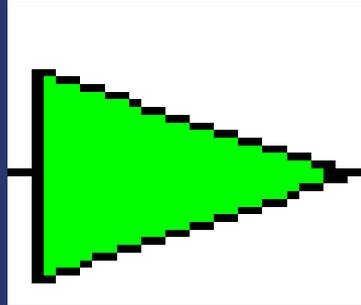


Amplifiers



Magdy Michael,
Director, Business Developments
and Key Accounts



narda  **MITEQ**

This presentation consists of L-3 Communications Corporation general capabilities and administrative information that does not contain controlled technical data as defined within the International Traffic in Arms (ITAR) Part 120.10 or Export Administration Regulations (EAR) Part 734.7 – 734.11.

Amplifiers

Low Noise
Medium Power
Satcom
Bi-Polar

AMF AMPLIFIER PRODUCTS



- Low-Noise Amplifiers
- Medium Power Amplifiers
- Power Amplifiers
- SATCOM LNAs
- Special Amplifier Designs



AMPLIFIERS

- APB SERIES
- JB SERIES



- LOW NOISE
- DETUNES
- MEDIUM POWER
- BROADBAND
- ULTRA-WIDEBAND
- DUAL FEED DESIGN
- SPACE-QUALIFIED DESIGN
- HIGH RELIABILITY
- SCREENING AVAILABLE



AMPLIFIERS TO 3 GHz

- AU SERIES
- AM SERIES



- LOW NOISE
- MEDIUM POWER
- WIDEBAND



narda  **MITEQ**

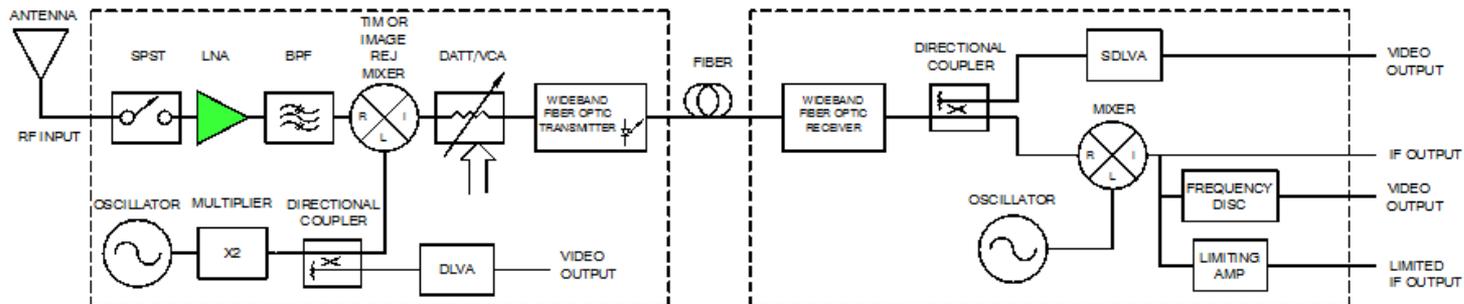
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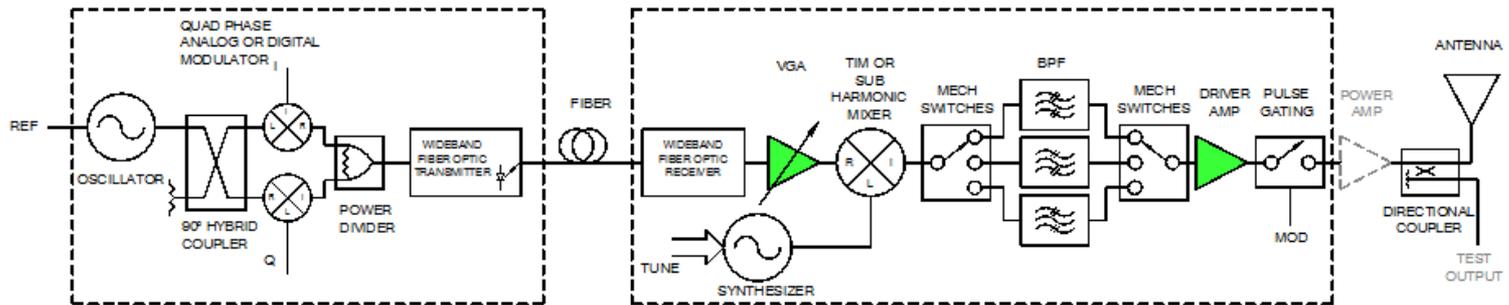
Block Diagram

GENERIC BLOCK DIAGRAM

AMPLIFIERS



DOWN-CONVERTER



UP-CONVERTER

Low Noise Amplifier (LNA)

- **Definition:**

- *An electronic amplifier used to amplify very weak signals (for example, captured by an antenna). It is usually located close to the detection device to reduce losses in the feed line.*
- *Its noise figure adds directly to the system noise.*

$S_i N_i$ = Signal to Noise Ratio at the amplifier input

$S_o N_o$ = Signal to Noise Ratio at the amplifier output

- *Typically high gain (40-60 dB). This reduces noise contribution (Second stage contribution) from other components in the chain.*

- $$T_{eq} = T_1 + T_2/G_1 + T_3/G_1 G_2 + \dots$$

Amplifiers

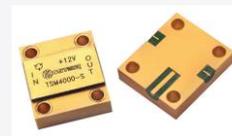
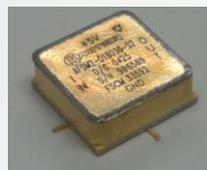
- Narda-MITEQ's largest Component product offering catalogue amplifiers and special designed to application amplifiers to the OEM market.
- Product Groups: LNA: Low Noise/Medium Power
- AMFW: Low Noise/Medium Power Waveguide

LNA and LNAS Series

- 10 MHz to 50 GHz with output powers up to +25 dBm
- Very broadband models (0.1 to 40 GHz)
- Small, lightweight, and can be utilized as drop-in or connectorized
- Surface mount designs to 20 GHz NSM, AFSM [SMT08]
- Ideal for High-Rel/Space applications (Hermetic packages)
- Waveguide Models (JS Series) available up to V-Band [55-67 GHz]
- Optional One Watt CW input limiters available!



AFS/JS



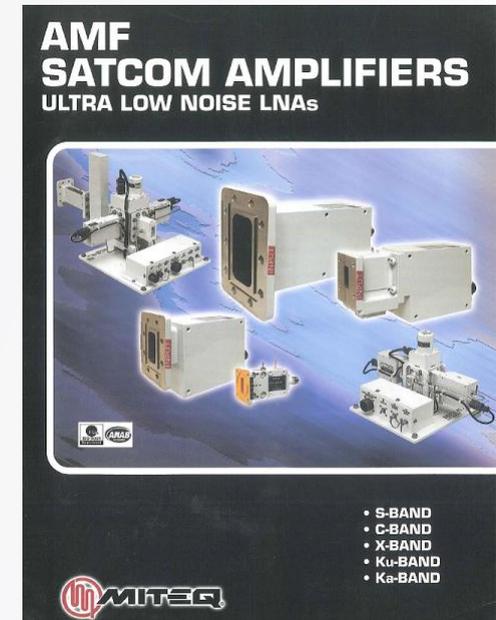
AFSM/TSM



NSM

AMFW (Satcom LNAs)

- Low Noise Waveguide packages
- Standard Satcom and Radar bands
- L-Band through Q-Band
- Noise Temperatures as low as 30 Kelvin



AMFW (Satcom LNAs)

- Noise performance specified in Noise Temperature
 - Noise Figure = $10 \log_{10} \left\{ \frac{\text{NoiseTemp (K)}}{290 \text{ K}} + 1 \right\}$
- Our Best Noise Temperatures at +23°C
 - L Band: 30K
 - S and C-Band: 28K
 - X-Band: 65K
 - Ka (K): 110K

Band	Waveguide	Frequency	Dimensions (in)
S	WR- 284	2.60 to 3.95 GHz	2.840 x 1.340
C	WR-137	5.85 to 8.20 GHz	1.372 x 0.622
X	WR-90	8.2 to 12.4 GHz	0.900 x 0.400
X-Ku	WR-75	10.0 to 15.0 GHz	0.750 x 0.375
Ku	WR-62	12.4 to 18.0 GHz	0.622 x 0.311
K	WR-51	15.0 to 22.0 GHz	0.510 x 0.255
K	WR-42	18.0 to 26.5 GHz	0.420 x 0.170
Ka	WR-28	26.5 to 40.0 GHz	0.280 x 0.140
Q	WR-22	33 to 50 GHz	0.224 x 0.112

NF(dB)	T _N (°K)	NF(dB)	T _N (°K)
0.1	7	2.1	180
0.2	14	2.2	191
0.3	21	2.3	202
0.4	28	2.4	214
0.5	35	2.5	226
0.6	43	2.6	238
0.7	51	2.7	250
0.8	59	2.8	263
0.9	67	2.9	275
1.0	75	3.0	289
1.1	84	3.1	302
1.2	92	3.2	316
1.3	101	3.3	330
1.4	110	3.4	344
1.5	120	3.5	359
1.6	129	3.6	374
1.7	139	3.7	390
1.8	149	3.8	406
1.9	159	3.9	422
2.0	170	4.0	438

Amplifiers

- Model Number Key:

ORDERING INFORMATION

Specify by part number: xxx-

LNA - 30 - 010002000 - 06 -10P
↑ Gain dB ↑ Frequency GHz ↑ Noise Figure dB

Example: 1 to 2 GHz, 30 dB gain, 0.6 dB noise figure, +10 dBm
LNA-30-01000200-06-10P

ORDERING INFORMATION

Specify by part number: xxx-

LNA - 30 - 010002000 - 10 -15P
↑ Gain dB ↑ Frequency GHz ↑ Noise Figure dB

Example: 1 to 2 GHz, 30 dB gain, 1.0 dB noise figure, +15 dBm
LNA-30-01000200-10-15P

ORDERING INFORMATION

Specify by part number: xxx-

LNA - 40 - 010002000 - 30 -25P
↑ Gain dB ↑ Frequency GHz ↑ Noise Figure dB

Example: 1 to 2 GHz, 40 dB gain, 3.0 dB noise figure, +25 dBm
LNA-40-01000200-30-25P

Amplifier Options [AFS/JS/AMF]

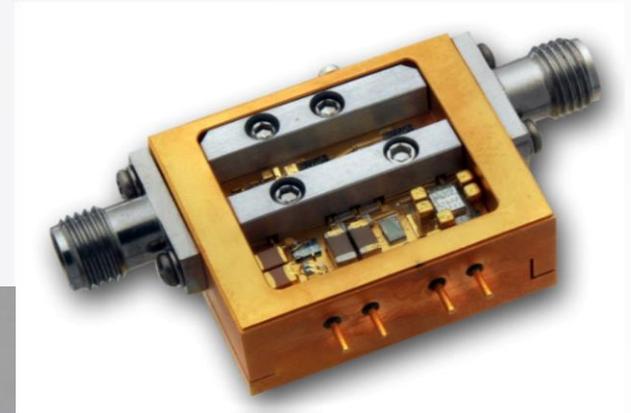
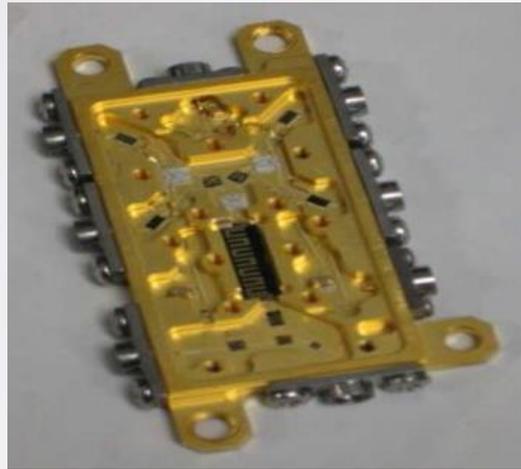
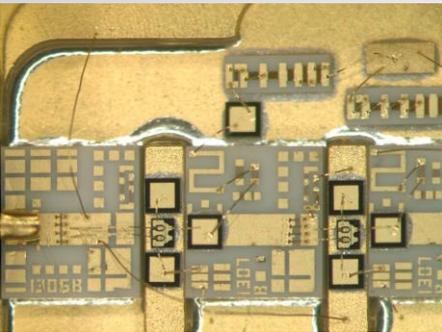
- Standard Options
 - *Some options may affect other parameters.*

STANDARD PERFORMANCE OPTIONS	SUFFIX	STANDARD CONNECTOR OPTIONS	SUFFIX
Input Limiter	-L	SMA Male Connector	-M
Gain Window	-GW	K Type Connector	-K
Temperature Compensation	-TC	V Type Connector	-V
Phase Match	-PM	Waveguide Input	-WG
Amplitude Match	-AM	NPC Connector	-NP
Amplitude/Phase Match	-APM	N Type Connector	-N
Gain Control	-GC	TNC Type Connector	-T
Gain Slope	-GS		
Hermetic	-H		
Kovar Chassis	-KC		
Bias Through Output	-BTO		
Bias Through Input	-BTI		
Specific Operating Voltage	-XXDC*		
Gain Slope	-GS		
Phase and Gain Tracking	-PG		
Power Supply	-PS or -AS		
Combination of three or more standard options	-S		

NOTE:
 *XX is the DC operating voltage.
 When specifying these options, please include applicable detailed information.

Amplifiers Technology/Construction

- GaAs FET/GAN/MMIC [Chip & Wire Hybrid]
 - Narda-MITEQ is not a foundry. We procure the best parts available for the customer specific application.
- KOVAR and Aluminum housings
- Hermetic and Non Hermetic designs.



The Ins and Outs of MITEQ

*Offering a Wide Variety of
input and output options Today!*

Surface Mount

- Mixers
- Amplifiers
- PLL Oscillators



Coaxial

- Standard
- Blind Mate
- 90 Degree



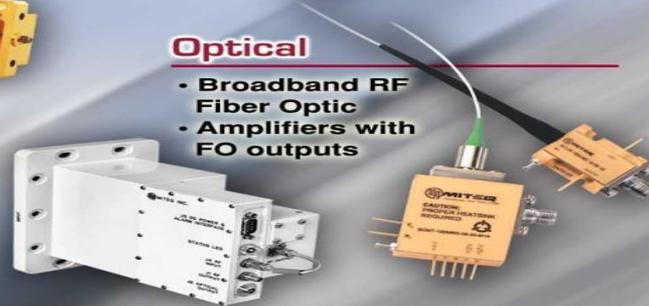
Standard and Custom Waveguide

- Mixers
- Amplifiers
- Converters



Optical

- Broadband RF
- Fiber Optic
- Amplifiers with FO outputs



Drop in/open Substrate

- Mixers
- Amplifiers



PC Mount

- Flat Pack Logs
- Hybrid Couplers



Let MITEQ help you process your signals!

 **MITEQ**
Component Products

Amplifiers

- In-house Screening per MIL-STD-883 and 202

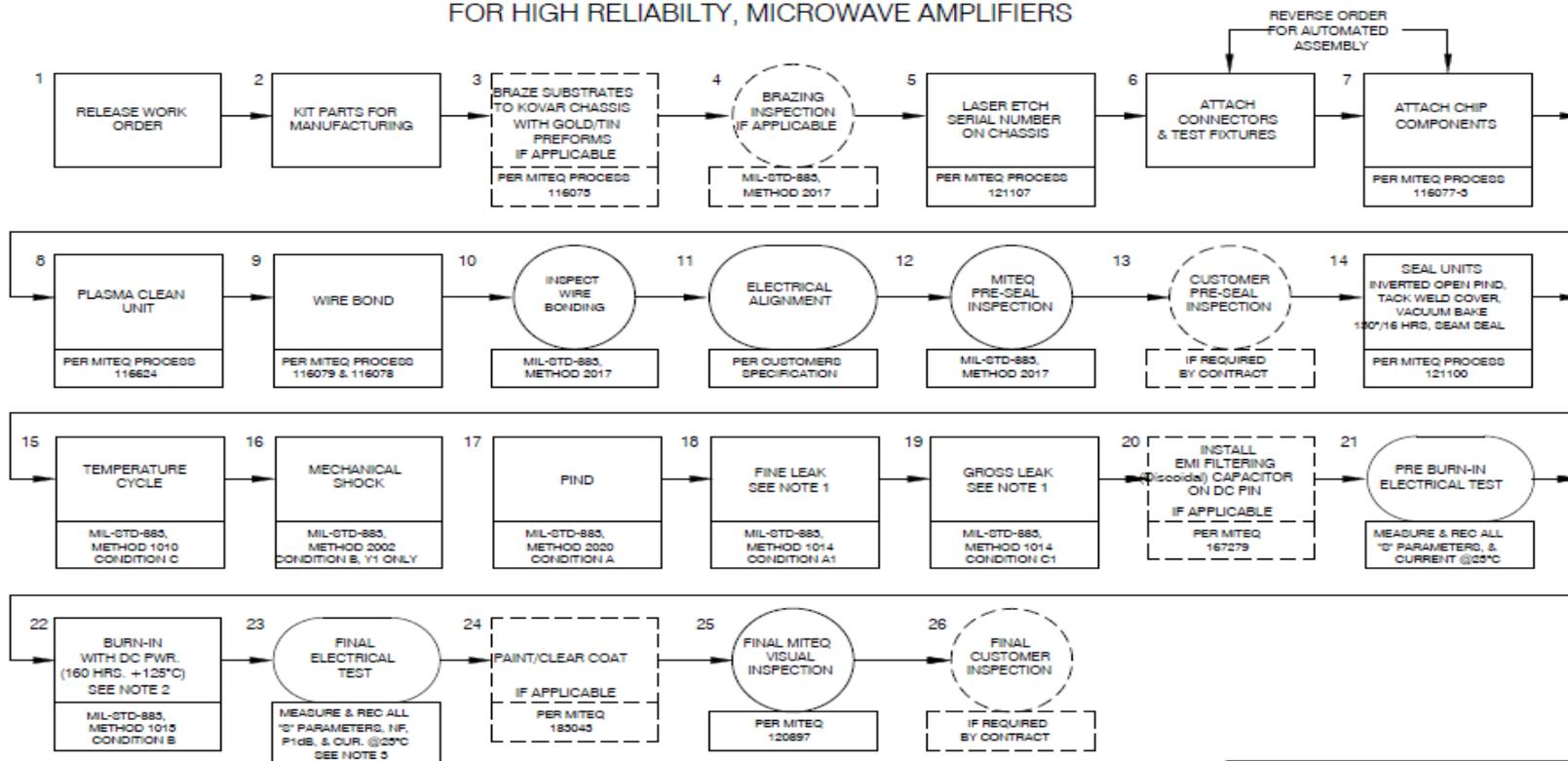


- Hermetic sealing
- Leak Testing
- Temp. Cycling
- Mechanical Shock
- PIND
- Burn-in
- Vibration



ASSEMBLY, SCREENING FLOW CHART FOR HIGH RELIABILITY, MICROWAVE AMPLIFIERS

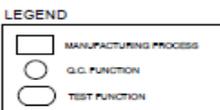
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	D	Incorporate ECN 30511	03/20/14	<i>R. Johnson</i>



Notes:
 1. Leak rate is determined by package volume or customer specification. Leak testing may be performed any time after mechanical shock and prior to final external visual.

2. Higher output power active devices (> +17 dBm) and devices with discoidal caps installed will utilize A 100°C Burn-In temperature. Enter Duration, Temperature, and Voltage on Traveler.

3. Test data provided at +23°C only. Test at temperature extremes only if required by P.O. Must be performed within 96 hours of completion of Burn-In



THIS FLOW CHART IS THE TEMPLATE FOR MITEQ'S PRODUCTION POSTING AND ELECTRONIC TRAVELER. EVERY STEP THAT IS USED ON THE JOB SPECIFIC TRAVELER SHALL BE SIGNED ELECTRONICALLY

THIS DOCUMENT IS NOT ITAR CONTROLLED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS: .XX ± .01 .XXX ± .005 ANGLES: ± 0°30'		DRAWN	<i>R. Johnson</i>	DATE	08/08/08	
		DESIGN	<i>R. Johnson</i>	DATE	08/24/14	
		APPROVED BY				
		PROJ. ENGR.	<i>J. Baranowski</i>	DATE	08/22/14	
PROJECTION		MFG. ENGR.	<i>J. Johnson</i>	DATE	08/24/14	
		Q.A.				
NEXT ASSY	USED ON					
APPLICATION						

SIZE	CODE IDENT. NO.		REV.
C	33592	184004	D
SCALE	REF	SHEET 1 OF 1	

Low Noise Amplifiers

- Key Specifications/Attributes[What to ask the customer]
- Frequency Range
- Noise Figure/Noise Temperature @ +23C
 - *NF varies as a function of temp at a rate of ± 0.01 dB per $^{\circ}$ C typ.*
- Gain [Min & Max] & Flatness across Frequency
 - *Gain vs. Temp. (± 0.01 dB per $^{\circ}$ C per stage typ.)*
- Operating temperature Range
 - *Most AFS and JS products will operate from -54 to +85 $^{\circ}$ C*
 - *Catalog specifications are at +23 $^{\circ}$ C*
- Linearity [Input & Output IP3]
 - *Most of Narda-MITEQ amplifiers are specified at output*
 - *IP3 not always 10 dB above P1dB*
- Operating Environment [Hermetic?]
- When do they need it!
- Narda-MITEQ web site search engine is a good starting point

Web Site Search Engine

- Start Here!

Amplifier Search

Not all fields are required.

Frequency Range Min to Max

Search range Wider Narrower Exact

Gain (dB) Min

Noise Figure (dB) Max

Noise Temperature (K) Max

Output Power (dBm) at 1db Comp. Min Min

[Advanced Search](#)

Amplifier Search By Model

Partial Model numbers may be entered.

Results Per Page

Applications [LNA]

- Military communications
- Data links [UAV]
- Satellite Communications/In Flight Entertainment
- Space borne Communications [Satellite]
- Radar Front Ends
- Scientific and Research labs
- Radio astronomy, Cryogenic
- EMI/Compliance Testing

KU & KA-Band In Flight Internet

YOU ARE HERE: HOME / PRODUCTS & SERVICES / IN-FLIGHT BROADBAND

In-Flight Broadband

Row 44 offers commercial airlines—anywhere in the world—the most robust and scalable satellite-based in-flight broadband platform.

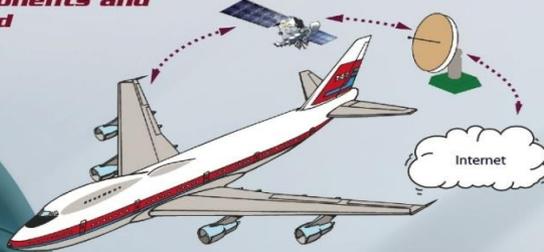
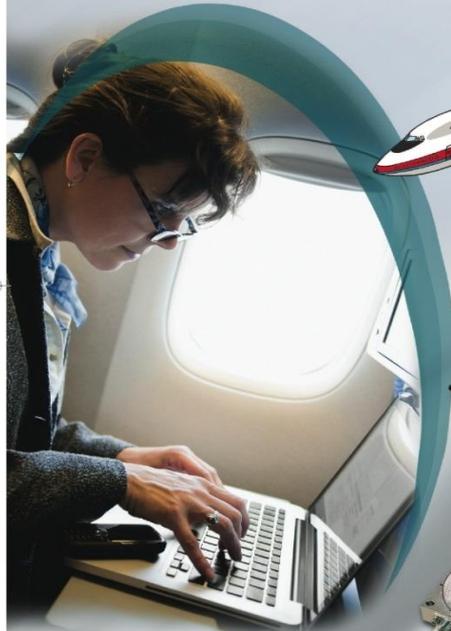


In Flight Communications/Entertainment

AD646 7.8125x10.75:Layout 1 4/17/13 11:14 AM Page 1

Ka-Band Inflight Communication Solutions

MITEQ offers a wide range of flight proven [RTCA DO-160 E/F] components and subsystems at Ka-Band



Low Noise Amplifiers

- 17.7-21.2 GHz with Noise Figures as low as 1.25 dB
- Lightweight/Hermetic
- Waveguide or Coaxial
- Low Voltage [+5 VDC]



Modular Frequency Converters

- Small Efficient Up/Downconverters
- Wideband IF coverage
- High Linearity



Power Amplifiers

- 29.5-31 GHz
- Power levels to 10 watts
- Adjustable Gain



PIN Diode Switches

- SP2T-SP4T Coaxial Absorptive type
- High Isolation



Frequency Sources

- Ultra-low Phase Noise vibration insensitive
- Step sizes down to 1 kHz (synthesizer)



100 Davids Drive, Hauppauge, NY 11788 • Tel: (631) 439-9220 • Fax: (631) 436-7430 • www.miteq.com

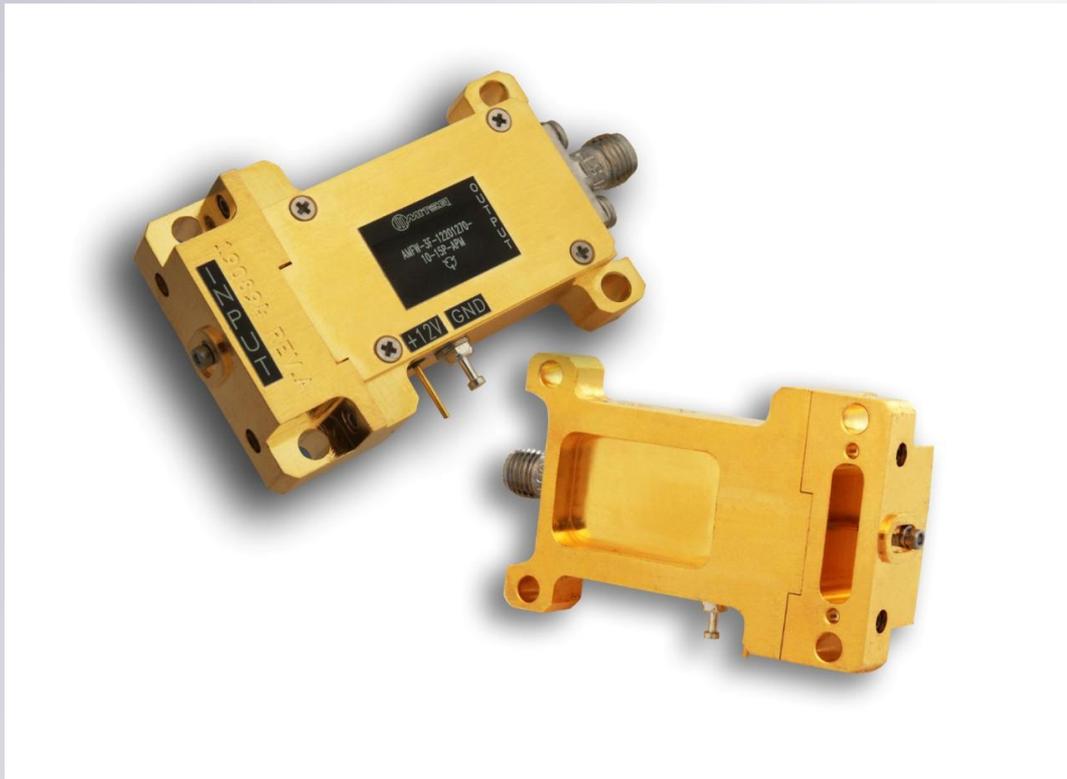
KA-Band LNA



[SAFSW5-18002100-13-8P](#)

- Freq Band:18-21 GHz
- Noise Figure:1.25 dB @+23C
- Hermetic [Electronics]
- DO-160 Qualified
- Optional Integral transmit reject filter 60 dBc @ 30 GHz
- Optional +5 VDC operation
- Optional One watt input limiter
- DC bias through RF output connector [EMI immunity]

Ku-Band LNA Airborne Direct TV



- 12.2-12.7 GHz
- 0.9 dB NF Typ.
- 23 dB +/- 3 dB
- 1.5 VSWR Max
- 70 mA Typ.
- -50 to +70 deg-C
- Phase matched
- 1/2 Height Waveguide Flange
- RTCA/DO-160 F
- 1700 pcs currently flying

AMFW-3F-12201270-10-15P-APM

UAV Applications



UAV Applications

- Use of UAV's continues to grow within DOD
- UAV's have RF applications for Spectrum Surveillance, Radar & Electronic Attack[Jamming].
- UAV's utilize X/KU/KA bands for Communications [Data Links] and Control back to the ground control Hub . Many of the ground command hubs being deployed use multiple bands for a variety of UAV's and missions.
- The Frequency bands used for the data links are almost identical to many existing Satcom Bands[existing Narda-MITEQ products]!
- Applications for Narda-MITEQ amplifiers on both ends of the Data Link [Ground & Airborne].

UAV KA-Band LNA's

New Products!

Waveguide Low Noise **AMPLIFIERS**

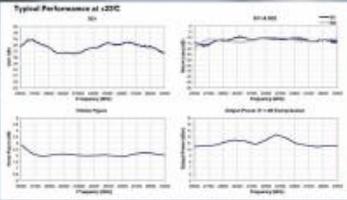
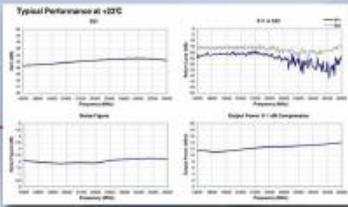
Airborne Ka-Band Low Noise Amplifier

- Small size at 1.18" X 0.87" square
- Lightweight (less than 23 grams)
- Hermetically sealed
- Operating temperature range of -30 to +65°C
- Noise temperature of 97K² (1.25 dB NF)
- Low power dissipation of less than a watt
- Optional RF input limiters, DC power connections and waveguide flanges are also available



Ka-Band

- Weather tight enclosure with hermetically sealed hybrid MIC
- Pressure windows available
- Various waveguide flanges available
- Optimizable narrow band performance
- Adaptable for cryogenic applications
- Space qualifiable



Ka-Band

- Weather tight enclosure with hermetically sealed hybrid MIC
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MITEQ
Component Products

Compliance Testing Application



Compliance Testing Applications

- Semiconductor Manufacturer/Designer
- Computer Manufacturers
- Third Party Test labs
- T & M Equipment Manufacturers [OEM]
- Automotive Test Labs
- Medical Equipment Manufacturers
- Cellular Phone Industry

Amplifier Strengths

- Large Diverse Catalog Offering [Over 5,000 models]
- Excellent starting point for custom applications
 - *Low or no NRE in many cases*
- Wide Freq Coverage: 1 KHz-67 GHz
- Commercial & Hi-Rel Grades
 - *Hybrid assemblies use the same MIL-STD-883 Inspection criteria and assembly processes*
- Wide range of mechanical outlines [Surface mount, Coax, Waveguide, etc]
- Wide range of Standard options
- More Multipurpose amplifiers being built for stock
- Web Store [shows what is in stock and price]
- Make it easy for the customer to buy from Narda-MITEQ!
- Three Year Warranty for all indoor application!*

What we need from the field force

- Customers sometimes ask for a specific model amplifier.
- Please ask the basic performance requirements about Freq.Band, NF, Package Etc. as covered earlier!
- The customer may be able to use an alternative amplifier model.
- Always ask how soon the customer needs his parts and if there are tradeoffs between his specs vs Schedule!
- Use the web portal to help your customer find an amplifier model and quote it. You will have that capability!
- Know the customers price points also!
- This will help us decide on which way to proceed!