.82	10.7	.384	.29	91.5	8.5
1.12	24.9	.014	.06	99.7	.3	1.84	10.6	.398	.30	91.3	8.7
1.13	24.3	.016	.06	99.6	.4	1.86	10.4	.412	.30	91.0	9.0
1.14	23.7	.019	.07	99.6	.4	1.88	10.3	.426	.31	90.7	9.3
1.15	23.1	.021	.07	99.5	.5	1.90	10.2	.440	.31	90.4	9.6
1.16	22.6	.024	.07	99.5	.5	1.92	10.0	.454	.32	90.1	9.9
1.17	22.1	.027	.08	99.4	.6	1.94	9.9	.468	.32	89.8	10.2
1.18	21.7	.030	.08	99.3	.7	1.96	9.8	.483	.32	89.5	10.5
1.19	21.2	.033	.09	99.2	.8	1.98	9.7	.497	.33	89.2	10.8
1.20	20.8	.036	.09	99.2	.8	2.00	9.5	.512	.33	88.9	11.1
1.21	20.4	.039	.10	99.1	.9	2.50	7.4	.881	.43	81.6	18.4
1.22	20.1	.043	.10	99.0	1.0	3.00	6.0	1.249	.50	75.0	25.0
1.23	19.7	.046	.10	98.9	1.1	3.50	5.1	1.603	.56	69.1	30.9
1.24	19.4	.050	.11	98.9	1.1	4.00	4.4	1.938	.60	64.0	36.0
						4.50	3.9	2.255	.64	59.5	40.5
1.25	19.1	.054	.11	98.8	1.2	5.00	3.5	2.553	.67	55.6	44.4
1.26	18.8	.058	.12	98.7	1.3	5.50	3.2	2.834	.69	52.1	47.9
1.27	18.5	.062	.12	98.6	1.4	6.00	2.9	3.100	.71	49.0	51.0
1.28	18.2	.066	.12	98.5	1.5	6.50	2.7	3.351	.73	46.2	53.8
1.29	17.9	.070	.13	98.4	1.6	7.00	2.5	3.590	.75	43.7	56.2
						7.50	2.3	3.817	.76	41.5	58.5
1.30	17.7	.075	.13	98.3	1.7	8.00	2.2	4.033	.78	39.5	60.5
1.32	17.2	.083	.14	98.1	1.9	8.50	2.1	4.240	.79	37.7	62.3
1.34	16.8	.093	.15	97.9	2.1	9.00	1.9	4.437	.80	36.0	64.0
1.36	16.3	.102	.15	97.7	2.3	9.50	1.8	4.626	.81	34.5	65.5
1.38	15.9	.112	.16	97.5	2.5	10.00	1.7	4.807	.82	33.1	66.9
						11.00	1.6	5.149	.83	30.6	69.4
1.40	15.6	.122	.17	97.2	2.8	12.00	1.5	5.466	.85	28.4	71.6
1.42	15.2	.133	.17	97.0	3.0	13.00	1.3	5.762	.86	26.5	73.5
1.44	14.9	.144	.18	96.7	3.3	14.00	1.2	6.042	.87	24.9	75.1
1.46	14.6	.155	.19	96.5	3.5	15.00	1.2	6.301	.88	23.4	76.6
1.48	14.3	.166	.19	96.3	3.7	16.00	1.1	6.547	.88	22.1	77.9
						17.00	1.0	6.780	.89	21.0	79.0
1.50	14.0	.177	.20	96.0	4.0	18.00	1.0	7.002	.89	19.9	80.1
1.52	13.7	.189	.21	95.7	4.3	19.00	0.9	7.212	.90	19.0	81.0
1.54	13.4	.201	.21	95.5	4.5	20.00	0.9	7.413	.90	18.1	81.9
1.56	13.2	.213	.22	95.2	4.8	25.00	0.7	8.299	.92	14.8	85.2
1.58	13.0	.225	.22	94.9	5.1	30.00	0.6	9.035	.94	12.5	87.5

Decibels-Volts-Watts Conversion Table, 50-ohm System Terminated

dBm	V	Po	dBm	mV	Po	dBm	μ V	Po	dBm	nV	Po
+53	100.0	200 W									
+50	70.7	100 W	0	225	1.0 mW	-50	710	.01 μ W	-100	2250	.1 pW
+49	64.0	80 W	-1	200	.80 mW	-51	640		-101	2000	
+48	58.0	64 W	-2	180	.64 mW	-52	570		-102	1800	
+47	50.0	50 W	-3	160	.50 mW	-53	500		-103	1600	
+46	44.5	40 W	-4	141	.40 mW	-54	450		-104	1410	
+45	40.0	32 W	-5	125	.32 mW	-55	400		-105	1270	
+44	35.4	25 W	-6	115	.25 mW	-56	355		-106	1180	
+43	32.0	20 W	-7	100	.20 mW	-57	320		-107	1000	
+42	28.0	16 W	-8	90.0	.16 mW	-58	280		-108	900	
+41	26.2	12.5 W	-9	80.0	.125 mW	-59	251		-109	800	
+40	22.5	10 W	-10	71.0	.10 mW	-60	225	.001 μ W	-110	710	.01 pW
+39	20.0	8 W	-11	64.0		-61	200		-111	640	
+38	18.0	6.4 W	-12	58.0		-62	180		-112	580	
+37	16.0	5 W	-13	50.0		-63	160		-113	500	
+36	14.1	4 W	-14	44.5		-64	141		-114	450	
+35	12.5	3.2 W	-15	40.0		-65	128		-115	400	
+34	11.5	2.5 W	-16	35.5		-66	115		-116	355	
+33	10.0	2 W	-17	31.5		-67	100		-117	320	
+32	9.0	1.6 W	-18	28.5		-68	90		-118	285	
+31	8.0	1.25 W	-19	25.1		-69	80		-119	251	
+30	7.10	1.0 W	-20	22.5	.01 mW	-70	71	.1 nW	-120	225	.001 pW
+29	6.40	800 mW	-21	20.0		-71	65		-121	200	
+28	5.80	640 mW	-22	17.9		-72	58		-122	180	
+27	5.00	500 mW	-23	15.9		-73	50		-123	160	
+26	4.45	400 mW	-24	14.1		-74	45		-124	141	
+25	4.00	320 mW	-25	12.8		-75	40		-125	128	
+24	3.55	250 mW	-26	11.5		-76	35		-126	117	
+23	3.20	200 mW	-27	10.0		-77	32		-127	100	
+22	2.80	160 mW	-28	8.9		-78	29		-128	90	
+21	2.52	125 mW	-29	8.0		-79	25		-129	80	
+20	2.25	100 mW	-30	7.1	.001 mW	-80	22.5	.01 nW	-130	71	.1 fW
+19	2.00	80 mW	-31	6.25		-81	20.0		-131	61	
+18	1.80	64 mW	-32	5.8		-82	18.0		-132	58	
+17	1.60	50 mW	-33	5.0		-83	16.0		-133	50	
+16	1.41	40 mW	-34	4.5		-84	11.1		-134	45	
+15	1.25	32 mW	-35	4.0		-85	12.9		-135	40	
+14	1.15	25 mW	-36	3.5		-86	11.5		-136	35	
+13	1.00	20 mW	-37	3.2		-87	10.0		-137	33	
+12	.90	16 mW	-38	2.85		-88	9.0		-138	29	
+11	.80	12.5 mW	-39	2.5		-89	8.0		-139	25	
+10	.71	10 mW	-40	2.25	.1 μ W	-90	7.1	.001 nW	-140	23	.01 fW
+9	.64	8 mW	-41	2.0		-91	6.1				
+8	.58	6.4 mW	-42	1.8		-92	5.75				
+7	.500	5 mW	-43	1.6		-93	5.0				
+6	.445	4 mW	-44	1.4		-94	4.5				
+5	.400	3.2 mW	-45	1.25		-95	4.0				
+4	.355	2.5 mW	-46	1.18		-96	3.51				
+3	.320	2.0 mW	-47	1.00		-97	3.2				
+2	.280	1.6 mW	-48	.90		-98	2.9				
+1	.252	1.25 mW	-49	.80		-99	2.51				

Fraction-Decimal-Millimeter Conversion Table

Fraction	Decimal	Millimeter	Fraction	Decimal	Millimeter
1/64	.015625	0.397	33/64	.515625	13.097
1/32	.03125	0.794	17/32	.53125	13.494
3/64	.046875	1.191	35/64	.546875	13.891
1/16	.0625	1.588	9/16	.5625	14.288
5/64	.078125	1.984	37/64	.578125	14.684
3/32	.09375	2.381	19/32	.59375	15.081
7/64	.109375	2.778	39/64	.609375	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.140625	3.572	41/64	.640625	16.272
5/32	.15625	3.969	21/32	.65625	16.669
11/64	.171875	4.366	43/64	.671875	17.066
3/16	.1875	4.762	11/16	.6875	17.462
13/64	.203125	5.159	45/64	.703125	17.859
7/32	.21875	5.556	23/32	.71875	18.256
15/64	.234375	5.953	47/64	.734375	18.653
1/4	.250	6.350	3/4	.750	19.050
17/64	.265625	6.747	49/64	.765625	19.447
9/32	.28125	7.144	25/32	.78125	19.844
19/64	.296875	7.541	51/64	.796875	20.241
5/16	.3125	7.938	13/16	.8125	20.638
21/64	.328125	8.334	53/64	.828125	21.034
11/32	.34375	8.731	27/32	.84375	21.431
23/64	.359375	9.128	55/64	.859375	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.390625	9.921	57/64	.890625	22.622
13/32	.40625	10.319	29/32	.90625	23.019
27/64	.421875	10.716	59/64	.921875	23.416
7/16	.4375	11.112	15/16	.9375	23.812
29/64	.453125	11.509	61/64	.953125	24.209
15/32	.46875	11.906	31/32	.96875	24.606
31/64	.484375	12.303	63/64	.984375	25.003
1/2	.500	12.700	1	1.00	25.400

Length-Mass Conversion Table

	1		2		3
<p>How to Use this Table:</p> <p>Find the term that you are currently using in Column 1.</p> <p>Multiply by the conversion factor in column 2 to obtain the equivalent in column 3.</p> <p>If you want to convert column 3 back to column 1, reverse the process by dividing by the conversion factor in column 2.</p>	Centimeters	×	0.3937	=	Inches
	Millimeters	×	0.03937	=	Inches
	Meters	×	39.37	=	Inches
	Feet	×	12	=	Inches
	Yards	×	36	=	Inches
	Inches	×	25.4	=	Millimeters
	Inches	×	25,400	=	Microns
	Meters	×	3.281	=	Feet
	Feet	×	0.3048	=	Meters
	Meters	×	1.093	=	Yards
	Yards	×	0.9144	=	Meters
	Kilometers	×	0.621	=	Miles
	Mile	×	1.609	=	Kilometers
	Mils	×	0.0254	=	Millimeters
	Microns	×	0.03937	=	Mils
	Grams	×	0.03527	=	Ounces
	Grams	×	0.0022	=	Pounds
	Pounds/Inch	×	17.512685	=	Newtons/100 Millimeters
	Ounces/Inch	×	10.94543	=	Newtons/Meter

Temperature Conversion

- To convert °C to °F, multiply by 1.8 and add 32
(ie. $100^{\circ}\text{C} \times 1.8 + 32 = 212^{\circ}\text{F}$)
- To convert °F to °C, subtract 32 and divide by 1.8
(ie. $212^{\circ}\text{F} - 32 / 1.8 = 100^{\circ}\text{C}$)

Representatives**US Representatives:***(Listed from East to West Coast)**Area: Upstate New York & New England***MMS, Inc.**

238 Littleton Road, Suite 207

Westford, MA 01886

Tel: 978.392.0110

Fax: 978.392.0220

Email: info@mmstechrep.com

Web: www.mmstechrep.com

*Area: New York City (vicinity),
Northern New Jersey, Long Island,
E. Pennsylvania & Connecticut***Tekmar Sales, Inc.**

10 Saddle Brook Court

Dix Hills, NY 11746

Tel: 631.254.9026

Fax: 631.254.9026

Email: joanne.littera@tekmarsales.com

Web: www.tekmarsales.com

*Area: Eastern Pennsylvania,
Southern New Jersey & Delaware***Eastern Instrumentation**

710 E. Main Street, Suite 1A

Moorestown, NJ 08057

N39 58.375, W74 55.067

Tel: 856.231.0668

Fax: 856.231.9022

Email: sales@eiphila.com

Web: www.eiphila.com

*Area: Maryland, Virginia, W. Virginia & DC***MHz Marketing, Inc.**

3060 Maryland Rt. 97, Suite 178

Glenwood, MD 21738

Tel: 410.489.9255

Fax: 410.489.9117

Email: insidesales@mhzmktg.com

Web: www.mhzmktg.com

*Area: Alabama, Florida, Georgia, N. Carolina,
S. Carolina, Tennessee & Mississippi***SPARTECH-South, Inc.**

2115 Palm Bay Road NE, Suite 4

Palm Bay, Florida 32905

Tel: 321.727.8045

Fax: 321.543.1841

Email: jim@spartech-south.com

Web: www.spartech-south.com

*Area: Indiana, Kentucky, Michigan,
Ohio & Western Pennsylvania***Micro Sales**

7442 Coventry Woods

Dublin, OH 43017

Tel: 614.792.9117

Fax: 614.792.9938

Email: info@micro-sales.com

Web: www.micro-sales.com

*Area: Illinois, Missouri, Iowa, Minnesota,
Kansas, Nebraska, N. Dakota, S. Dakota
& Wisconsin***KJS Marketing**

7954 Big Bend Blvd.

Webster Grove, MO 63119

Tel: 314.961.6885

Fax: 314.961.6881

Email: support@kjsmarketing.com

Web: www.kjsmarketing.com

*Area: Arizona & New Mexico***Saguaro Technical Sales Inc.**

4300 North Miller Road, Suite 121

Scottsdale, Arizona 85251

Tel: 480.947.3724

Fax: 480.947.3094

Email: artstsi@aol.com

*Area: Texas, Oklahoma, Arkansas & Louisiana***PMR Technical, LP**

6031 W. I-20, Suite 242

Arlington, TX 76017

Tel: 817.483.5676

Fax: 817.860.1633

Email: amber@pmrtexas.com

Web: www.pmrntexas.com

*Area: Southern California***Associated Technical Sales**

13681 Newport Avenue, Suite 8, #315

Tustin, CA 92780

Tel: 877.ATS.1REP (287-1737)

Fax: 714.242.9991

Email: sales@ats1rep.com

Web: www.ats1rep.com

*Area: Northern California & Nevada***NWN, Inc. LP**

1754 Technology Drive, Suite 142

San Jose, CA 95110

Tel: 408.437.2700

Fax: 408.437.2705

Email: sales@nwn-inc.com

Web: www.nwn-inc.com

International Representatives:*(Listed in alphabetical order by area)**Area: Australia***Alliance Electronics Pty Ltd.**

P.O. Box 8882

Unit 3, 1 Lieber Grove

Carrum Downs VIC 3201

Tel: 61-0397708222

Fax: 61-0397708122

Email: sales@allianceelectronics.com.au

Web: www.allianceelectronics.com

International Representatives: (Cont.)

Area: Czech Republic & Slovakia

Telemeter Electronics s.r.o.

České Vrbné 2364
370 11 České Budějovice
ČESKÁ REPUBLIKA
Tel: +420-385-310-637
Fax: +420-385-510-124
Email: info@telemeter.cz
Web: www.telemeter.info

Area: France

P2M

8, Allée des châtaigniers
ZA du buisson de la couldre
78190 Trappes
FRANCE
Tel: +33-01-30-62-64-64
Fax: +33-01-30-62-40-10
Email: gmajcherczyk@p2m.com
Web: www.p2m.com

*Area: Germany, Austria & Switzerland
Note: Limited to Rohde + Schwarz and
BPS-Bögl & Partner Systemtechnik*

GLOBES Elektronik GmbH & Co KG

Berliner Platz 12, 74072 Heilbronn
or
P.O. Box 1850, 74008 Heilbronn
GERMANY
Tel: +49-7131-7810-0
Fax: +49-7131-7810-20
Email: hf-welt@globes.de
Web: www.globes.de

*Area: Germany, Austria, Liechtenstein
& Switzerland*

Telemeter Electronic GmbH

Joseph-Gänsler-Straße 10
86609 Donauwörth
GERMANY
Tel: +49-906-70693-0
Fax: +49-906-70693-50
Email: info@telemeter.cz
Web: www.telemeter.info

Area: India

Aarjay International Pvt Ltd.

Bangalore

948 B, 5th B Main, Vijaya Bank Layout
Bilekahalli
Bangalore 560 076
INDIA
Contact: P.K. Ramachandran
Tel: 91-080-4340 9200
Fax: 91-080-4340 9299
Email: aarjay@aarjay.com

Delhi

201, Sethi Bhawan
7, Rajendra Place
New Delhi, 110 008
INDIA
Contact: Akhil Kant Agardwal
Tel: 91-120-407-7000
Fax: 91-120-407-7077
Email: aarjay_del@aarjay.com

Hyderabad

UBAS, 302, Babu Khan Estate
Basheer Bagh
Hyderabad - 500 001
INDIA
Contact: G. Venkat Ramana
Tel: 91-40-6666-9981
Fax: 91-40-6666-9988
Email: aarjay_hyd@aarjay.com

Pune

ABIN #3, Global Trade Center
1/1, Rambaug Colony, L.B.S. Marg
Pune - 411 030
INDIA
Tel: 91-20-2433-5460/5490
Fax: 91-11-2433-0881
Email: aarjay_pune@aarjay.com
Web: www.aarjay.com

Area: India

Elkay International, Inc.

230 U.S. Highway 206, Suite 102
Flanders, NJ 07836
USA
Tel: 973-927-8647
Fax: 973-927-5370
Email: vikas@elkayintl.com
Web: www.elkayintl.com

Area: Israel

Starlight Technologies Ltd.

P.O. Box 25369
Tel-Aviv 61253
ISRAEL
Tel: +972-3-941-0555
Fax: +972-3-941-0666
Email: rami@starlight.co.il
Web: www.starlight.co.il

Area: Italy & Greece

MicroElit, S.P.A

Milano

Milano via Sardegna, 1
Milano 20146
ITALY
Tel: +39-024817900
Fax: +39-024813594
Email: m.cugusi@microelit.it
Email: info@microelit.it
Web: www.microelit.it

Rome

Rome Via Nicola Marchese, 10
Rome 00141
ITALY
Tel: +39-0686894323
Fax: +39-068275270
Email: m.santarelli@microelit.it
Email: info@microelit.it
Web: www.microelit.it

International Representatives: (Cont.)*Area: Japan***Shoshin USA, Inc.****USA**

1700 East Garry Avenue, Suite 115
Santa Ana, CA 92705-5828

USA

Fax: 949-250-9574

Tel: 949-250-4073

Email: linda@shoshin.com

Web: www.shoshin.com

Tokyo

Suruga Building, 6F

1-7-1 Nihonbashi-Muromachi, Chuo-Ku

Tokyo, 103-0022

JAPAN

Contact: Setsuo Katayama

Tel: +81-3-3270-5921

Fax: +81-3-3245-0369

Email: katayama@shoshin.co.jp

Web: www.shoshin.co.jp

Nagoya

2-41-20, Mei-eki, Nakamura-Ku

Nagoya, Aichi 450-0002

JAPAN

Contact: Masahiro Oguri

Email: moguri@ngo.shoshin.co.jp

Contact: Mitsunobu Kaneko

Email: mkaneko@ngo.shoshin.co.jp

Tel: +81-52-581-7291

Fax: +81-52-581-7290

Web: www.shoshin.co.jp

Osaka

2-3-8 Uchihonmachi, Chuo-KU

Osaka, 504-0026

JAPAN

Contact: Akio Tsumura

Tel: +81-6-6946-7751

Fax: +81-6-6946-7760

Email: atsumura@osk.shoshin.co.jp

Web: www.shoshin.co.jp

*Area: Seoul & Korea***Karmel Technologies, Co., Ltd.****USA**

220 Goddard, Suite B

Irvine, CA 92618

Tel: 949-450-9933

Fax: 949-450-9988

Korea

11F, Mirae Asset Venture Tower

Sampyeong-dong, Bundang-gu

Gyeonggi

KOREA

Tel: +82-31-780-1400

Fax: +82-31-780-1401

Email: sales@karmeltech.com

Web: www.karmeltech.com

*Area: Spain & Portugal***Spantech Microwave Technology S.A.****Spain**

Aptdo.de correos n° 38

29130 Alhaurín de La Torre

Málaga

SPAIN

Tel: +34-95-241-7024

Fax: +34-95-241-7025

Email: sales@spantech.es

Web: www.spantech.es

Portugal

Email: sales@spantech.pt

Web: www.spantech.pt

*Area: Sweden, Finland, Estonia, Latvia & Lithuania***Amtele AB****Sweden**

Jägerhornsväg 10

SE-141 75 Kungens Kurva, 29130

SWEDEN

Tel: +46-8-556-466-00

Fax: +46-8-556-466-10

Email: www.amtele.se

Web: amtele@amtele.se

Amtele AB (Continued)**Finland**

Makituvantie 9

FIN-015 10 Vantaa

FINLAND

Tel: +358-9-727-300-70

Fax: +358-9-727-4010

Email: tomi.kivilahti@amtele.fi

Web: www.amtele.se

*Area: Taiwan***STEP Electronics, Ltd.****Taipei**

6F, 176 Nanking East Road, Section 2

Taipei

Taiwan 10489, R.O.C.

Tel: 886 2-25067451

Fax: 886 2-25064436

Email: : stepspkw@ms3.hinet.net

Web: www.stepelectronics.com.tw

Hsinchu

2F, 45, Alley 57, Lane 271, Wuling Road

Hsinchu

Taiwan 30053, R.O.C.

Tel: 886 3-5343462

Fax: 886 3-5343367

Email: stepmw@ms33.hinet.net

Web: www.stepelectronics.com.tw

*Area: United Kingdom & Republic of Ireland***Novacom**

Novalis Place, Deepdale Lane,

Deepdale Enterprise Nettleham, Lincoln LN2

2LL

United Kingdom

Tel: +44-1522-751136

Fax: +44-1522-754408

Email: sales@apc-novacom.co.uk

Web: sales@apc-novacom.co.uk