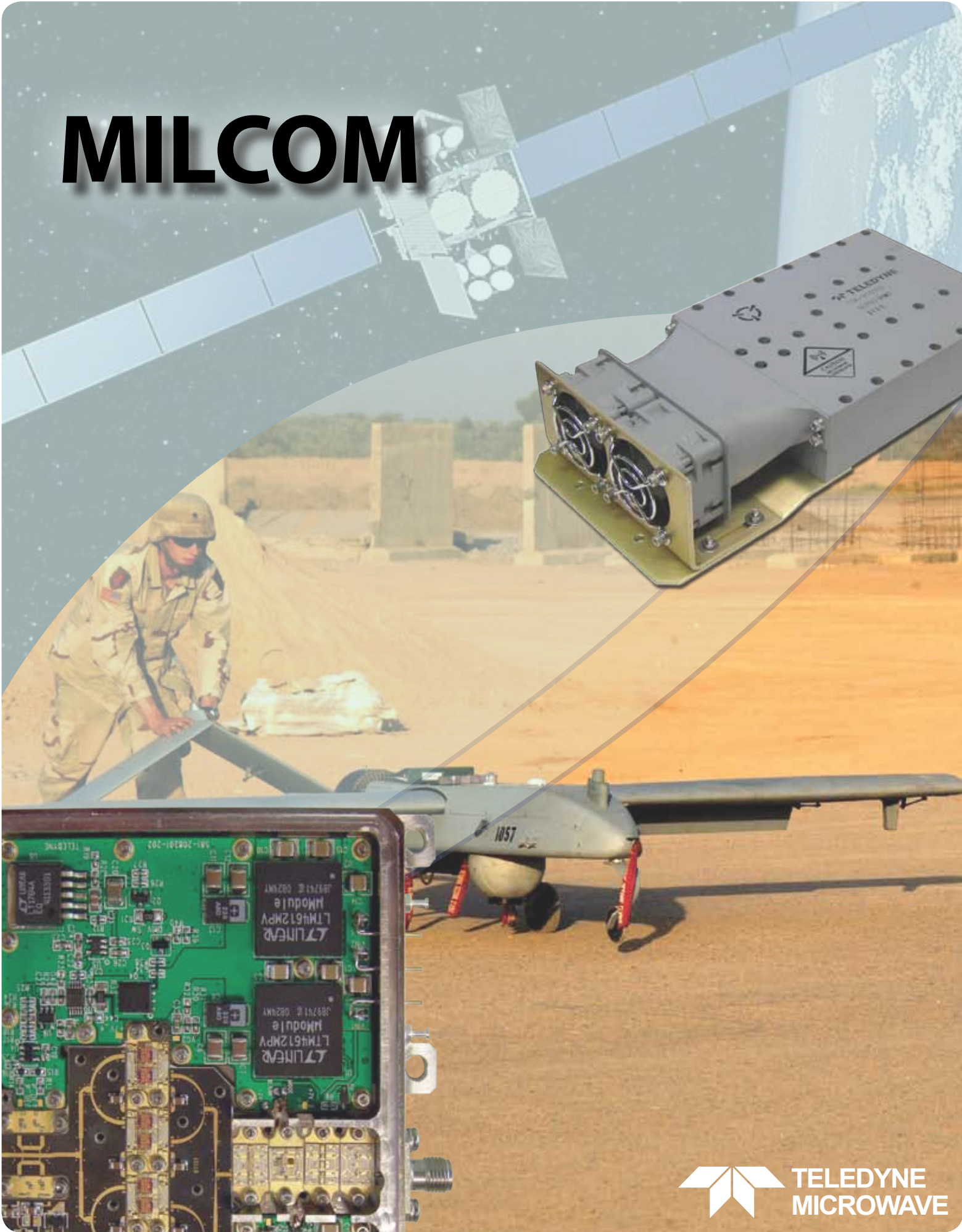


MILCOM



Introduction

TELEDYNE MICROWAVE INTRODUCTION

Teledyne Microwave, a business unit of Teledyne Electronics and Communications, is located in Mountain View, CA, and has over 50 years experience as a worldwide leader in the design, development, and manufacture of microwave components and integrated assemblies. We have delivered high quality products for communications, aerospace, defense, aviation, and instrumentation markets. Recent acquisition of some parts of Filtronic Solid State, Celeritek, Filtronic in the UK and KW Microwave has given Teledyne Microwave the ability to strengthen its product portfolio and to design new sub-systems.

Our product line includes:

- Amplifiers
- Filters
- Synthesizers
- YIG Filters & Oscillators
- Transceivers and Converters
- Integrated Microwave Assemblies (IMA's)
- BAW Delay lines



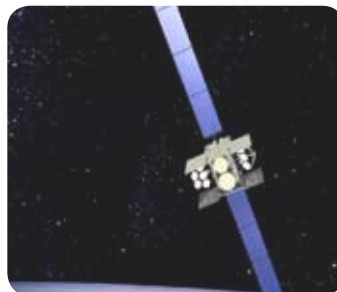
Communications



Military



Instrumentation



Space

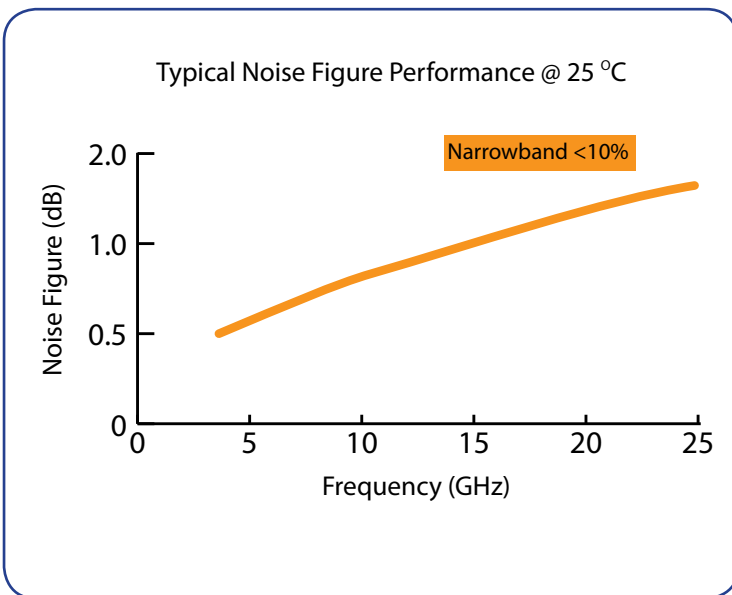
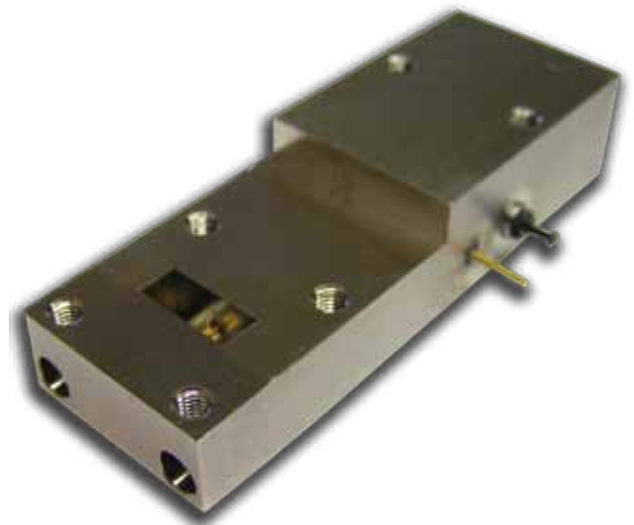
Low Noise Amplifiers

WITH CUSTOM TELEDYNE DEVICES

Teledyne Microwave is investing in a new range of LNA products specifically designed for the communications market. With an internally designed MMIC using our own fab we are now able to offer one of the best noise figures available on the market.

A typical example of this is our new K-Band LNA. This model operates over 20.2 GHz - 21.2 GHz with 1.4 dB Noise Figure at 25°C and has an integrated WR42 Waveguide output and K(f) Connector input. The aluminum alloy housing is environmentally sealed and also fully EMI shielded. The waveguide cavity is also sealed to support up to 15 psi. The waveguide flange can incorporate tapped or through holes with available configurations including choke, grooved, and cover. The low-noise amplifier is lightweight and has a small profile and footprint. LNA includes reverse voltage protection and full internal regulation. The unit has a typical noise figure of 2.0 dB and a P1dB of 17 dBm. Output IP3 is 20 dBm minimum. Small-signal gain is 40 dB and gain flatness is ± 1 dB maximum. Current draw is nominally 180 mA from a single +15V supply, with an operating temperature of -54 to +85°C case.

Other LNA examples are available on request.



Converters

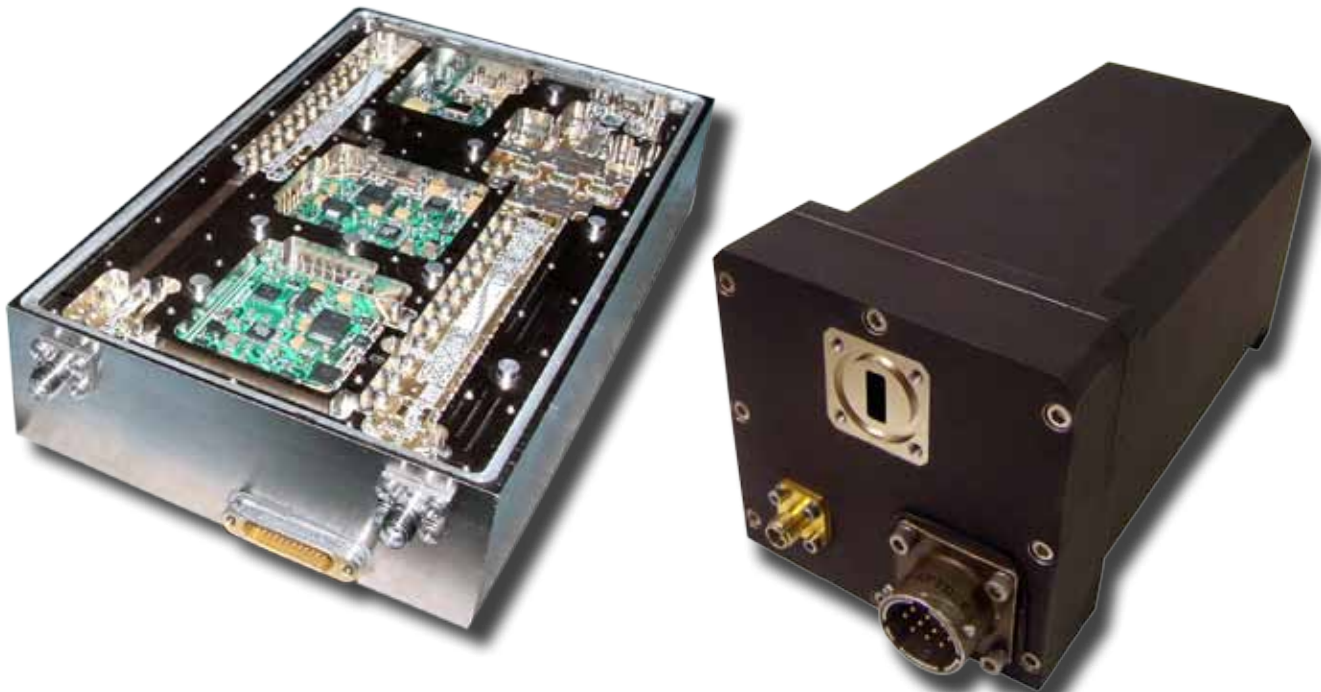
TELEDYNE MICROWAVE HAS DEVELOPED A NUMBER OF INTEGRATED CONVERTERS USED IN TODAY'S MODERN SYSTEMS

Teledyne Microwave offers a full range of integrated converters for many applications including Satcom and MilComs.

General construction consists of a RF/Microwave circuit using microwave modules and either a single or multiple printed circuit boards for control and power conditioning. The microwave modules are produced in house, on thin film circuits which are then wire bonded together to make a complete microwave chain. By using a common module concept, design cycles and risk are very much reduced when developing new designs for custom applications. With over 1,500 microwave modules designed and available, most requirements are met using existing proven module designs. The power and control circuit boards usually circle the main microwave modules, as these circuits are more flexible in location, and are therefore more specialized for any given frequency converter.

With experiences from UHF to 40 GHz we have a wide portfolio of circuit architectures, configurations and functionality to meet many different platform needs. A large part of our work when designing new converters is power management and digital control and functionality. Over the years we have found these criteria often more demanding than the microwave design itself. Experience in isolating supply lines and designing the unit with utmost isolation between adjacent circuits is critical to achieving the best design possible.

In general most of the converters we produce are custom designs based on existing units and modules available. With the recent need to push frequencies higher, Teledyne Microwave has developed a number of Ka-Band upconverters specifically for the Military Satellite communications market. These converters also include the option for a Solid State Power Amplifier (SSPA) with power levels up to 15 W available. A range of down converters have also been developed, in the K-Band, to support the platforms very low noise figure requirements.

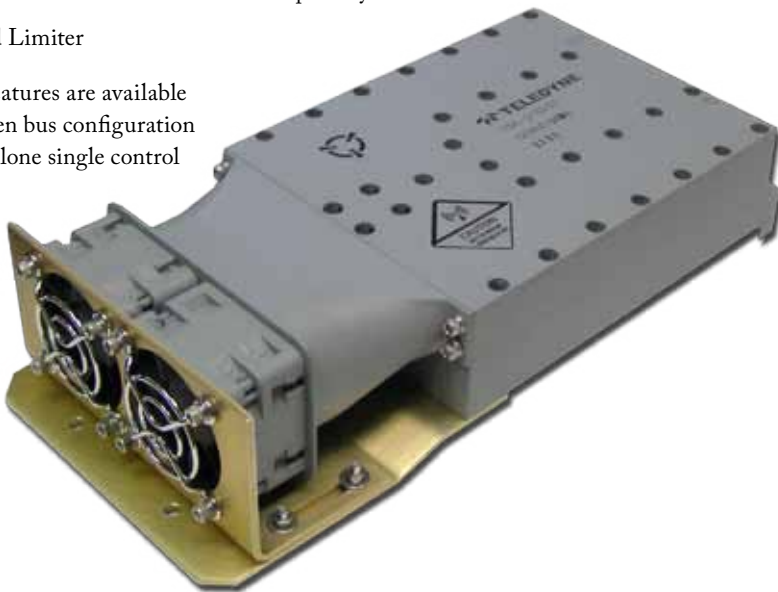


Critical to all converters designs is the consideration of the local Oscillator circuit to maintain the phase noise and spurious specifications, which are often system critical. In some cases this is supplied by the system, but in most cases the converter is responsible for generation these signals internally. Teledyne Microwave has the ability to design these circuits in house. From the very complex dual loop frequency synthesizer to more simple phase locked loop designs, our engineers have proven our ability to not only design these circuits but also to manufacture them in a production environment.

Additional functionality is also common place in the design of the converter. A list of common functionality requirements that we see and support is shown below (note: this is not a complete list):

- ◆ Current Monitoring
- ◆ Digital Frequency Control
- ◆ Automatic Gain Control
- ◆ Temperature Compensation
- ◆ Battle Short
- ◆ Temperature Monitoring
- ◆ RF Log and Linear Power Monitors
- ◆ Output VSWR monitoring and automatic shut down
- ◆ Return Power Detect with shut down capability
- ◆ Front End Limiter

All of these features are available over any chosen bus configuration or as a stand alone single control line.



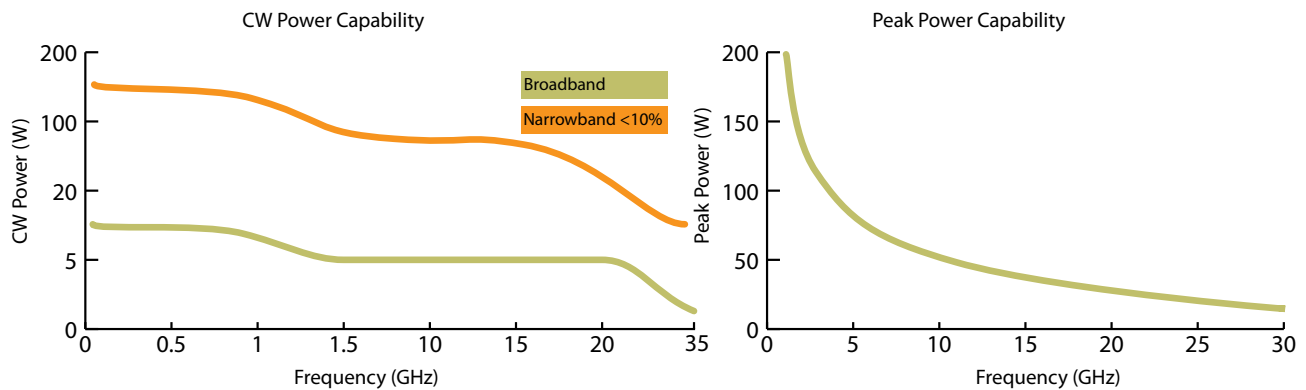
Ka-Band BUC	
Input Freq. Range	1.5 +/- 0.5 GHz
Input Instantaneous Bandwidth	120 MHz max.
Output Frequency Range	29 - 30 GHz 30 - 31 GHz
Output Power	40 dBm min.
Conversion Gain	60 dB, typical
Spectrum Inversion	None
VSWR Input	2.0:1
VSWR Output	1.7:1
Noise Figure	18 dB, typical
Gain Variation	2.0dBp-p
Gain Variation with Temperature	+/-2.0dB
OIP3	44dBm
Phase Noise	-82 dBc/Hz @ 10KHz Offset

Solid State Power Amplifiers

Incorporated into many communications applications, Teledyne Microwave has become the benchmark in RF SSPA design

SOLID STATE POWER AMPLIFIERS

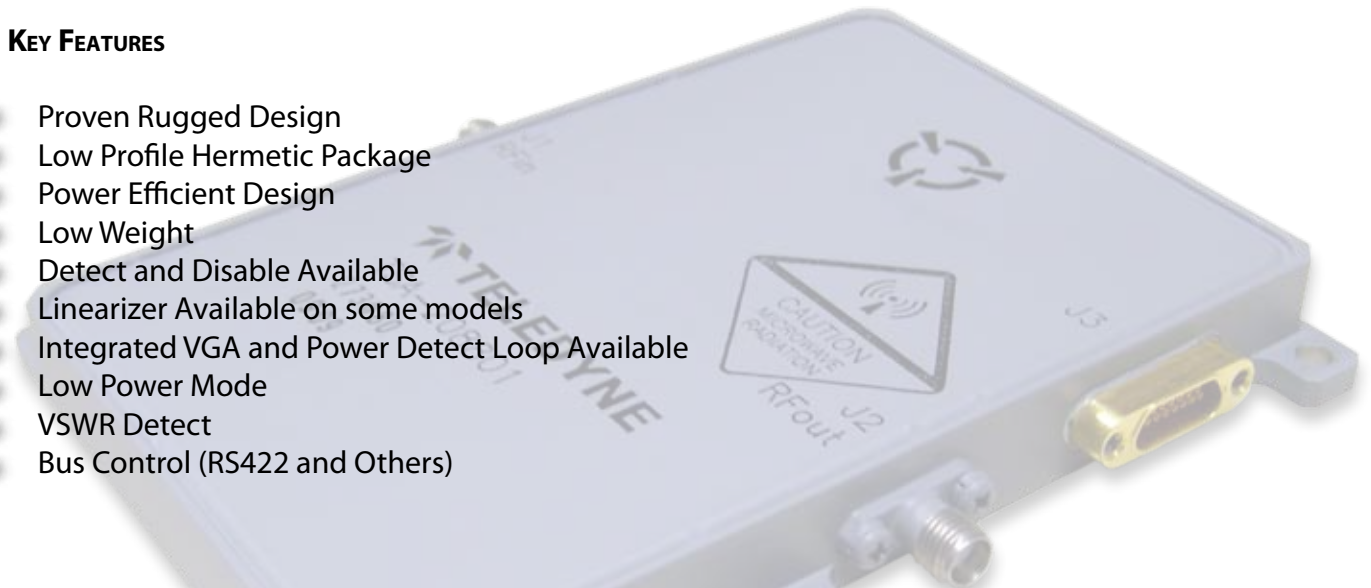
A strong recent development within Teledyne Microwave has been the strengthening of our Solid State Power Amplifier (SSPA) portfolio. Over recent years we've had the opportunity to work with most of the large OEM system manufacturers to develop custom SSPA's for both pulsed and CW needs. These amplifier developments have a frequency of operation as low as L-Band (1 KW) and as high as Ka-Band (15W) with plans to move into Q-Band. Our units have worked in a number of applications including; Satcom Subsystems, common data link (CDL), Space qualified CDL, Airborne, Ship & Ground EW, IED Jammer, Radar and Missile (CDL). Many of our SSPA designs are only 0.6" high making them ideally suited for airframe or mobile applications. With reduced size comes reduced weight. At only 0.6lbs our 15W, Ku-Band amplifier is the smallest and lightest on the market. A graphic example of our RF power capabilities for both peak & CW is shown below.



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KEY FEATURES

- ▶ Proven Rugged Design
- ▶ Low Profile Hermetic Package
- ▶ Power Efficient Design
- ▶ Low Weight
- ▶ Detect and Disable Available
- ▶ Linearizer Available on some models
- ▶ Integrated VGA and Power Detect Loop Available
- ▶ Low Power Mode
- ▶ VSWR Detect
- ▶ Bus Control (RS422 and Others)



Frequency Range (GHz)	4.4 - 5.0	7.0 - 8.0	13.75 - 14.5	13.75 - 14.5	13.75 - 14.5	13.75 - 14.5	13.75 - 14.5	13.75 - 14.5	29.0 - 31.0
Power (P1dB)	25W	25W	5W	10W	15W	15W	20W	25W	20W
Small Signal Gain	45dB	45dB	35 dB	47 dB	47 dB	43 dB	43 dB	43 dB	42 dB
Spurious	-60dBc	-60dBc	-60 dBc	-60 dBc	-60 dBc	-60 dBc	-60 dBc	-60 dBc	-50 dBc
Low Power Mode incl	N	N	N	Y	Y	Y	Optional	Optional	N
Temperature Monitor Incl	N	N	N	Y	Y	Y	Y	Y	Y
Detect and Disable Incl	Y	Y	Y	Y	Y	Y	Y	Y	Y
Blanking	30mS	30mS	1.5µS	30mS	30mS	30mS	30mS	30mS	30mS
DC Power @P1dB	100W	100W	31W	75W	150W	100W	175W	200W	250W
Linearizer Available	N	N	N	Y	Y	Y	Y	Y	N
Weight	0.8 lbs	0.8 lbs	0.3 lbs	0.5 lbs	0.5 lbs	0.5 lbs	0.8 lbs	0.8 lbs	1.2 lbs
Operating Temperature Range	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C	-45°C to +85°C
Hermetic	Y	Y	Y	Y	Y	Y	Y	Y	Y

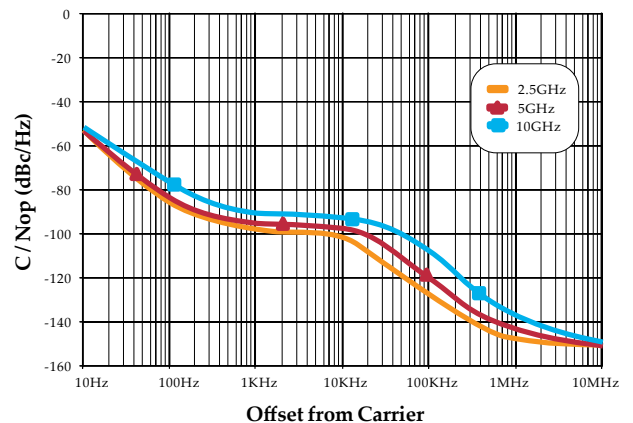


Frequency Synthesizers

Advanced Single Loop Frequency Synthesizer is another example of Teledyne Microwave's ability to incorporate unique technological features to create an exceptional design. This Synthesizer offers superior phase noise performance over various Satcom bands covering L, X and Ku-Bands. The novel design (patented) exhibits excellent microphonic performance with no phase hits. This very low cost design, incorporates a unique modular design enabling multiple component usage no matter what the output frequency or options adopted. The 9700 series unit comes with an optional fixed frequency oscillator. Wide input voltage range and selectable control protocol, enable this unit to be incorporated in any modern system with little modification to the supporting architecture.

Future developments in higher frequency units is on going.

Typical Phase Noise Performance



Model	Frequency Range (GHz)	Output Power (dBm)	Step Size (KHz)	Phase Noise				Reference (MHz)
				1 KHz	10 KHz	100 KHz	1 MHz	
9715	4.40-5.60	+10	1.0	-90	-90	-112	-132	10
9717	1.73-2.93	+10	1.0	-88	-90	-118	-135	10
9720	3.35-4.55	+12	1.0	-90	-90	-112	-132	10
9727	11.40-12.84	+14	1.0	-80	-90	-98	-112	10

