Solid-State Amplifier Solutions for Military and Commercial Applications

CTT INC
A KRATOS Company

A Proud History for Over 40 Years

Since 1981 CTT has been supplying customers worldwide with power amplifiers, frequency converters, frequency multipliers, transmitters, transceivers, and receivers within the frequency spectrum of 10 MHz to 100 GHz. CTT's products are designed to provide the best price versus performance combination for each customer, whether the end use is military, industrial or commercial.

Having built thousands of products with power levels that range from a few milliwatts to 1 kW, CTT has become a leader in solid-state microwave amplification.

Incorporation of new Gallium Nitride (GaN) technology into solid-state power amplifiers (SSPAs) is our latest innovation and has brought dramatic results in amplifier performance. Over the past few years CTT has been continually optimizing its proprietary designs to take advantage of the unique characteristics of the latest GaN devices.

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One of the most important features of GaN is the high power density it offers, effectively offering the system designer increased RF power in a smaller footprint than previously available. GaN's higher operating voltage reduces the necessity of DC-to-DC conversion, thus resulting in increased efficiency with consequent savings in power consumption and reduction of cooling concerns.

CTT's latest innovative circuit and coupler designs have contributed to our amplifiers having frequency performance ranges of more than 6:1.

Program Management

CTT Realizes that in today's microwave markets there exists a dynamic condition of product requirements and scheduling and has in place a strategic partnership mind set with its employees towards its customers. CTT customers enjoy a single contact point that looks after their needs as the product is being manufactured and delivered. These Program Managers will use their staff to provide weekly status reports, daily WIP analysis and real-time product tracking. All of this information is available to CTT customers on request.

Contents

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Infusing GaN Power Amplifier Technology into Microwave System Design

Numerous components in all microwave systems have continuously evolved and are now being optimized for specific applications. Both military and commercial configurations can benefit from improvements in:

- **Increased Sensitivity**
- **Reduced Size & Weight**
- **Higher Efficiency**
- **Wider Bandwidth**
- **Reduced Cost**
- **System Power Efficiency**

Improvements in these areas can spring from either the system designer or from breakthroughs at the component level.

Tracing their history back to Defense Advanced Research Project Agency (DARPA) investments in the mid 2000s, the latest generation of GaN-based semiconductors available to component manufacturers, points the way to many next-generation systems including radar, communication and unmanned aerial vehicles (UAVs).

With 5 to 10 times the power handling capability, a GaN device can handle twice the voltage and current of a comparable GaAs device. Likewise, with nearly 7 times the thermal conductivity of GaAs, GaN components can operate at a much higher temperature.

Capitalizing on these physical attributes CTT's GaN-based amplifiers are designed to provide, for example, considerably more power than a GaAs or Silicon-based system while at the same time occupying a much smaller volume.

CTT engineers have developed a proprietary open architecture/common platform GaN-based power amplifier family, which relies on advanced coupler design and unique substrate material selection. The result is a selection of adaptable, modular amplifiers requiring only a single supply voltage.

These innovative new designs lend themselves to a variety of amplification functions in many current and future commercial and military systems. Additionally, whenever legacy systems are upgraded, whether to address new requirements or to benefit from improved technology, you can count on CTT's thirty years of experience in microwave amplification and subsystem integration.

CTT offers not only form, fit, function of microwave amplifier replacements for many mature systems, but also incorporates leading-edge technology components.

Multipurpose, Flexible, Universal, and Scalable Designs

Only a few decades ago, military requirements and developments were a primary driving force of the microwave equipment market. With the emergence and explosion of the commercial communications market, military requirements now constitute a much smaller market share.

Since both commercial and military equipment share the same spectrum,* they are bounded by physics and thereby share electrical characteristics.

Fundamental to the differences is the commercial world's established, well maintained infrastructure. Military microwave, on the other hand, frequently operates without infrastructure in complex electromagnetic environments. This includes hostile temperatures, shock and vibration.

These tactical issues are different enough from commercial environments to warrant additional design and manufacturing considerations. The key issues being:

- Temperature operating ranges
- Tolerance to moisture
- Tolerance to vibration
- Tolerance to high altitude environments
- Tolerance to G-forces
- Cycle life

Commercially derived designs, technology and processes, commonly referred to as Commercial Off-the-Shelf (COTS), can be successfully applied to these military systems

*DARPA-BAA-15-24, Shared Spectrum Access for Radar and Communications (SSPARC).

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Infusing GaN Power Amplifier Technology into Microwave System Design (continued)

requirements, potentially increasing overall system performance. The advantages of this approach are readily understood. Commercial electronic designs are often more advanced than what is currently available within the military sector.

Taking these factors into consideration, CTT's latest evolution of GaN and GaAs microwave amplifier designs are truly "Dual Use." The difference between commercial and military applications being addressed by insertion of military grade components into basic design layouts, subject to the appropriate Mil-Standard screening procedures.

Moreover, a single CTT amplifier design, due to it's wideband performance envelope, is often suitable for diverse applications (i.e.: from radar, to instrumentation, to commercial communications). CTT's design philosophy offers the customer military or commercial significant benefits by:

- Mitigating risk with proven technology
- Reducing time-to-market
- Reducing overall system cost

CTT's newest GaN power amplifiers are finding applications in many of the next generation of high-performance Synthetic Aperture Radar (SAR) on both commercial and military UAVs. With SAR transmit power requirements of less than 100 watts at X-band, and UAV payload maximums of less than 50 pounds, CTT's new GaN power amplifiers – with 30% operating efficiencies – offer cost-effective performance solutions as final transmission elements.

With system power consumption as an increasingly important design criteria CTT offers TTL-controlled main bias shut-off circuitry matched to the system's pulse operation. With the amplifier drawing much less power between pulses, both total power consumption and temperature rise is reduced.

As an example, most commercial and military pulse radars operate at a duty cycle of 10% or less. As such, CTT's GaN power amplifiers are an attractive solution. Using a TTL control, by turning off the FETs (drain) the amplifier only consumes 100 to 200 mA for the logic and bias circuit. When the TTL is turned on, the unit will operate after a short rise time. During this "on time" the amplifier's power consumption is identical to that in CW operation. Thus, when the duty cycle is 10% or less, the unit will consume much less power. Therefore, the amplifier's heat sink and power supply can be significantly smaller.

Some Examples of Differences Between Various Grades of Parts

Characteristic	Mil-Spec Grade	Consumer Grade
Temperature Range	-55°C to +125°C	0°C to +70°C
Packaging/Encapsulation	Ceramic or Metal	Epoxy Seal
Screening	Yes	Usually None
Footprint	Mil-Spec Baseline	Usually Incompatible

Engineered specifically to meet the stringent requirements imposed by many modern system designs, CTT's family of GaN power amplifiers, perform a wide range of functions making them ideal for applications in cutting-edge multi-function systems. Whether the application is narrowband, wideband or ultra-wideband, operating in pulsed or CW mode, CTT's GaN power amplifiers are an especially attractive choice for new multi-functioned systems that effectively conserve weight, space and power consumption.

CTT's amplifiers are designed for commercial, industrial and military applications. For military applications power amplifiers are manufactured to meet the requirements of MIL-STD-883, Methods 2010 and 2017, with soldering compliant to J-STD-001. These procedures also make the amplifiers excellent choices for applications requiring MIL-E-5400.

Microwave Power Modules

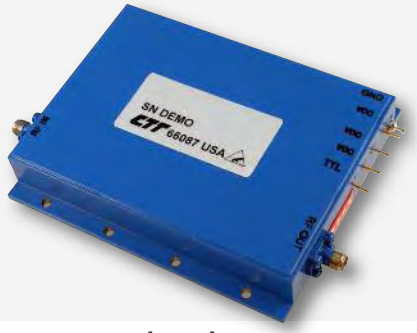
Microwave Power Modules (MPMs) typically consist of a low-noise, high-gain solid-state power amplifier (SSPA) driving a relatively low-gain, high-efficiency Helix traveling-wave tube (TWT) with a control and protection module providing electrical power to both the SSPA and TWT. Many of CTT's high power GaN amplifiers are suitable for MPM as well as TWT replacement applications.

MPMs have found applications in systems ranging from satellite communications (SATCOM) to electronic warfare (EW) and synthetic aperture radar (SAR). Combining the best features of both solid-state and vacuum device technology, MPMs have been able to offer significant performance advantages in reduced size and weight, reduced noise coupled with large improvements in efficiency.

With the current state of development of GaN devices CTT has produced SSPAs that are effectivity an all "solid-state MPM" offering increased reliability and lower cost than conventional MPMs.

GaN Power Amplifiers
Wideband, Ultra-Wideband & Narrowband up to 1kW

- **High Power Density**
- **Reduced Footprint – Compact Size**
- **Increased Efficiency**
- **Lower Cost-per-Watt**
- **Custom Engineered Options (CEOs)** (See page 36)
- **Individual Driver & Power Amplifiers Available** (See page 22)



Wideband & Ultra-Wideband Power Amplifiers (CW)

GaN Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	Psat Band Edge (+dBm)	VSWR In/Out	Volts (DC)	Current @SSG (mA)	Current @Psat (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Typ	Min	Max		Typ	Typ	
AGX/020-3545	0.1-2.0	45	2	4	36.0	35.0	2:1	30	300	700	HPC8
AGX/002025-3835	0.2-2.5	38	3.0	4	39.0	38.0	2:1	30	600	990	HPC8
AGM/030-4252	1.0-3.0	52	2.5	4	42.5	42.0	2:1	30	800	2400	HDS12
AGO/030-4045	1.5-3.0	45	2.0	5	40.0	40.0	2:1	30	800	1800	HDS12
AGO/030-4343	1.5-3.0	43	2.0	5	43.0	43.0	2:1	30	900	3700	HDS12
AGO/030-4646	1.5-3.0	46	2.0	5	46.0	46.0	2:1	30	1600	6600	HDS12
AGO/040-4045	2-4	45	2.0	5	40.0	40.0	2:1	30	800	1800	NDS12
AGO/040-4343	2-4	43	2.0	5	43.0	43.0	2:1	30	900	3700	NDS12
AGO/040-4646	2-4	46	2.0	5	46.0	46.0	2:1	30	1600	6600	NDS12
AGX/005060-4050	0.5-6	50	3.0	4.5	39.5	39.0	2:1	30	800	2400	HDS12
AGM/060-4343	2-6	43	2.5	5	43.0	43.0	2:1	30	1820	4200	NDS12
AGM/060-4356	2-6	56	2.5	5	43.0	43.0	2:1	30	1880	4260	NDS12
AGM/060-4646	2-6	46	2.5	5	46.0	45.5	2:1	30	3420	7700	NDS12
AGM/060-4658	2-6	58	2.5	5	46.0	45.5	2:1	30	3500	7800	NDS12
AGM/060-4955	2-6	55	2.5	5	50.0	49.0	2:1	30	6400	14200	SP
AGM/060-5056	2-6	56	2.5	5	50.5	50.0	2:1	30	6400	17200	SP
AGM/060-5257	2-6	57	3.0	5	52.0	52.0	2:1	30	11700	27000	SP
AGW/085-4655	5.5-8.5	55	3	5	46.0	46.0	2:1	30	3000	7200	SP
AGW/085-4952	5.5-8.5	52	3	5	49.0	48.5	2:1	30	5600	12800	SP

New Products

Continued on Next Page

GaN Power Amplifiers
Wideband Power Amplifiers (CW) up to 1kW

Wideband & Ultra-Wideband Power Amplifiers (CW)

GaN Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	Psat Band Edge (+dBm)	VSWR In/Out	Volts (DC)	Current @SSG (mA)	Current @Psat (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Typ	Min	Max		Typ	Typ	
AGW/105-4045	8.5-10.5	45	2.5	7	40.0	40.0	2:1	30	1100	2150	NGX15A
AGW/105-4344	8.5-10.5	44	3.0	7	43.0	43.0	2:1	30	1500	3800	NGX15A
AGW/105-4650	8.5-10.5	50	3.0	7	46.5	46.0	2:1	30	3000	7000	NDX14A
AGW/105-4855	8.5-10.5	55	3.0	7	49.0	48.0	2:1	30	4700	15800	NQX14A
AGW/105-5061	8.5-10.5	61	3.0	7	52.0	50.0	2:1	30	6080	15900	SP
AGW/110-4045	7.0-11.0	45	2.5	7	40.0	40.0	2:1	30	1100	2150	NGX15A
AGW/110-4344	7.0-11.0	44	3.0	7	43.5	43.0	2:1	30	1500	3800	NGX15A
AGW/110-4650	7.0-11.0	50	3.0	7	46.5	46.0	2:1	30	3000	7000	NDX14A
AGW/110-4855	7.0-11.0	55	3.0	7	49.0	48.0	2:1	30	4700	15800	NQX14A
AGW/110-5061	7.0-11.0	61	3.0	7	52.0	50.0	2:1	30	6080	15900	SP
AGO/120-4450	6-12	50	3.0	7	46	44.0	2:1	30	1700	6000	NQX14A
AGO/120-4750	6-12	50	3.0	7	49	47.0	2:1	30	2700	12000	SP
AGO/120-5050	6-12	50	3.0	7	52	50.0	2:1	30	6000	15800	SP
AGO/120-5061	6-12	61	3.0	7	52	50.0	2:1	30	6080	15900	SP
AGX/0218-3735	2-18	35	3.0	7	37	36.5	2.2:1	28	850	1500	NGX15A
AGX/0218-3747	2-18	47	3.0	7	37	36.5	2.2:1	28	950	1600	NGX15A
AGX/0218-3942	2-18	42	3.0	7	39	38.5	2.2:1	32	1350	2800	NGX15A
AGX/0218-3954	2-18	54	3.0	7	39	38.5	2.2:1	32	1400	2900	NGX15A
AGX/0318-4242	3-18	42	3.5	7	42	41	2:1	32	1900	4200	NDX14A
AGX/0318-4252	3-18	52	3.5	7	42	41	2:1	32	1980	4280	NDX14A
AGX/0318-4453	3-18	53	3.5	7	44	43	2:1	32	3400	8000	NQX14A
AGX/0318-4465	3-18	65	3.5	7	44	43	2:1	32	3500	8100	NQX14A
AGM/180-3745	6-18	45	2.5	6	37	36.5	2:1	30	850	1600	NGX15A
AGM/180-3948	6-18	48	2.5	6	39	38	2:1	30	1700	2900	NGX15A
AGM/180-4243	6-18	43	3.0	6	42	41	2:1	30	3000	4800	NDX14A
AGM/180-4252	6-18	52	3.0	6	42	41	2:1	30	3050	4860	NDX14A
AGM/180-4442	6-18	42	2.5	6	44	43	2:1	30	5600	11000	NQX14A
AGM/180-4450	6-18	50	3.0	6	44	43	2:1	30	5700	11060	NQX14A
AGM/180-4648	6-18	48	3.0	6	46	45.5	2:1	30	12800	17950	SP
AGM/180-4655	6-18	55	3.0	6	46	45.5	2:1	30	12900	18000	SP
AGO/180-3745	8-18	45	2.5	6	37	36.5	2:1	30	850	1600	NGX15A
AGO/180-3948	8-18	48	2.5	6	39	38	2:1	30	1400	2800	NGX15A
AGO/180-4243	8-18	43	3.0	6	42	41	2:1	30	3000	4860	NDX14A
AGO/180-4450	8-18	50	3.0	6	44	43	2:1	30	5700	11060	NQX14A
AGO/180-4648	8-18	48	3.0	6	46	45.5	2:1	30	12800	17950	SP

New Products

Expediting RF Design for TCDL

Originally designed for voice transmission, military tactical radios are now used to transmit and receive digital voice, data, and video between vehicles and command and control facilities. These data link radios are being interfaced with a variety of computers and monitors. Even while newly designed systems proliferate, a wide range of legacy platforms are undergoing upgrade to incorporate new data link capability. Clearly, the need for a common data link (CDL) solution to be used in multiple applications exists.

A relatively new common data link (CDL) compliant system is the tactical common data link (TCDL) which embodies characteristics most likely to meet the needs of the rapidly evolving demand envelope for both UAV and manned platforms. TCDL is a Ku-band digital data link that transmits wide-bandwidth information using CDL wave-form standards.

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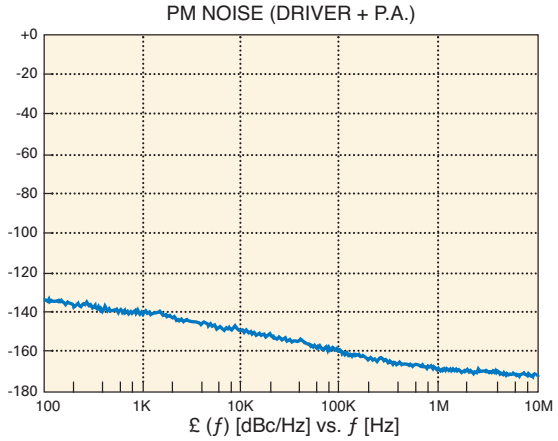
GaN Power Amplifiers
Narrowband Power Amplifiers (CW) up to 1kW

CTT GaN Power Amplifier
Phase Noise Performance



Narrowband Power Amplifiers (CW)

GaN Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	Psat CW (Watts)	VSWR In/Out	Volts (DC)	Current @SSG (mA)	Current @Psat (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Min	Max		Typ	Typ	
AGW/025-3814	1.6-2.5	14	1.0	6	38.0	6.3	2:1	30	250	650	SP
AGW/025-3840	1.6-2.5	40	2.0	6	38.0	6.3	2:1	30	600	1100	SP
AGW/025-4045	1.6-2.5	45	2.0	5	40.0	10.0	2:1	30	800	1500	HDS12
AGW/025-4343	1.6-2.5	43	2.0	5	43.0	20.0	2:1	30	900	3700	HDS12
AGW/025-4646	1.6-2.5	46	2.0	5	46.0	40.0	2:1	30	1600	6600	HDS12
AGW/035-4346	2.7-3.5	46	2.0	6	43.0	20.0	2:1	30	1700	3800	HDS12
AGW/035-4658	2.7-3.5	58	2.5	6	46.0	40.5	2:1	30	3500	7800	NDS12
AGW/035-5055	2.7-3.5	55	2.5	5	50.0	100.0	2:1	30	6400	14200	SP
AGW/060-3740	4.0-6.0	40	2.5	6	37.0	5.0	2:1	30	550	1100	HPC10
AGW/060-4044	4.0-6.0	44	2.5	6	40.0	10.0	2:1	30	930	1930	HDC12
AGW/060-4345	4.0-6.0	45	2.5	6	43.0	20.0	2:1	30	1700	3800	HDC12
AGW/060-4658	4.0-6.0	58	2.5	6	46.0	40.0	2:1	30	3500	7800	NDS12
AGW/060-4955	4.0-6.0	55	2.5	5	49.0	80.0	2:1	30	6400	14200	SP
AGW/060-5056	4.0-6.0	56	2.5	5	50.0	100.0	2:1	30	6400	17200	SP
AGW/060-5257	4.0-6.0	57	3.0	5	52.0	160.0	2:1	30	11700	27000	SP
AGN/064-4145	5.9-6.4	45	2.0	6	41.0	12.5	2:1	30	930	1930	HDC12
AGN/064-4346	5.9-6.4	46	2.0	6	43.0	20.0	2:1	30	1700	3800	HDC12
AGW/085-3740	6.4-8.5	40	2.5	7	37.0	5.0	2:1	30	550	1300	NGX15A
AGW/085-4346	6.4-8.5	46	2.5	7	43.0	20.0	2:1	30	1700	3800	NDX14A
AGW/085-4646	6.4-8.5	46	2.5	7	46.0	40.0	2:1	30	1700	3800	NDX14A
AGN/093-4346	8.5-9.3	46	2.0	6	43.0	20.0	2:1	30	1700	3800	NDX14A
AGN/093-4652	8.5-9.3	52	2.0	6	46.0	40.0	2:1	30	2200	7000	NDX14A
AGN/093-4855	8.5-9.3	55	2.0	6	48.0	63.0	2:1	30	3000	11000	NQX14A
AGN/099-4145	9.0-9.9	45	2.0	6	41.0	12.5	2:1	30	930	1950	NGX15A
AGN/099-4346	9.0-9.9	46	2.0	6	43.0	20.0	2:1	30	1700	3800	NDX14A
AGN/099-4652	9.0-9.9	52	2.0	6	46.0	40.0	2:1	30	2200	7000	NDX14A
AGN/099-4855	9.0-9.9	55	2.0	6	48.0	63.0	2:1	30	3000	11000	NQX14A
AGN/100-4145	9.1-10.0	45	2.0	6	41.0	12.5	2:1	30	930	1950	NGX15A
AGN/100-4346	9.1-10.0	46	2.0	6	43.0	20.0	2:1	30	1700	3800	NDX14A
AGN/100-4652	9.1-10.0	52	2.0	6	46.0	40.0	2:1	30	2200	7000	NDX14A
AGN/100-4855	9.1-10.0	55	2.0	6	48.0	63.0	2:1	30	3000	11000	NQX14A

New Products

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Turn ON Sequence: GaN & GaAs SSPAs

1. Mount the SSPA to the heat sink as described in **Heat Sinking Requirements**.
2. Connect the amplifier to the RF Input and RF Output cables. Ensure there is enough padding or attenuation between the amplifier and the load, so the SSPA (or test equipment) will not be damaged by high VSWR or high power.
3. Adjust the DC power supply voltage(s) to the value(s) specified for the particular SSPA. For example, this might be +30 VDC (or +28 to +50 VDC), +12 VDC, and -5 VDC.
4. Connect the DC power to the SSPA. Apply **ALL NEGATIVE** voltages to the SSPA **FIRST**, before applying the positive voltages. For this example, the sequence can be: -5V first, +12V and then +30V. **DO NOT** slowly turn up the voltages to the SSPA with the power supply or supplies connected.
5. If the unit is a CW SSPA, skip Step 5 and go directly to Step 6. If the unit is a Pulsed SSPA, the amplifier will be ON when the TTL is low; the amplifier will be OFF when the TTL is high or floating. If a different condition is required, consult the factory. Be sure to follow the specified conditions for maximum pulse width and duty cycle when setting the pulsed waveform parameters. If the maximum pulse width and duty cycle are exceeded, permanent damage or degradation may occur.
6. Set the RF generator to small signal level, turn on the RF signal generator to apply RF to the SSPA. Adjust the input power level to the desired range to get full output power.

Turn OFF Sequence (Pulsed & CW)

1. Turn OFF the signal generator.
2. If this is a Pulsed SSPA, turn OFF the pulse generator.
3. **ALL** external negative voltages should be left **ON and CONNECTED** until ALL positive voltages have been disconnected.
4. Disconnect positive voltages **FIRST**.

GaN Power Amplifiers
Narrowband Power Amplifiers (CW) up to 1kW (continued)

GaN Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	Psat CW (Watts)	VSWR In/Out	Volts (DC)	Current @SSG (mA)	Current @Psat (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Min	Max		Typ	Typ	
AGN/105-4145	9.5-10.5	50	2.0	6	41.0	12.5	2:1	30	950	1950	NGX15A
AGN/105-4346	9.5-10.5	46	2.0	6	43.0	20.0	2:1	30	1700	3800	NDX14A
AGN/105-4652	9.5-10.5	52	2.0	6	46.0	40.0	2:1	30	2200	7000	NDX14A
AGN/105-4855	9.5-10.5	55	2.0	6	48.0	63.0	2:1	30	3000	11000	NQX14A
AGN/105-4866	9.5-10.5	66	2.0	6	48.0	63.0	2:1	30	3080	11000	NQX14A
AGN/107-4145	9.9-10.7	45	2.0	6	41.0	12.5	2:1	30	950	1950	NGX15A
AGN/107-4346	9.9-10.7	46	2.0	6	43.0	20.0	2:1	30	1700	3800	NDX14A
AGN/107-4652	9.9-10.7	52	2.0	6	45.5	32.0	2:1	30	2200	7000	NDX14A
AGN/107-4855	9.9-10.7	55	2.0	6	47.5	56.0	2:1	30	3000	11100	NQX14A
AGN/145-4445	13.5-15.5	45	2.0	6	44.0	25.0	2:1	30	1500	6000	NGX15A
AGN/154-4752	13.5-15.5	52	2.0	6	47.0	50.0	2:1	30	2400	12000	NDX14A
AGN/154-5055	13.5-15.5	55	2.0	6	50.0	100.0	2:1	30	4600	24000	NQX14A

New Products

Heat Sinking Requirements for GaN & GaAs SSPAs

1. Units can operate at CASE temperature between -30°C to +70°C. For wider temperature range requirements contact the factory.
2. Proper heat sinking is **ABSOLUTELY** required, otherwise, permanent damage or degradation may occur. Heat sinks should be selected based on the dissipated power within the PA (ie: DC power into the unit in Watts, minus the RF output that is delivered to the load).
3. Thermal grease or some alternate highly-conductive thermal interface material should be applied between the mounting surface of the amplifier and the heat sink.
4. Good mechanical pressure is imperative to guarantee effective thermal transfer to the heat sink for reliable operation. Customers should use all mounting features provided on the amplifier units to apply this mechanical pressure.

Heat Sink Selection Example

ie: Amplifier Model AGW105-4855

- P_{diss} = Dissipated Power within the SSPA (AKA Heat)
- $P_{diss} = P_{DC}$ (Watts) – P_{out} (Watts) + P_{in} (Watts)
- P_{DC} = +30 VDC 13.0 Amps = 390 Watts
- P_{out} = RF Output Power = 63 Watts
- $P_{in} \approx$ 0 dBm = 1 Milliwatt – 0.001 Watt is negligible
- P_{diss} = 390 Watts – 63 Watts – 327 Watts

In this example a heat sink is selected for a temperature rise of +20°C, or less, due to ambient temperature and maximum allowable case temperature boundary conditions. Thermal resistance of the heat sink must therefore be: 20°C/327 Watts = 0.06°C/W or lower. Conclusion: A thermal resistant 0.06°C/W heat sink is needed for this amplifier. Based on this number, forced air cooling is necessary.

Optional Gating or Blanking Function

For CTT's CW amplifiers the blanking function can be built-in. In this case there is a TTL pin on the amplifier. When +5V (TTL high) or no voltage (floating) is applied, the amplifier is ON all the time. If the TTL is 0V (shorted to ground), the amplifier is turned OFF (the majority of DC current will be cut off while the bias, delay and protection circuits remain on). This turn ON/OFF time can vary from 250ns to 10ms. If faster speed is required consult the factory.

Engineered specifically to meet the stringent requirements imposed by many modern system designs, CTT's family of GaN power amplifiers, perform a wide range of functions making them ideal for applications in cutting-edge multi-function systems. Whether the application is narrowband, wideband or ultra-wideband, operating in pulsed or CW mode, CTT's GaN power amplifiers are an especially attractive choice for new multi-functioned systems that effectively conserve weight, space and power consumption.

The export of some CTT Inc. products are subject to current International Trade Regulations and Export Administration Regulations. Contact CTT for additional information.

GaN Power Amplifiers
Narrowband Power Amplifiers (Pulsed) up to 1kW

- **High Power Density**
- **Increased Efficiency**
- **Low Average Power Consumption**
- **Excellent Phase Linearity & Phase Linearity**
- **Low Thermal Noise**
- **Custom Engineered Options (CEOs)** (See page 36)

Narrowband Power Amplifiers (Pulsed)* [≤100 µS pulse width or 10% duty cycle.**]

GaN Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	Psat Peak (Watts)	VSWR In/Out	Volts (DC)	Current Psat (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Min	Max		Typ	
AGN/035-4959-P	3.1-3.5	59	2.0	6	49.0	80	2:1	30	–	SP
AGN/035-5262-P	3.1-3.5	62	2.0	6	51.8	150	2:1	30	–	SP
AGN/035-5565-P	3.1-3.5	65	2.0	6	54.5	280	2:1	30	–	SP
AGW/085-4858-P	5.5-8.5	58	3.0	6	47.8	60	2:1	30	–	SP
AGW/085-5060-P	5.5-8.5	60	3.0	6	50.0	100	2:1	30	–	SP
AGN/093-4652-P	8.5-9.3	52	2.0	6	46.0	40	2:1	30	7000	NDX14A
AGN/093-4957-P	8.5-9.3	57	2.0	6	49.0	80	2:1	30	13800	NQX14A
AGN/093-5260-P	8.5-9.3	60	2.0	6	52.0	160	2:1	30	27000	SP
AGN/096-4652-P	8.5-9.6	52	2.0	6	46.0	40	2:1	30	7000	NDX14A
AGN/096-4957-P	8.5-9.6	57	2.0	6	49.0	80	2:1	30	13800	NQX14A
AGN/096-5260-P	8.5-9.6	60	2.0	6	52.0	160	2:1	30	27000	SP
AGN/096-5360-P	8.5-9.6	60	2.0	6	53.0	200	2:1	42	–	SP
AGN/096-5660-P	8.5-9.6	60	2.0	6	56.0	400	2:1	42	–	SP
AGN/096-5360-P	8.5-9.6	60	2.5	7	53.0	200	2:1	40	24 A	SP
AGN/096-5664-P	8.5-9.6	64	2.5	7	56.0	400	2:1	40	45 A	SP
AGN/098-5864-P	8.5-9.8	64	2.5	7	58.0	600	2:1	50	58 A	SP
AGN/098-6060-P	8.5-9.8	60	3.0	7	60.0	1000	2:1	50	116 A	SP
AGN/099-4652-P	9.0-9.9	52	2.0	6	46.0	40	2:1	30	7000	NDX14A
AGN/099-4957-P	9.0-9.9	57	2.0	6	49.0	80	2:1	30	13800	NQX14A
AGN/099-5260-P	9.0-9.9	60	2.0	6	52.0	160	2:1	30	27000	SP
AGN/100-5360-P	9.0-10.0	60	2.0	6	53.0	200	2:1	42	–	SP
AGN/100-5660-P	9.0-10.0	60	2.0	6	56.0	400	2:1	42	–	SP
AGN/105-4652-P	9.5-10.5	52	2.0	6	46.0	40	2:1	30	7000	NDX14A
AGN/105-4957-P	9.5-10.5	57	2.0	6	49.0	80	2:1	30	13800	NQX14A
AGN/105-5260-P	9.5-10.5	60	2.0	6	52.0	160	2:1	30	27000	SP
AGN/107-4652-P	9.9-10.7	52	2.0	6	46.0	40	2:1	30	7000	NDX14A
AGN/107-4957-P	9.9-10.7	57	2.0	6	49.0	80	2:1	30	13800	NQX14A
AGN/107-5260-P	9.9-10.7	60	2.0	6	52.0	160	2:1	30	27000	SP

New Products ***AGN-P pulse mode series amplifiers can ONLY operate at pulse mode**, requiring an external TTL signal to turn On/Off the amplifier. The delay plus rise time, or delay plus fall time, is less than 500µS. Shorter response times are available, ie: 250µS or faster. Contact the factory. **Exceeding 10% duty will damage the amplifier.

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GaAs Solid-State Power Amplifiers for Commercial and Military Multi-Function System Design

Both commercial and military systems will continue to be developed throughout the entire electromagnetic spectrum. Twenty-year federal spectrum requirements for radar bands L through Ku bear out the need for this requirement. With five to ten times the power handling capability, solid-state power amplifiers, employing GaN devices, are ideal for such applications making them suitable replacements in systems where TWTs are currently employed.

Although the use of GaN technology in these applications is growing, CTT's GaAs-based power amplifiers continue to offer specific benefits in low-power low-voltage systems, as well as in those system applications demanding high linearity – GaAs having established a long record of reliability, low cost, wide availability and excellent overall performance.

The nature of continuingly emerging applications rely on the complexities made possible by advancements from the digital arena, requiring electronic systems of the future to incorporate faithfully amplified complex wave forms, with multiple modulation schemes and pulse patterns distributed over wide bandwidths.

Multi-function systems will have to transmit and receive with maximum flexibility across a wide bandwidth, sometimes in adjacent channels and/or within the same frequency and/or time slot.

This evolution points toward multiple use hardware to maximize versatility and minimize multi-function cost, size, weight and power. In one specific application this versatility proves its value by limiting a radar's succeptibility to jamming by operating in a frequency-agile mode. This forces any jamming effort to spread its power over the whole bandwidth, even though the radar is only using a very narrow instantaneous bandwidth.

More advanced systems will employ "look ahead" frequency agility wherein the system selects the next operating frequency and checks to see that it is unoccupied. If clear, that frequency is used. If not, another frequency selection is checked, then made.

20-Year Federal Spectrum Radar Requirement for Specific Bands

Band	Frequency	Usage
L	1215–1390 MHz	Air Traffic Control (ATC), Synthetic Aperture Radar (SAR), DoD early warning air defense, battlefield, shipborne long-range surveillance
S	2700–3100 MHz	ATC, maritime, weather, DoD shipborne, airborne, ground surveillance
S	3100–3650 MHz	DoD surveillance and air defenses (airborne, shipborne, land-based), ATC, SAR
C	5250–5925 MHz	NOAA weather, FAA TDWR; DoD surveillance and air defenses (airborne, shipborne, land-based)
X	8.5–10.55 GHz	Airborne and shipborne surveillance and navigation fire control, battlefield, maritime, weather, test range, airborne radio navigation, ATC, SAR
Ku	13.25–14.20 GHz	Airborne and shipborne search and acquisition Doppler, airborne weather, environmental research
Ku	15.40–17.30 GHz	Airborne and shipborne multi-mode search, battlefield, fire-control, precipitation, atmospheric research

CTT engineers have developed a proprietary open architecture/common platform which relies on advanced multi-octave combiner design and unique substrate material selection. The result is adaptable, modular amplifiers requiring only a single supply voltage.

Whether commercial or military, radar system power consumption is an increasingly important design criteria. CTT offers TTL-controlled main bias shut-off circuitry matched to the system's pulse operation. With the amplifier drawing much less power between pulses, both total power consumption and temperature rise is reduced.

In general, most pulse radars operate at a duty cycle of 10% or less. As such, CTT's pulsed power amplifiers are an attractive solution. Using a TTL control, by turning off the FETs (drain) the amplifier only consumes 100 to 200 mA for the logic and bias circuit. When the TTL is turned on, the unit will operate after a short rise time. During this "on time" the amplifier's power consumption is identical to that in CW operation. Thus, when the duty cycle is 10% or less, the unit will consume much less power. Therefore, the amplifier's heat sink and power supply can be significantly smaller.

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Power Amplifiers are CTT's forte. Over the past 20 years, the preponderance of our research and development has been devoted to this market segment. As a result, numerous proprietary, unique approaches to microwave power amplification have been incorporated in, both our narrow-band, and broad-band power amplifiers. For example, development in low-loss broad-band output stage power combiners allow CTT to deliver 6–18 GHz, 40 Watt amplifiers in volume – an industry first!

In narrow band applications, CTT's ability to deliver 1 Kilowatt at X-band and 200 Watts at C-band has allowed system designers to eliminate intermediate amplification stages formerly required; thus, improving overall system reliability as well as reducing cost.

CTT's most recent contribution to microwave power is focused on the automated production of power modules.

This capital investment has improved individual productivity by a factor of 3, and resulted in the introduction of more than 90 new power amplifiers!

These GaAs FET and GaN FET power amplifiers are available in narrowband (APN, ASN), wideband (APW, ASW), octave (APO, ASO), and multi-octave band (APM, ASM). Covering from 0.5 to 15 GHz, the AP series are designed to operate as linear amplifiers, to maximize third order

GaAs Power Amplifiers
Wideband 0.2 to 200 Watts

- **Solid-State Power Amplifiers from 0.2 to 100 Watts**
- **Frequency Coverage from 100 MHz to 40 GHz**
- **MIC Thin-Film Design for High Reliability**
- **Custom Engineered Options (CEOs)** (See page 36)
- **Replacements for Legacy GaAs Power Amplifiers**

Wideband Power Amplifiers

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APM/020-2416	0.5-2.0	16	1.00	8.0	24	2:1	15	280	HC2
APM/020-2425	0.5-2.0	25	1.00	4.5	24	2:1	15	330	HC2
APM/020-2435	0.5-2.0	35	1.25	4.5	24	2:1	15	380	HC2
APM/020-2715	0.5-2.0	15	1.00	8.5	27	2:1	15	450	HC2
APM/020-2724	0.5-2.0	24	1.25	5.0	27	2:1	15	520	HC2
APM/020-2733	0.5-2.0	33	1.50	4.5	27	2:1	15	580	HC2
APM/020-2746	0.5-2.0	46	1.75	4.5	27	2:1	15	680	HC4
APM/020-3010	0.5-2.0	10	1.00	8.5	30	2:1	15	550	HS2
APM/020-3027	0.5-2.0	27	1.25	6.0	30	2:1	15	720	HS4
APM/020-3036	0.5-2.0	36	1.50	4.5	30	2:1	15	800	HS4
APM/020-3045	0.5-2.0	45	1.75	4.5	30	2:1	15	900	HS4
APM/020-3326	0.5-2.0	26	1.25	8.0	33	2:1	15	1200	HPS6
APM/020-3335	0.5-2.0	35	1.50	5.0	33	2:1	15	1250	HPS6
APM/020-3344	0.5-2.0	44	1.50	5.0	33	2:1	15	1300	HPS6
APM/020-3532	0.5-2.0	32	1.50	6.0	35	2:1	15	2800	HDS8
APM/020-3542	0.5-2.0	42	2.00	5.0	35	2:1	15	2850	HDS8
APM/020-3635	0.5-2.0	35	1.50	5.0	36	2:1	15	3000	HDS8
APM/020-3644	0.5-2.0	44	2.00	5.0	36	2:1	15	3050	HDS8
APO/020-2724	1.0-2.0	24	1.00	5.0	27	2:1	15	520	HC2
APO/020-2733	1.0-2.0	33	1.25	4.5	27	2:1	15	580	HC4
APO/020-3027	1.0-2.0	27	1.25	5.5	30	2:1	15	720	HS4
APO/020-3046	1.0-2.0	46	1.50	5.0	30	2:1	15	830	HS6
APO/020-3327	1.0-2.0	27	1.25	8.0	33	2:1	15	1200	HPS6
APO/020-3336	1.0-2.0	36	1.50	5.0	33	2:1	15	1250	HPS6
APO/020-3345	1.0-2.0	45	1.50	5.0	33	2:1	15	1300	HPS6
APO/020-3535	1.0-2.0	35	1.50	5.5	35	2:1	15	2400	HPS8
APO/020-3545	1.0-2.0	45	2.00	5.0	35	2:1	15	2500	HPS8
APO/020-3735	1.0-2.0	35	1.50	5.0	37	2:1	15	3600	HPS10
APO/020-3745	1.0-2.0	45	2.00	5.0	37	2:1	15	3700	HPS10
APO/020-4040	1.0-2.0	40	1.50	8.0	40	2:1	15	7700	HDS14
APO/020-4050	1.0-2.0	50	1.50	8.0	40	2:1	15	7800	HDS14

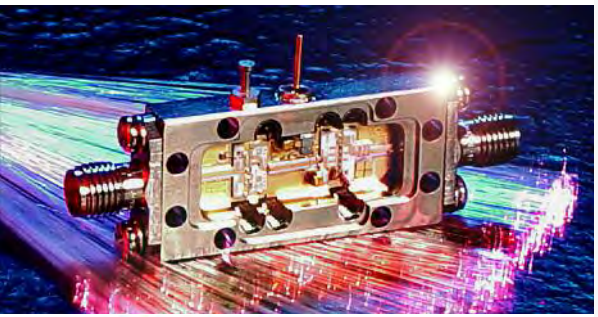
New Products

Continued on Next Page

intercept point. The AS series operate in the saturated mode to attain the maximum output power. The CW output power ranges from 3W to 100W. Special pulsed amplifiers can be ordered with even higher output power. CTT's unique MIC modules are designed to obtain higher output power, better VSWR and wider bandwidth. These MIC thin-film modules are eutectically attached to metal carriers and mechanically mounted to the aluminum housings. Many units now use the state-of-the-art internally matched power FETs for the final stages.

All units have built in regulator and/or sequential bias circuit for protection. The specifications shown are guaranteed at +25°C case temperature.

These units are ideally suitable for commercial, industrial, and military applications which need low maintenance, good performance, high reliability and quick delivery. They are most suitable for TWT replacement, IPA, driver amplifier, transmitter, radar, EW, RPV, UAV, point-to-point and datalink communications.



GaAs Power Amplifiers
Wideband 0.2 to 200 Watts

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APM/025-2724	0.8-2.5	24	1.25	5.0	27	2:1	15	520	HC2
APM/025-2733	0.8-2.5	33	1.50	5.0	27	2:1	15	580	HC2
APM/025-2746	0.8-2.5	46	1.75	5.0	27	2:1	15	680	HC4
APM/025-3027	0.8-2.5	27	1.25	6.0	30	2:1	15	720	HS4
APM/025-3036	0.8-2.5	36	1.50	5.0	30	2:1	15	800	HS4
APM/025-3045	0.8-2.5	45	1.75	5.0	30	2:1	15	900	HS4
APM/025-3326	0.8-2.5	26	1.25	8.0	33	2:1	15	1200	HPS6
APM/025-3335	0.8-2.5	35	1.50	5.0	33	2:1	15	1250	HPS6
APM/025-3344	0.8-2.5	44	1.50	5.0	33	2:1	15	1300	HPS6
APO/040-2724	2-4	24	1.00	5.5	27	2:1	15	450	HS4
APO/040-2738	2-4	38	1.00	4.0	27	2:1	15	520	HS4
APO/040-3033	2-4	33	1.25	4.0	30	2:1	15	870	HS6
APO/040-3045	2-4	45	1.50	4.0	30	2:1	15	950	HS6
APO/040-3330	2-4	30	1.25	5.5	33	2:1	15	1350	HPS6
APO/040-3345	2-4	45	1.50	4.0	33	2:1	15	1450	HPS6
APO/040-3525	2-4	25	1.50	8.0	35	2:1	15	2400	HPS8
APO/040-3540	2-4	40	1.50	4.0	35	2:1	15	2500	HPS8
APO/040-3730	2-4	30	1.50	8.0	37	2:1	15	4150	HPS10
APO/040-3737	2-4	37	1.50	5.5	37	2:1	15	4200	HPS10
APO/040-4032	2-4	32	1.75	8.0	40	2:1	15	8600	HDS14
APO/040-4047	2-4	47	2.00	4.0	40	2:1	15	8700	HDS14
APM/060-2720	2-6	20	1.00	5.5	27	2:1	15	450	HS4
APM/060-2730	2-6	30	1.25	4.5	27	2:1	15	500	HS4
APM/060-2736	2-6	36	1.50	4.5	27	2:1	15	580	HS6
APM/060-3027	2-6	27	1.25	4.5	30	2:1	15	900	HS6
APM/060-3032	2-6	32	1.50	4.5	30	2:1	15	1000	HS6
APM/060-3040	2-6	40	1.75	4.5	30	2:1	15	1050	HS6
APM/060-3335	2-6	35	1.50	4.5	33	2:1	15	1900	HPS6
APM/060-3342	2-6	42	1.50	4.5	33	2:1	15	2000	HPS6
APM/060-3636	2-6	36	1.75	6.0	36	2:1	15	3000	HPS10
APM/060-3646	2-6	46	2.00	4.5	36	2:1	15	3100	HPS10
APM/060-3932	2-6	32	1.75	6.0	39	2:1	15	5300	HDS12
APM/060-3944	2-6	44	2.00	4.5	39	2:1	15	5350	HDS12
APM/060-4148	2-6	48	2.00	4.5	41	2:1	15	10100	SP

New Products

Continued on Next Page

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GaAs Power Amplifiers
Wideband 0.2 to 200 Watts (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	**Min**	**Min**	**Max**	**Max**	**Min**	**Max**	**Typ**	**Typ**	
APM/080-2419	2-8	19	1.50	5.0	24	2:1	15	350	HC4
APM/080-2430	2-8	30	1.50	4.5	24	2:1	15	400	HC4
APM/080-2440	2-8	40	1.50	4.5	24	2:1	15	460	HC4
APM/080-2724	2-8	24	1.50	5.5	27	2:1	15	700	HC6
APM/080-2734	2-8	34	1.50	5.5	27	2:1	15	750	HC6
APM/080-2740	2-8	40	1.50	5.5	27	2:1	15	830	HC6
APM/080-3021	2-8	21	1.50	6.0	30	2:1	15	1100	HC6
APM/080-3036	2-8	36	2.00	5.5	30	2:1	15	1250	HC8
APM/080-3326	2-8	26	1.50	6.5	33	2:1	15	1950	HPC8
APM/080-3334	2-8	34	2.00	6.0	33	2:1	15	2000	HPC8
APM/080-3343	2-8	43	2.00	6.0	33	2:1	15	2050	HPC8
APO/080-2430	4-8	30	1.00	4.5	24	2:1	15	400	HC4
APO/080-2440	4-8	40	1.25	4.5	24	2:1	15	460	HC4
APO/080-2724	4-8	24	1.25	5.0	27	2:1	15	700	HC6
APO/080-2734	4-8	34	1.25	5.0	27	2:1	15	750	HC6
APO/080-2740	4-8	40	1.25	5.0	27	2:1	15	830	HC6
APO/080-3021	4-8	21	1.25	6.0	30	2:1	15	1100	HC6
APO/080-3033	4-8	33	1.50	5.0	30	2:1	15	1250	HC8
APO/080-3045	4-8	45	1.50	5.0	30	2:1	15	1330	HC8
APO/080-3326	4-8	26	1.50	6.5	33	2:1	15	1950	HPC8
APO/080-3334	4-8	34	2.00	6.0	33	2:1	15	2000	HPC8
APO/080-3342	4-8	42	2.00	5.0	33	2:1	15	2050	HPC8
APO/080-3430	4-8	30	1.50	6.0	34	2:1	15	2700	HPC10
APO/080-3445	4-8	45	2.00	5.0	34	2:1	15	2800	HPC10
APO/080-3637	4-8	37	1.50	5.0	36	2:1	15	5300	HDC12
APO/080-3648	4-8	48	2.00	5.0	36	2:1	15	5400	HDC12
APO/080-3930	4-8	30	2.00	8.0	39	2:1	15	10.0A	HDC12
APO/080-3942	4-8	42	2.00	5.0	39	2:1	15	10.1A	HDC12
APM/120-2323	4-12	23	2.00	5.5	23	2:1	12	420	HX4
APM/120-2333	4-12	33	2.00	5.0	23	2:1	12	470	HX4
APM/120-2727	4-12	27	2.00	5.5	27	2:1	12	770	HPX6
APM/120-2736	4-12	36	2.00	5.0	27	2:1	12	820	HPX6
APO/120-2323	6-12	23	1.50	5.5	23	2:1	12	420	HX4
APO/120-2727	6-12	27	2.00	5.5	27	2:1	12	770	HPX6
APO/120-3030	6-12	30	2.00	5.5	30	2:1	15	1400	HPX8
APO/120-3040	6-12	40	2.00	5.0	30	2:1	15	1450	HPX8
APO/120-3434	6-12	34	2.00	5.5	34	2:1	15	3000	HPX10
APO/120-3444	6-12	44	2.00	5.0	34	2:1	15	3100	HPX10
APO/120-3637	6-12	37	2.00	5.5	36	2:1	15	5800	PDX
APO/120-3647	6-12	47	2.00	5.5	36	2:1	15	5900	PDX

New Products

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GaAs Power Amplifiers
Wideband 0.2 to 200 Watts (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APW/124-3433	8-12	33	2.00	8.0	34	2:1	12	3.3A	HPX10
APW/124-3740	8-12	40	2.50	8.0	37	2:1	12	7.6A	PDX
APW/124-3940	8-12	40	2.50	8.0	39	2:1	12	12.0A	PQX
APW/124-2420	8-12.4	20	1.25	5.0	24	2:1	12	500	HX4
APW/124-2430	8-12.4	30	1.50	4.5	24	2:1	12	550	HX4
APW/124-2439	8-12.4	39	1.50	4.5	24	2:1	12	600	HX6
APW/124-2733	8-12.4	33	1.50	6.0	27	2:1	12	900	HPX8
APW/124-2742	8-12.4	42	1.50	6.0	27	2:1	12	960	HPX8
APW/124-3034	8-12.4	34	1.75	6.0	30	2:1	12	1600	HPX8
APW/124-3043	8-12.4	43	1.75	6.0	30	2:1	12	1650	HPX8
APX/0218-2319	2-18	19	2.00	8.0	23	2:1	12	800	HX4
APX/0218-2324	2-18	24	2.50	8.0	23	2:1	12	900	HX4
APX/0218-2330	2-18	30	2.50	8.0	23	2:1	12	980	HX6
APX/0218-2718	2-18	18	2.00	8.0	27	2.2:1	15	1000	HPX6
APX/0218-2730	2-18	30	2.00	7.0	27	2.2:1	15	1050	HPX6
APX/0218-2742	2-18	42	2.50	7.0	27	2.2:1	15	1120	HPX6
APM/180-2324	6-18	24	1.50	6.0	23	2:1	12	600	HX4
APM/180-2335	6-18	35	1.75	6.0	23	2:1	12	700	HX6
APM/180-2623	6-18	23	2.00	8.0	26	2:1	12	770	HPX6
APM/180-2627	6-18	27	2.00	6.0	26	2:1	12	850	HPX6
APM/180-2639	6-18	39	2.00	6.0	26	2:1	12	950	HPX6
APM/180-2723	6-18	23	2.00	8.0	27	2:1	12	770	HPX6
APM/180-2727	6-18	27	2.00	6.0	27	2:1	12	850	HPX6
APM/180-2739	6-18	39	2.00	6.0	27	2:1	12	950	HPX6
APM/180-2930	6-18	30	2.00	6.0	29	2:1	12	1550	HDX8
APM/180-2936	6-18	36	2.00	6.0	29	2:1	12	1600	HDX8
APM/180-2941	6-18	41	2.00	6.0	29	2:1	12	1650	HDX8
APM/180-3030	6-18	30	2.00	6.0	30	2:1	12	1550	HDX8
APM/180-3036	6-18	36	2.00	6.0	30	2:1	12	1600	HDX8
APM/180-3041	6-18	41	2.00	6.0	30	2:1	12	1650	HDX8
APM/180-3333	6-18	33	2.00	8.0	33	2:1	12	3.3A	HPX10
APM/180-3338	6-18	38	2.00	8.0	33	2:1	12	3.4A	HPX10
APM/180-3640	6-18	40	2.50	8.0	36	2:1	12	7.6A	PDX
APM/180-3648	6-18	48	2.50	8.0	36	2:1	12	7.7A	PDX
APM/180-3832	6-18	32	2.50	8.0	38	2:1	12	11.9A	PQX
APM/180-3840	6-18	40	2.50	8.0	38	2:1	12	12.0A	PQX
ASM/180-4032	6-18	32	2.50	8.0	40*	2:1	12	12.0A	PQX
ASM/180-4040	6-18	40	2.50	8.0	40*	2:1	12	12.0A	PQX

New Products

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CTT can provide replacements for many hard to find amplification products including those formerly produced by Amplica, Avantek Inc., Celeritek, and Watkins-Johnson Company (WJ).

Amplica, Inc.

Avantek

CELERITEK

WATKINS-JOHNSON

GaAs Power Amplifiers
Wideband 0.2 to 200 Watts (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APX/0220-2219	2-20	19	2.50	8.5	22	2.2:1	12	720	HX4
APX/0220-2224	2-20	24	2.75	8.5	22	2.2:1	12	800	HX4
APX/0220-2230	2-20	30	3.00	8.5	22	2.2:1	12	880	HX6
APW/265-2317	18-26.5	17	2.50	8.0	23	2:1	12	470	GK4
APW/265-2322	18-26.5	22	2.50	7.5	23	2:1	12	530	GK6
APW/265-2328	18-26.5	28	2.50	7.0	23	2:1	12	600	GK6
APW/265-2524	18-26.5	24	2.50	7.5	25	2:1	12	850	HDK8
APW/265-2530	18-26.5	30	2.50	7.0	25	2:1	12	920	HDK8
APW/265-2536	18-26.5	36	2.50	7.5	25	2:1	12	980	HDK8
APW/265-2735	18-26.5	35	2.50	7.0	27	2:1	12	1300	HDK8
APW/265-2741	18-26.5	41	2.50	7.0	27	2:1	12	1360	HDK8
APW/265-3030	18-26.5	30	2.50	7.0	30	2:1	12	2000	GDK8
APW/265-3036	18-26.5	36	2.50	7.0	30	2:1	12	2050	GDK8
APW/320-3030	26.5-32.0	30	2.50	7.0	30	2:1	12	2000	GDK8
APW/320-3036	26.5-32.0	36	2.50	7.0	30	2:1	12	2050	GDK8
APW/400-2025	26.5-40.0	25	2.50	8.0	20	2.5:1	12	700	GPK6
APW/400-2030	26.5-40.0	30	2.50	8.0	20	2.5:1	12	780	GPK6
APW/400-2035	26.5-40.0	35	2.50	8.0	20	2.5:1	12	860	GPK6

New Products

Power Amplifier Comments:

1. Proper **heat sinking** is **REQUIRED** to keep the **CASE** temperature below +70°C. Otherwise, permanent damage or degradation may occur.
2. CTT can provide replacements for many hard to find products including those formerly produced by Amplica, Avantek, Celeritek, and Watkins-Johnson Company (WJ).
3. Noise figure will rise 0.015 dB/°C typically as the temperature increases.
4. P1dB will drop approximately 1 dB from +25°C to +70°C.
5. All units contain internal voltage regulators.
6. TTL control, pulsed amplification, monitor, detector and DC-DC power supplies are optional.
7. Consult the factory for additional gain, power, frequencies, temperature compensation or any special functions.
8. SP = Special Enclosure. Please contact the factory for outline drawing.
9. * = Saturated power (All AS Series amplifiers).

GaAs Power Amplifiers
Narrowband Up to 1 Kilowatt

Narrowband Power Amplifiers

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APW/027-3730	1.7-2.7	30	1.50	8.0	37	2:1	15	4150	HPS10
APW/027-3737	1.7-2.7	37	1.50	5.5	37	2:1	15	4200	HPS10
APW/027-4032	1.7-2.7	32	1.75	8.0	40	2:1	15	8600	HDS14
APW/027-4047	1.7-2.7	47	2.00	4.0	40	2:1	15	8700	HDS14
APW/032-3345	2.7-3.2	45	1.50	4.0	33	2:1	15	1450	HPS6
APW/032-3840	2.7-3.2	40	0.75	4.5	38	1.5:1	15	4500	HPS10
APW/032-4140	2.7-3.2	40	0.75	4.5	41	1.5:1	15	7300	HDS14
APW/035-2738	2.1-3.5	38	1.00	4.0	27	2:1	15	520	HS4
APW/035-3033	2.1-3.5	33	1.00	4.0	30	2:1	15	870	HS6
APW/035-3045	2.1-3.5	45	1.00	4.0	30	2:1	15	950	HS6
APW/035-3330	2.1-3.5	30	1.00	5.5	33	2:1	15	1350	HPS6
APN/035-3540	3.1-3.5	40	0.75	4.0	35	1.5:1	15	2500	HPS10
APN/035-3840	3.1-3.5	40	0.75	4.5	38	1.5:1	15	4500	HPS10
APN/035-4140	3.1-3.5	40	0.75	4.5	41	1.5:1	15	7300	HDS14
ASN/035-4343	3.1-3.5	43	0.75	4.5	43	1.5:1	15	12000	SP
ASN/035-4646	3.1-3.5	46	0.75	4.5	46	1.5:1	15	22500	SP
ASN/035-4040	3.1-3.5	40	0.75	4.5	40*	1.5:1	15	4500	HPS10
ASN/035-4240	3.1-3.5	40	0.75	4.5	42*	1.5:1	15	7400	HDS14
APN/042-3840	3.4-4.2	40	0.75	4.5	38	1.5:1	15	4500	HPS10
APN/042-4140	3.4-4.2	40	0.75	4.5	41	1.5:1	15	7300	HDS14
ASN/042-4040	3.4-4.2	40	0.75	4.5	40*	1.5:1	15	4500	HPS10
APN/050-3840	4.4-5.0	40	0.75	5.0	38	1.5:1	15	5300	HPC10
APN/050-4144	4.4-5.0	44	0.75	5.0	41	1.5:1	15	8500	HDC12
ASN/050-4040	4.4-5.0	40	0.75	5.0	40*	1.5:1	15	5500	HPC10
ASN/050-4245	4.4-5.0	45	0.75	5.0	42*	1.5:1	15	8500	HDC12
ASN/050-4652	4.4-5.0	52	0.75	5.0	46*	1.5:1	15	25000	SP
ASN/050-5050	4.4-5.0	50	0.75	5.0	50*	1.5:1	15	45000	SP
APN/055-3840	5.0-5.5	40	0.75	5.0	38	1.5:1	15	5300	HDC12
ASN/055-4040	5.0-5.5	40	0.75	5.0	40*	1.5:1	15	5500	HDC12
APN/058-4340	5.25-5.8	40	1.25	7.0	43	2.0:1	15	12400	SP
ASN/058-4747	5.25-5.8	47	1.50	7.0	47*	2.0:1	15	24000	SP

New Products

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* = Saturated power.

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GaAs Power Amplifiers
Narrowband Up to 1 Kilowatt (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APW/059-2730	3.4-5.9	30	1.00	4.5	27	2:1	15	500	HS4
APW/059-3032	3.4-5.9	32	1.00	4.5	30	2:1	15	1000	HS6
APW/059-3040	3.4-5.9	40	1.00	4.5	30	2:1	15	1050	HS6
APW/059-3335	3.4-5.9	35	1.00	4.5	33	2:1	15	1900	HPS6
APW/059-3342	3.4-5.9	42	1.00	4.5	33	2:1	15	2000	HPS6
APN/059-3840	5.3-5.9	40	0.75	5.0	38	1.5:1	15	5300	HPC10
APN/059-4042	5.3-5.9	42	1.00	7.0	40	1.5:1	15	8000	HDC12
APN/059-4340	5.3-5.9	40	1.00	7.0	43	1.5:1	15	12400	SP
APN/059-4638	5.3-5.9	38	1.25	7.0	46	1.5:1	15	25750	SP
ASN/059-3733	5.3-5.9	33	0.75	5.0	37*	1.5:1	15	2800	HPC10
ASN/059-4040	5.3-5.9	40	0.75	5.0	40*	1.5:1	15	5500	HDC12
APW/060-3746	4.0-6.0	46	2.00	4.5	37	2:1	15	3100	HPS10
APW/060-4044	4.0-6.0	44	2.00	4.5	40	2:1	15	5350	HDS12
APM/060-4248	4.0-6.0	48	2.00	4.5	41.8	2:1	15	10100	SP
CPN/064-4042	5.85-6.45	42	1.00	7.0	40	1.5:1	15	8000	SP
CPN/064-4340	5.85-6.45	40	1.00	7.0	43	1.5:1	15	12400	SP
CPN/064-4646	5.85-6.45	46	1.25	7.0	46	1.5:1	15	24000	SP
CPN/064-5050	5.85-6.45	50	1.25	7.0	50	1.5:1	15	45000	SP
APN/072-3740	6.4-7.2	40	1.00	5.5	37	1.5:1	15	5300	HPC10
APN/072-4040	6.4-7.2	40	1.00	5.5	40	1.5:1	15	8000	HDC12
APN/077-3035	7.1-7.7	35	0.50	6.0	30	1.5:1	15	1050	HPC8
APN/077-3334	7.1-7.7	34	0.75	6.0	33	1.5:1	15	2000	HPC8
APN/077-3740	7.1-7.7	40	1.00	5.5	37	1.5:1	15	5300	HPC10
APN/077-4040	7.1-7.7	40	1.00	5.5	40	1.5:1	15	8000	HDC12
APW/085-2734	5.9-8.5	34	1.00	5.0	27	2:1	15	750	HC6
APW/085-3033	5.9-8.5	33	1.00	5.0	30	2:1	15	1250	HC8
APW/085-3045	5.9-8.5	45	1.00	5.0	30	2:1	15	1330	HC8
APW/085-3334	5.9-8.5	34	1.00	6.0	33	2:1	15	2000	HPC8
APW/085-3342	5.9-8.5	42	1.00	5.0	33	2:1	15	2050	HPC8
APW/085-3737	6.4-8.5	37	1.50	5.0	37	2:1	15	5300	HDC12
APW/085-3748	6.4-8.5	48	2.00	5.0	37	2:1	15	5400	HDC12
APW/085-4042	6.4-8.5	42	2.00	5.0	40	2:1	15	10.1A	HDC12
APN/085-3737	7.7-8.5	37	1.00	5.5	37	1.5:1	15	5300	HPC10
APN/085-4040	7.7-8.5	40	1.00	5.5	40	1.5:1	15	8000	HDC12
APN/085-4340	7.7-8.5	40	1.00	7.0	43	1.5:1	15	15A	SP

New Products

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GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APN/096-3430	8.5-9.6	30	1.00	7.5	34	1.5:1	15	2800	HPX8
APN/096-3733	8.5-9.6	33	1.00	7.5	37	1.5:1	15	4350	SP
ASN/096-4040	8.5-9.6	40	1.25	8.0	40*	1.5:1	15	7000	SP
ASN/096-4242	8.5-9.6	42	1.25	8.0	42*	1.5:1	15	8500	SP
ASN/096-4444	8.5-9.6	44	1.25	8.0	44*	1.5:1	15	18A	SP
ASN/096-4646	8.5-9.6	46	1.25	8.0	46*	1.5:1	15	32A	SP
ASN/096-4848	9.0-9.6	48	1.25	8.0	48*	1.5:1	15	35A	SP
APN/100-2733	9.0-10.0	33	1.50	6.0	27	2:1	12	900	HPX8
APN/100-3034	9.0-10.0	34	1.75	6.0	30	2:1	12	1600	HPX8
APN/100-3438	9.0-10.0	38	2.00	8.0	34	2:1	12	2.5A	HPX10
APN/100-3740	9.0-10.0	40	2.50	8.0	37	2:1	12	5.0A	HDX8
APN/100-3940	9.0-10.0	40	2.50	8.0	39	2:1	12	7.0A	SP
ASN/100-4032	9.0-10.0	32	2.50	8.0	40*	2:1	12	7.0A	SP
ASN/100-4040	9.0-10.0	40	2.50	8.0	40*	2:1	12	7.0A	SP
ASN/100-4848	9.0-10.0	48	2.50	8.0	48*	2:1	12	36A	SP
APW/105-2730	8.5-10.5	30	2.00	5.5	27	2:1	15	770	HX6
APW/105-3032	8.5-10.5	32	2.00	5.0	30	2:1	15	1400	HPX8
APW/105-3042	8.5-10.5	42	2.00	5.0	30	2:1	15	1450	HPX8
APW/105-3335	8.5-10.5	35	2.00	5.5	33	2:1	15	2600	HPX10
APN/105-3430	9.5-10.5	30	1.00	7.5	34	1.5:1	15	2800	HPX10
APN/105-3733	9.5-10.5	33	1.00	7.5	37	1.5:1	15	4550	SP
ASN/105-4040	9.5-10.5	40	1.25	8.0	40*	1.5:1	15	7000	SP
ASN/105-4242	9.5-10.5	42	1.25	8.0	42*	1.5:1	15	8500	SP
ASN/105-4444	9.5-10.5	44	1.25	8.0	44*	1.5:1	15	18A	SP
ASN/105-4646	9.5-10.5	46	1.25	8.0	46*	1.5:1	15	32A	SP
APN/117-3733	10.7-11.7	33	1.00	7.0	37	1.5:1	15	4550	SP
APN/117-3940	10.7-11.7	40	1.00	7.0	39	1.5:1	15	7500	SP
APW/132-2727	10.5-13.2	27	2.00	5.5	27	2:1	12	770	HPX6
APW/132-3030	10.5-13.2	30	2.00	5.5	30	2:1	15	1400	HPX8
APW/132-3040	10.5-13.2	40	2.00	5.0	30	2:1	15	1450	HPX8
APW/132-3333	10.5-13.2	33	2.00	5.5	33	2:1	15	3000	HDX8
APN/132-3733	12.7-13.2	33	1.00	7.5	37	1.5:1	15	4750	SP
ASN/132-4040	12.7-13.2	40	1.25	8.0	40*	1.5:1	15	9000	SP

New Products

Continued on Next Page

* = Saturated power.

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The export of some CTT Inc. products are subject to current International Trade Regulations and Export Administration Regulations. Contact CTT for additional information.

GaAs Power Amplifiers
Narrowband Up to 1 Kilowatt (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
ASN/140-3434	13.5-14.0	34	1.00	7.5	34*	1.5:1	15	3000	SP
ASN/140-3733	13.5-14.0	33	1.00	7.5	37*	1.5:1	15	5200	SP
APN/145-3636	14.0-14.5	36	1.00	7.5	36	1.5:1	15	5000	SP
APN/145-3940	14.0-14.5	40	1.00	7.5	39	1.5:1	15	8000	SP
APN/145-4040	14.0-14.5	40	1.00	8.0	40	1.5:1	15	12000	SP
APN/145-4242	14.0-14.5	42	1.00	8.0	42	1.5:1	15	15000	SP
APN/149-3740	14.4-14.9	40	1.25	8.0	37	2:1	12	5A	SP
APN/149-4040	14.4-14.9	40	1.25	8.0	40	2:1	12	10A	SP
APN/149-4343	14.4-14.9	43	1.50	8.0	43	2:1	12	19A	SP
APW/154-2730	13.0-15.4	30	2.00	5.5	27	2:1	12	850	HPX6
APW/154-3032	13.0-15.4	32	2.00	5.5	30	2:1	12	1550	HDX8
APW/154-3038	13.0-15.4	38	2.00	5.5	30	2:1	12	1600	HDX8
APW/154-3333	13.0-15.4	33	2.00	5.5	33	2:1	12	2550	HDX8
APW/154-3340	13.0-15.4	40	2.00	5.5	33	2:1	12	2600	HDX10
APN/154-3740	14.4-15.4	40	1.25	8.0	37	2:1	12	5A	SP
APN/154-4040	14.4-15.4	40	1.25	8.0	40	2:1	12	10A	SP
APN/154-4343	14.4-15.4	43	1.50	8.0	43	2:1	12	19A	SP
APN/162-2724	15.7-16.2	24	0.50	6.0	27	1.5:1	15	800	HPX8
APN/165-3030	15.7-16.2	30	0.75	7.0	30	1.5:1	15	1250	HPX10
APN/165-3333	15.7-16.2	33	0.75	7.0	33	1.5:1	15	3400	HDX10
APN/165-3540	15.7-16.2	40	1.00	7.0	35	1.5:1	15	4500	HQX12
APN/165-2724	16.0-16.5	24	0.50	6.0	27	1.5:1	15	800	HPX8
APN/165-3030	16.0-16.5	30	0.75	7.0	30	1.5:1	15	1250	HPX10
APN/165-3334	16.0-16.5	34	0.75	7.0	33	1.5:1	15	3400	HDX10
APN/165-3540	16.0-16.5	40	1.00	7.0	35	1.5:1	15	4500	HQX12
APN/177-2730	15.7-17.7	30	0.50	7.0	27	1.8:1	15	1000	HPX8
APN/177-3034	15.7-17.7	34	0.75	7.0	30	1.8:1	15	1350	HPX10
APN/177-3333	15.7-17.7	33	0.75	7.0	33	1.8:1	15	3400	HDX10
APN/186-3030	18.0-18.6	30	1.00	7.0	30	2:1	12	1500	HDX10
APN/186-3232	18.0-18.6	32	1.00	7.0	32	2:1	12	2550	HDX10
APN/186-3246	18.0-18.6	46	1.00	7.0	32	2:1	12	3400	SP
APN/195-3030	18.5-19.5	30	1.00	7.0	30	2:1	12	1700	SP
APN/195-3232	18.5-19.5	32	1.00	7.0	32	2:1	12	2550	HDX10
APN/195-3246	18.5-19.5	46	1.00	7.0	32	2:1	12	3400	SP
APN/197-2324	17.7-19.7	24	0.5	7.0	23	1.5:1	12	600	HX4
APN/197-2735	17.7-19.7	35	0.5	7.0	27	1.5:1	12	1050	HPX6

New Products

Continued on Next Page

* = Saturated power.

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Power Amplifier Comments:

1. Proper **heat sinking** is **REQUIRED** to keep the **CASE** temperature below +70°C. Otherwise, permanent damage or degradation may occur.

2. CTT can provide replacements for many hard to find products including those formerly produced by Amplica, Avantek, Celeritek, and Watkins-Johnson Company (WJ).

3. Noise figure will rise 0.015 dB/°C typically as the temperature increases.

4. P1dB will drop approximately 1 dB from +25°C to +70°C.

5. All units contain internal voltage regulators.

6. TTL control, pulsed amplification, monitor, detector and DC-DC power supplies are optional.

7. Consult the factory for additional gain, power, frequencies, temperature compensation or any special functions.

8. SP = Special Enclosure. Please contact the factory for outline drawing.

9. * = Saturated power (All AS Series amplifiers).

GaAs Power Amplifiers
Narrowband Up to 1 Kilowatt (continued)

GaAs Power Amplifiers	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
Model Number	Min	Min	Max	Max	Min	Max	Typ	Typ	
APW/240-2328	20.0-24.0	28	2.50	7.0	23	2:1	12	600	GK6
APW/240-2524	20.0-24.0	24	2.50	7.5	25	2:1	12	850	HDK8
APW/240-2530	20.0-24.0	30	2.50	7.0	25	2:1	12	920	HDK8
APW/240-2536	20.0-24.0	36	2.50	7.5	25	2:1	12	980	HDK8
APW/240-2735	20.0-24.0	35	2.50	7.0	27	2:1	12	1300	HDK8
APW/240-2741	20.0-24.0	41	2.50	7.0	27	2:1	12	1360	HDK8
APN/259-2427	23.3-25.9	27	1.00	6.0	24	1.8:1	12	600	GPK6
APN/259-2740	23.3-25.9	40	1.00	6.0	27	1.8:1	12	1200	GPK8
APN/259-3040	23.3-25.9	40	1.00	6.0	30	1.8:1	12	2000	GPK8
APN/259-3340	23.3-25.9	40	1.00	6.0	33	1.8:1	12	3000	GPK8
APN/265-2427	24.5-26.5	27	1.00	6.0	24	1.8:1	12	600	GPK6
APN/265-2740	24.5-26.5	40	1.00	6.0	27	1.8:1	12	1200	GPK8
APN/265-3040	24.5-26.5	40	1.00	6.0	30	1.8:1	12	2000	GPK8
APN/265-3340	24.5-26.5	40	1.00	6.0	33	1.8:1	12	3000	GPK8
APN/294-2327	27.5-29.4	27	1.00	6.0	23	1.8:1	12	690	GPK6
APN/294-2737	27.5-29.4	37	1.00	6.0	27	1.8:1	12	1200	GPK8
APN/294-3037	27.5-29.4	37	1.00	6.0	30	1.8:1	12	2000	GPK8
APN/294-3337	27.5-29.4	37	1.00	6.0	33	1.8:1	12	3000	GPK8
APN/313-2327	29.1-31.3	27	1.00	6.0	23	2.0:1	12	690	GPK6
APN/313-2737	29.1-31.3	37	1.00	6.0	27	2.0:1	12	1200	GPK8
APN/313-3037	29.1-31.3	37	1.00	6.0	30	2.0:1	12	2000	GPK8
APN/313-3237	29.1-31.3	37	1.00	6.0	32	2.0:1	12	3000	GPK8
ASN/310-3333	30.0-31.0	33	1.50	8.0	33*	2.0:1	12	2800	GPK8
ASN/310-3636	30.0-31.0	36	1.50	8.0	36*	2.0:1	12	3080	GPK8
ASN/310-3838	30.0-31.0	38	1.50	8.0	38*	2.0:1	12	4080	GPK8
APN/400-2026	38.0-40.0	26	1.50	7.0	20	2.0:1	12	810	GPK6
APN/400-2434	38.0-40.0	34	1.50	7.0	24	2.0:1	12	1800	GPK6
APN/400-2734	38.0-40.0	34	1.50	7.0	27	2.0:1	12	2500	GPK8
APN/400-3037	38.0-40.0	37	1.50	7.0	30	2.0:1	12	4000	GPK8

New Products

* = Saturated power.

For unique subassembly configurations, requiring separate driver and power amplifiers, CTT's **AD Series** offer small size, single voltage, with up to 1 Watt of output power.

Compact, Wideband Low-Noise & Medium Power Amplifiers 0.1 GHz to 20 GHz

- **AB Series Low-Noise**
- **AD Series Drivers for TWTAs or GaN Power Amplifiers**
- **Wide Dynamic Range**
- **Frequency Coverage from 0.1 GHz to 20.0 GHz**

Wideband Amplifiers

WIDEBAND [AB & AD Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ABX/00102-1512	0.1-2.0	12	0.75	1.5	8	2:1	8–15	80	AB2
ABX/00102-1522	0.1-2.0	22	1.00	1.5	10	2:1	8–15	120	AB2
ABX/00102-1530	0.1-2.0	30	1.25	1.5	10	2:1	8–15	200	AB2
ABM/025-1512	0.5-2.5	12	0.75	1.5	8	2:1	8–15	80	AB2
ABM/025-1522	0.5-2.5	22	1.00	1.5	10	2:1	8–15	120	AB2
ABM/025-1530	0.5-2.5	30	1.25	1.5	10	2:1	8–15	200	AB2
ABW/124-2510	8-12.4	10	0.75	2.5	10	2:1	8–15	60	AB2
ABW/124-2520	8-12.4	20	1.00	2.5	15	2:1	8–15	120	AB2
ABW/124-2530	8-12.4	30	1.25	2.5	15	2:1	8–15	180	AB3
ABW/124-5020	8-12.4	20	1.00	5.0	20	2:1	12–15	200	AB2
ABW/124-4530	8-12.4	30	1.25	4.5	20	2:1	12–15	280	AB3
ABM/180-5015	6-18	15	1.25	5.0	20	2:1	12–15	200	AB2
ABM/180-5022	6-18	22	1.25	5.0	20	2:1	12–15	260	AB3
ABM/180-5032	6-18	32	1.50	5.0	20	2:1	12–15	420	AB4
ABX/00518-2815	0.5-18	15	2.00	2.8	6	2.2:1	8–15	80	AB2
ABX/00518-2822	0.5-18	22	2.00	2.8	8	2.2:1	8–15	140	AB2
ABX/00518-2830	0.5-18	30	2.00	2.8	10	2.2:1	8–15	200	AB3
ABX/0218-2610	2-18	10	1.25	2.6	6	2.2	8–15	60	AB2
ABX/0218-2620	2-18	20	1.50	2.6	8	2.2	8–15	120	AB2
ABX/0218-2630	2-18	30	2.00	2.6	10	2.2	8–15	180	AB3
ABX/0218-5020	2-18	20	2.00	5.0	20	2.2	12–15	380	AB2
ABX/0218-5032	2-18	32	2.25	5.0	20	2.2	12–15	460	AB3
ABX/0218-5040	2-18	40	2.50	5.0	20	2.2	12–15	540	AB4
ABX/0220-4512	2-20	12	1.75	4.5	8	2.2:1	8–15	80	AB2
ABX/0220-4520	2-20	20	2.00	4.5	10	2.2:1	8–15	140	AB2
ABX/0220-4530	2-20	30	2.50	4.5	12	2.2:1	8–15	200	AB3
ABX/0220-5014	2-20	14	1.50	5.0	20	2.2:1	12–15	400	AB2
ABX/0220-5020	2-20	20	1.50	5.0	20	2.2:1	12–15	480	AB2
ADW/124-2729	8-12.4	29	1.25	5.0	27	2:1	12–15	500	AB3
ADW/124-2740	8-12.4	40	1.25	4.5	27	2:1	12–15	580	AB4
ADM/180-2723	6-18	23	1.50	6.0	27	2:1	12–15	460	AB4
ADM/180-2731	6-18	31	1.75	6.0	27	2:1	12–15	540	AB4
ADM/180-2740	6-18	40	2.00	6.0	27	2:1	12–15	600	AB4

New Products

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Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz

Low-noise amplifiers (LNAs) are, by design and application, small signal amplifiers, intended to be the primary signal booster in RF subsystems; especially those where link-margins are critical.

Since overall LNA performance is determined largely by the first stage of amplification, CTT has combined its many years of experience in characterizing these devices with its expertise in the design of matching circuits to optimize noise figure performance.

CTT has developed an extensive "Library" of device parameters and compatible matching solutions, which allow predictable, repeatable noise performance. This "Library" is the basis for CTT's automated module production capability, which has been able to virtually triple module production efficiency.

These amplifiers are high performance, low-cost, GaAs FET amplifiers. Each LNA comes with removable SMA connectors.

- **Low Cost**
- **Low-Noise**
- **Aluminum Package with Removable Connectors**
- **Tig Welded Aluminum Housing**
- **Designed to Meet MIL-STD-883**
- **Custom Engineered Options (CEOs)** (See page 36)

Wideband Low-Noise Amplifiers

WIDEBAND [AF Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
AFX/010-1030	0.1-1.0	30	1.50	1.0	10	2:1	8–15	160	FC2
AFX/040-1530	0.1-4.0	30	1.50	1.5	10	2:1	8–15	160	FC2
AFM/020-1015	0.5-2.0	15	0.75	1.0	8	2:1	8–15	80	FC2
AFM/020-1030	0.5-2.0	30	1.00	1.0	10	2:1	8–15	120	FC2
AFM/020-1045	0.5-2.0	45	1.50	1.0	10	2:1	8–15	200	FC2
AFM/020-1515	0.5-2.0	15	0.75	1.5	8	2:1	8–15	80	FC2
AFM/020-1530	0.5-2.0	30	1.00	1.5	10	2:1	8–15	120	FC2
AFM/020-3015	0.5-2.0	15	1.00	3.0	20	2:1	12–15	150	FC2
AFM/020-3026	0.5-2.0	26	1.00	3.0	20	2:1	12–15	180	FC2
AFM/020-3036	0.5-2.0	36	1.50	3.0	20	2:1	12–15	220	FC2
AFM/020-3046	0.5-2.0	46	1.50	3.0	20	2:1	12–15	300	FC2
AFM/040-2510	0.5-4.0	10	0.75	2.5	8	2:1	8–15	70	FC2
AFM/040-2522	0.5-4.0	22	1.00	2.5	12	2:1	8–15	100	FC2
AFM/040-2530	0.5-4.0	30	1.25	2.5	15	2:1	12–15	160	FC2
AFM/040-2540	0.5-4.0	40	1.25	2.5	15	2:1	12–15	200	FC2
AFM/040-5512	0.5-4.0	12	1.00	5.5	20	2:1	12–15	150	FC2
AFM/040-3525	0.5-4.0	25	1.25	3.5	20	2:1	12–15	200	FC2
AFM/040-3535	0.5-4.0	35	1.25	3.5	20	2:1	12–15	250	FC2

New Products

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Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz (continued)

WIDEBAND [AF Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
AFM/060-2511	2-6	11	0.75	2.5	8	2:1	8–15	80	FC2
AFM/060-2522	2-6	22	1.00	2.5	12	2:1	8–15	80	FC2
AFM/060-2533	2-6	33	1.25	2.5	12	2:1	8–15	120	FC2
AFM/060-2512	2-6	12	0.75	2.5	8	2:1	8–15	50	FC2
AFM/060-2520	2-6	20	1.25	2.5	12	2:1	8–12	80	FC2
AFM/060-2530	2-6	30	1.50	2.5	12	2:1	8–15	120	FC2
AFM/060-3011	2-6	11	0.75	3.0	20	2:1	12–15	120	FC2
AFM/060-3525	2-6	25	1.25	3.5	20	2:1	12–15	200	FC2
AFM/060-3540	2-6	40	1.50	3.5	20	2:1	12–15	280	FC4
AFX/080-2611	0.5-8	11	1.00	2.6	8	2:1	8–15	50	FC2
AFX/080-2620	0.5-8	20	1.25	2.6	12	2:1	8–15	80	FC2
AFX/080-2630	0.5-8	30	1.50	2.6	12	2:1	8–15	120	FC2
AFX/080-4512	0.5-8	12	1.00	4.5	20	2:1	12–15	120	FC2
AFX/080-4526	0.5-8	26	1.25	4.5	20	2:1	12–15	200	FC2
AFX/080-4540	0.5-8	40	1.50	4.5	20	2:1	12–15	260	FC4
AFM/080-2514	2-8	14	0.75	2.5	7	2:1	8–15	60	FC2
AFM/080-2528	2-8	28	1.25	2.5	12	2:1	8–15	120	FC2
AFM/080-2542	2-8	42	1.50	2.5	12	2:1	8–15	180	FC2
AFM/080-2612	2-8	12	0.75	2.6	8	2:1	8–15	50	FC2
AFM/080-2620	2-8	20	1.25	2.6	12	2:1	8–15	80	FC2
AFM/080-2630	2-8	30	1.50	2.6	12	2:1	8–15	120	FC2
AFM/080-2642	2-8	42	1.75	2.6	12	2:1	8–15	200	FC4
AFM/080-4012	2-8	12	0.75	4.0	20	2:1	12–15	120	FC2
AFM/080-4026	2-8	26	1.25	4.0	20	2:1	12–15	200	FC2
AFM/080-4040	2-8	40	1.50	4.0	20	2:1	12–15	280	FC4
AFO/080-2012	4-8	12	1.00	2.0	10	2:1	8–15	50	FC2
AFO/080-2022	4-8	22	1.00	2.0	15	2:1	12–15	120	FC2
AFO/080-2032	4-8	32	1.00	2.0	15	2:1	12–15	180	FC4
AFX/00510-2516	0.5-10	16	1.00	2.5	8	2:1	8–15	80	FX2
AFX/00510-2524	0.5-10	24	1.25	2.5	8	2:1	8–15	120	FX2
AFX/00510-2532	0.5-10	32	1.50	2.5	10	2:1	8–15	180	FX4
AFW/124-1518	8-12.4	18	1.00	1.5	8	2:1	8–15	80	FX2
AFW/124-1526	8-12.4	26	1.00	1.5	8	2:1	8–15	120	FX2
AFW/124-1534	8-12.4	34	1.25	1.5	10	2:1	8–15	180	FX4
AFW/124-2810	8-12.4	10	0.75	2.8	10	2:1	8–15	50	FX2
AFW/124-2820	8-12.4	20	1.00	2.8	15	2:1	12–15	120	FX2
AFW/124-2830	8-12.4	30	1.25	2.8	15	2:1	12–15	180	FX4
AFW/124-4509	8-12.4	9	1.00	4.5	20	2:1	12–15	100	FX2
AFW/124-4520	8-12.4	20	1.00	4.5	20	2:1	12–15	200	FX2
AFW/124-4530	8-12.4	30	1.25	4.5	20	2:1	12–15	280	FX4

New Products

Continued on Next Page

Low-Noise Amplifier Comments

Applies to all AM, AF and AL Series amplifiers

1. All specifications are guaranteed at +25°C **CASE** temperature as measured in the linear region.
2. CTT can provide replacements for many hard to find amplification products including those formerly produced by Amplica, Inc., Avantek, Inc., Celeritek and Watkins-Johnson Company (WJ).
3. Noise figure will rise 0.015 dB/°C typically as the temperature increases.
4. P1dB will drop approximately 1 dB from +25°C to +85°C.
5. All units contain internal voltage regulators which can operate from +12 to +15 VDC.
6. Proper **heat sinking** is **REQUIRED** to keep the case temperature below +105°C. Otherwise, permanent damage or degradation may occur.
7. Consult the factory for additional gain, power, higher frequencies, temperature compensation or any special functions.
8. Commercial versions are available with reduced screening and industrial-grade FETs.
9. Maximum power without damage is +12 dBm min. Up to +20 dBm option available, contact factory.
10. For selected applications, lower noise-figures are available, contact the factory.

Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz (continued)

WIDEBAND [AF Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
AFM/150-3510	5.5-15	10	1.25	3.5	8	2:1	8–15	60	FX2
AFM/150-3520	5.5-15	20	1.25	3.5	10	2:1	8–15	120	FX2
AFM/150-3530	5.5-15	30	1.50	3.5	10	2:1	8–15	170	FX4
AFM/150-4509	5.5-15	9	1.00	4.5	18	2:1	12–15	120	FX2
AFM/150-5520	5.5-15	20	1.25	5.5	18	2:1	12–15	200	FX2
AFM/150-5530	5.5-15	30	1.50	5.5	18	2:1	12–15	280	FX4
AFX/00518-2815	0.5-18	15	2.00	2.8	6	2.2	8–15	80	FX2
AFX/00518-2822	0.5-18	22	2.00	2.8	8	2.2	8–15	140	FX2
AFX/00518-3515	0.5-18	15	2.00	3.5	6	2.2	8–15	80	FX2
AFX/00518-3522	0.5-18	22	2.00	3.5	8	2.2	8–15	140	FX2
AFX/00518-3530	0.5-18	30	2.00	3.5	10	2.2	8–15	200	FX2
AFX/00518-4010	0.5-18	10	1.50	4.0	8	2.2	8–15	100	FX2
AFX/00518-4020	0.5-18	20	2.00	4.0	8	2.2	8–15	160	FX2
AFX/00518-4030	0.5-18	30	2.50	4.0	8	2.2	8–15	250	FX4
AFX/0218-2610	2-18	10	1.25	2.6	6	2.2	8–15	60	FX2
AFX/0218-2620	2-18	20	1.50	2.6	8	2.2	8–15	120	FX2
AFX/0218-2630	2-18	30	2.00	2.6	10	2.2	8–15	180	FX2
AFX/0218-3515	2-18	15	2.00	3.5	6	2.2	8–15	80	FX2
AFX/0218-3522	2-18	22	2.00	3.5	8	2.2	8–15	140	FX2
AFX/0218-3530	2-18	30	2.00	3.5	10	2.2	8–15	160	FX2
AFX/0218-4520	2-18	20	2.00	4.5	8	2.2	8–15	160	FX2
AFX/0218-4530	2-18	30	2.50	4.5	8	2.2	8–15	200	FX2
AFX/0218-5016	2-18	16	1.25	5.0	12	2.2	8–15	140	FX2
AFX/0218-5021	2-18	21	1.25	5.0	12	2.2	8–15	180	FX2
AFX/0218-6014	2-18	14	2.00	6.0	20	2.2	12–15	400	FX4
AFX/0218-6021	2-18	21	2.50	6.0	20	2.2	12–15	500	FX4
AFM/180-2512	6-18	12	1.00	2.5	8	2:1	8–15	80	FX2
AFM/180-2522	6-18	22	1.00	2.5	10	2:1	8–15	120	FX2
AFM/180-2530	6-18	30	1.25	2.5	12	2:1	8–15	180	FX2
AFM/180-3018	6-18	18	1.00	3.0	10	2:1	8–15	120	FX2
AFM/180-3030	6-18	30	1.50	3.0	15	2:1	12–15	220	FX4
AFM/180-3508	6-18	8	1.00	3.5	8	2:1	8–15	50	FX2
AFM/180-3520	6-18	20	1.00	3.5	15	2:1	12–15	150	FX2
AFM/180-3530	6-18	30	1.50	3.5	15	2:1	12–15	220	FX4
AFM/180-5015	6-18	15	1.25	5.0	20	2:1	12–15	200	FX2
AFM/180-5021	6-18	21	1.25	5.0	20	2:1	12–15	260	FX4
AFM/180-5032	6-18	32	1.50	5.0	20	2:1	12–15	380	FX4

New Products

Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz

- **Low Cost**
- **Low-Noise**
- **Standard Package (AL Series), Small Size: 0.63 Inches Height**
- **Aluminum Package with Removable Connectors**
- **Tig Welded Aluminum Housing**
- **Designed to Meet MIL-STD-883**
- **Custom Engineered Options (CEOs)** (See page 36)

Low-noise amplifiers (LNAs) are, by design and application, small signal amplifiers, intended to be the primary signal booster in RF subsystems; especially those where link-margins are critical.

Since overall LNA performance is determined largely by the first stage of amplification, CTT has combined its many years of experience in characterizing these devices with its expertise in the design of matching circuits to optimize noise figure performance.

CTT has developed an extensive “Library” of device parameters and compatible matching solutions, which allow predictable, repeatable noise performance. This “Library” is the basis for CTT’s automated module production capability, which has been able to virtually triple module production efficiency.

These compact amplifiers are high performance, low-cost, GaAs FET amplifiers. Each LNA comes with removable SMA connectors.

Wideband Low-Noise Amplifiers

WIDEBAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALX/010-1030	0.1-1	30	1.50	1.0	10	2:1	8–15	160	HC2
ALX/040-1530	0.1-4	30	1.50	1.5	10	2:1	8–15	160	HC2
ALX/020-2810	0.2-2	10	0.75	2.8	8	2:1	8–15	60	HC2
ALX/020-2822	0.2-2	22	1.25	2.8	12	2:1	8–15	80	HC2
ALX/020-2830	0.2-2	30	1.25	2.8	15	2:1	12–15	160	HC2
ALX/020-3012	0.2-2	12	1.00	3.0	20	2:1	12–15	150	HC2
ALX/020-3525	0.2-2	25	1.25	3.5	20	2:1	12–15	220	HC2
ALX/020-3535	0.2-2	35	1.50	3.5	20	2:1	12–15	260	HC2
ALM/020-1015	0.5-2	15	0.75	1.0	15	2:1	12–15	80	HC2
ALM/020-1030	0.5-2	30	1.00	1.0	15	2:1	12–15	160	HC2
ALM/020-1045	0.5-2	45	1.50	1.0	15	2:1	12–15	240	HC2
ALM/020-1515	0.5-2	15	0.75	1.5	15	2:1	12–15	80	HC2
ALM/020-1530	0.5-2	30	1.00	1.5	15	2:1	12–15	160	HC2
ALM/020-3015	0.5-2	15	1.00	3.0	20	2:1	12–15	150	HC2
ALM/020-3026	0.5-2	26	1.00	3.0	20	2:1	12–15	220	HC2
ALM/020-3036	0.5-2	36	1.50	3.0	20	2:1	12–15	260	HC2
ALM/020-3046	0.5-2	46	1.50	3.0	20	2:1	12–15	340	HC4
ALM/040-2210	0.5-4	10	0.75	2.2	8	2:1	8–15	70	HC2
ALM/040-2222	0.5-4	22	1.00	2.2	12	2:1	8–15	100	HC2
ALM/040-2230	0.5-4	30	1.25	2.2	15	2:1	12–15	160	HC2
ALM/040-2240	0.5-4	40	1.25	2.2	15	2:1	12–15	200	HC2
ALM/040-3512	0.5-4	12	1.00	3.5	20	2:1	12–15	150	HC2
ALM/040-3525	0.5-4	25	1.25	3.5	20	2:1	12–15	200	HC2
ALM/040-3535	0.5-4	35	1.25	3.5	20	2:1	12–15	250	HC2

New Products

Continued on Next Page

Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz (continued)

WIDEBAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALM/060-2511	2-6	11	0.75	2.5	8	2:1	8~15	50	HC2
ALM/060-2522	2-6	22	1.00	2.5	12	2:1	8~15	80	HC2
ALM/060-2533	2-6	33	1.20	2.5	12	2:1	8~15	120	HC4
ALM/060-2514	2-6	14	0.75	2.5	8	2:1	8~15	50	HC2
ALM/060-2528	2-6	28	1.25	2.5	12	2:1	8~15	120	HC2
ALM/060-2542	2-6	42	1.50	2.5	12	2:1	8~15	200	HC4
ALM/060-3511	2-6	11	0.75	3.5	20	2:1	12~15	120	HC2
ALM/060-3526	2-6	26	1.25	3.5	20	2:1	12~15	200	HC2
ALM/060-3540	2-6	40	1.50	3.5	20	2:1	12~15	280	HC4
ALX/080-2611	.5-8	11	1.00	2.6	8	2:1	8~15	50	HC2
ALX/080-2620	.5-8	20	1.25	2.6	12	2:1	8~15	80	HC2
ALX/080-2630	.5-8	30	1.50	2.6	12	2:1	8~15	120	HC2
ALX/080-2640	.5-8	40	1.50	2.6	12	2:1	8~15	200	HC4
ALX/080-4512	.5-8	12	1.00	4.5	20	2:1	12~15	120	HC2
ALX/080-4526	.5-8	26	1.25	4.5	20	2:1	12~15	200	HC2
ALX/080-4540	.5-8	40	1.50	4.5	20	2:1	12~15	260	HC4
ALM/080-2514	2-8	14	0.75	2.5	7	2:1	8~15	50	HC2
ALM/080-2528	2-8	28	1.25	2.5	12	2:1	8~15	120	HC2
ALM/080-2542	2-8	42	1.50	2.5	12	2:1	8~15	180	HC4
ALM/080-3012	2-8	12	0.75	3.0	8	2:1	8~15	50	HC2
ALM/080-3020	2-8	20	1.25	3.0	12	2:1	8~15	80	HC2
ALM/080-3030	2-8	30	1.50	3.0	12	2:1	8~15	120	HC2
ALM/080-3040	2-8	40	1.50	3.0	12	2:1	8~15	180	HC4
ALM/080-6012	2-8	12	0.75	6.0	20	2:1	12~15	120	HC2
ALM/080-4026	2-8	26	1.25	4.0	20	2:1	12~15	200	HC2
ALM/080-4040	2-8	40	1.50	4.0	20	2:1	12~15	280	HC4
ALM/120-3009	4-12	9	1.00	3.0	5	2:1	8~15	50	HX2
ALM/120-3020	4-12	20	1.25	3.0	10	2:1	8~15	120	HX2
ALM/120-3030	4-12	30	1.50	3.0	10	2:1	8~15	180	HX4
ALM/120-3040	4-12	40	1.50	3.0	10	2:1	8~15	260	HX4
ALM/120-4518	4-12	18	1.00	4.5	20	2:1	12~15	200	HX2
ALM/120-4528	4-12	28	1.50	4.5	20	2:1	12~15	260	HX4
ALM/120-4538	4-12	38	1.50	4.5	20	2:1	12~15	340	HX4

New Products

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SWaP
(Size Weight and Power)
SWaP-optimized electronic systems are critical to unmanned aerial vehicles.

Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz (continued)

WIDEBAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALW/124-1511	8-12.4	11	0.75	1.5	8	2:1	8–15	40	HX2
ALW/124-1522	8-12.4	22	1.00	1.5	15	2:1	12–15	120	HX2
ALW/124-1533	8-12.4	33	1.25	1.5	15	2:1	12–15	180	HX4
ALW/124-2510	8-12.4	10	0.75	2.5	10	2:1	12–15	50	HX2
ALW/124-2520	8-12.4	20	1.00	2.5	15	2:1	12–15	120	HX2
ALW/124-2530	8-12.4	30	1.25	2.5	15	2:1	12–15	180	HX4
ALW/124-6009	8-12.4	9	1.00	6.0	20	2:1	12–15	100	HX2
ALW/124-5020	8-12.4	20	1.00	5.0	20	2:1	12–15	200	HX2
ALW/124-4530	8-12.4	30	1.25	4.5	20	2:1	12–15	280	HX4
ALM/150-3510	5.5-15	10	1.25	3.5	8	2:1	8–15	60	HX2
ALM/150-3520	5.5-15	20	1.25	3.5	10	2:1	8–15	120	HX2
ALM/150-3530	5.5-15	30	1.50	3.5	10	2:1	8–15	170	HX4
ALM/150-3540	5.5-15	40	1.50	3.5	10	2:1	8–15	250	HX4
ALM/150-5520	5.5-15	20	1.25	5.5	18	2:1	12–15	200	HX2
ALM/150-5530	5.5-15	30	1.50	5.5	18	2:1	12–15	280	HX4
ALM/150-5540	5.5-15	40	1.50	5.5	18	2:1	12–15	360	HX4
ALX/00518-2815	0.5-18	15	2.00	2.8	6	2.2:1	8–15	80	HX2
ALX/00518-2822	0.5-18	22	2.00	2.8	8	2.2:1	8–15	140	HX2
ALX/00518-2830	0.5-18	30	2.00	2.8	10	2.2:1	8–15	200	HX2
ALX/00518-3515	0.5-18	15	2.00	3.5	6	2.2:1	8–15	80	HX2
ALX/00518-3522	0.5-18	22	2.00	3.5	8	2.2:1	8–15	140	HX2
ALX/00518-3530	0.5-18	30	2.00	3.5	10	2.2:1	8–15	200	HX2
ALX/00518-4013	0.5-18	13	1.50	4.0	5	2.2:1	8–15	60	HX2
ALX/00518-4020	0.5-18	20	2.00	4.0	8	2.2:1	8–15	140	HX2
ALX/00518-4026	0.5-18	26	2.00	4.0	8	2.2:1	8–15	200	HX2
ALX/00518-4033	0.5-18	33	2.25	4.0	8	2.2:1	8–15	260	HX2
ALX/00518-6010	0.5-18	10	1.50	6.0	8	2.2:1	8–15	90	HX2
ALX/00518-5520	0.5-18	20	2.00	5.5	8	2.2:1	8–15	160	HX2
ALX/00518-5530	0.5-18	30	2.25	5.5	10	2.2:1	8–15	250	HX2
ALX/00518-5536	0.5-18	36	2.50	5.5	10	2.2:1	8–15	280	HX4

New Products

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Wideband Low-Noise Amplifiers
100 MHz to 20.0 GHz (continued)

WIDEBAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALX/0218-2610	2-18	10	1.25	2.6	6	2.2	8–15	60	HX2
ALX/0218-2620	2-18	20	1.50	2.6	8	2.2	8–15	80	HX2
ALX/0218-2630	2-18	30	2.00	2.6	10	2.2	8–15	140	HX2
ALX/0218-3513	2-18	13	1.50	3.5	5	2.2	8–15	60	HX2
ALX/0218-3520	2-18	20	2.00	3.5	8	2.2	8–15	140	HX2
ALX/0218-3526	2-18	26	2.00	3.5	8	2.2	8–15	200	HX2
ALX/0218-3533	2-18	33	2.25	3.5	8	2.2	8–15	260	HX2
ALX/0218-4020	2-18	20	2.00	4.0	8	2.2	8–15	160	HX2
ALX/0218-4030	2-18	30	2.50	4.0	8	2.2	8–15	250	HX2
ALX/0218-6016	2-18	16	1.25	6.0	12	2.2	8–15	200	HX2
ALX/0218-6021	2-18	21	1.25	6.0	12	2.2	8–15	270	HX2
ALX/0218-6026	2-18	26	1.25	6.0	12	2.2	8–15	330	HX4
ALX/0218-7015	2-18	15	2.00	7.0	20	2.2	12–15	480	HX4
ALX/0218-7022	2-18	22	2.50	7.0	20	2.2	12–15	560	HX4
ALX/0218-7028	2-18	28	2.50	7.0	20	2.2	12–15	640	HX6
ALM/180-2410	6-18	10	1.00	2.4	8	2:1	8–15	70	HX2
ALM/180-2420	6-18	20	1.00	2.4	10	2:1	8–15	120	HX2
ALM/180-2430	6-18	30	1.25	2.4	12	2:1	8–15	180	HX2
ALM/180-3018	6-18	18	1.00	3.0	10	2:1	8–15	120	HX2
ALM/180-3030	6-18	30	1.50	3.0	15	2:1	12–15	220	HX4
ALM/180-3520	6-18	20	1.00	3.5	15	2:1	12–15	150	HX2
ALM/180-3530	6-18	30	1.50	3.5	15	2:1	12–15	220	HX4
ALM/180-3540	6-18	40	1.50	3.5	15	2:1	12–15	300	HX4
ALM/180-4515	6-18	15	1.25	4.5	20	2:1	12–15	200	HX2
ALM/180-4521	6-18	21	1.25	4.5	20	2:1	12–15	260	HX4
ALM/180-4532	6-18	32	1.50	4.5	20	2:1	12–15	350	HX4
ALM/180-4540	6-18	40	1.50	4.5	20	2:1	12–15	420	HX6
ALX/0220-4512	2-20	12	1.75	4.5	8	2.2:1	8–15	80	HX2
ALX/0220-4520	2-20	20	2.00	4.5	10	2.2:1	8–15	140	HX2
ALX/0220-4530	2-20	30	2.50	4.5	12	2.2:1	8–15	200	HX4
ALX/0220-6514	2-20	14	1.50	6.5	20	2.2:1	12–15	400	HX2
ALX/0220-6520	2-20	20	1.50	6.5	20	2.2:1	12–15	480	HX4

New Products

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Satellite communications (SATCOM) has become commonplace worldwide in both commercial and government enterprises. Development of smaller and inexpensive terrestrial stations for two-way voice, video and data is now available where traditional telecommunications networks did not exist or were cost prohibitive.

Advances in very small aperture terminal (VSAT) technology has greatly improved the price-performance ratio of SATCOM service. This is especially true for newer systems at Ka-band frequencies.

The importance of SATCOM to homeland security has also increased significantly. The flow of immediate information to small military units operating in remote locations has driven advances in VSAT designs including fixed site, transportable and SATCOM-on-the-move (SOTM).

CTT's SSPAs offer superior performance when used in uplink applications whether the application is integrated into the block up-converter (BUC) or as an augmenter amplifier.

CTT's wideband LNAs also offer similar advantages in low-noise block (LNB) downconverter operation when combined with mixer. L.O., and I.F. amplifier

Contact CTT with your custom BUC or LNB requirements.

Ka-Band Low-Noise Amplifiers
17.0 GHz to 40.0 GHz

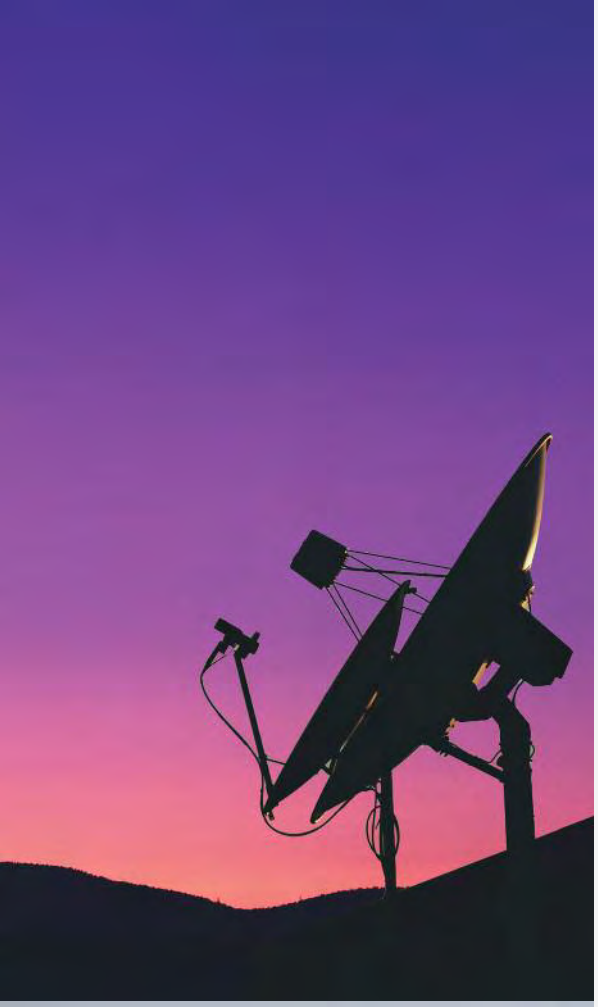
- **Low-Noise**
- **Compact GK Series Package**
- **Aluminum Package with Removable Connectors**
- **BUC and LNB Configurations**
- **Designed to Meet MIL-STD-883**
- **Custom Engineered Options (CEOs)** (See page 36)

Ka-Band Low-Noise Amplifiers

Ka-BAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALW/210-2817	17-21	17	1.00	2.8	12	2:1	8–15	150	SP
ALW/210-2824	17-21	24	1.00	2.8	12	2:1	8–15	220	SP
ALW/210-2830	17-21	30	1.50	2.8	12	2:1	8–15	350	SP
ALW/265-3511	18-26.5	11	1.00	3.5	12	2:1	8–15	130	GK2
ALW/265-3517	18-26.5	17	1.25	3.5	12	2:1	8–15	180	GK4
ALW/265-3522	18-26.5	22	1.50	3.5	12	2:1	8–15	260	GK4
ALW/265-3530	18-26.5	30	2.00	3.5	12	2:1	8–15	350	GK6
APW/265-2017	18-26.5	17	2.50	4.5	20	2:1	12	400	GK4
APW/265-2024	18-26.5	24	2.50	4.5	20	2:1	12	450	GK6
APW/265-2030	18-26.5	30	2.50	4.5	20	2:1	12	540	GK6
ALW/270-2817	21-27	17	1.00	2.8	12	2:1	8–15	150	SP
ALW/270-2824	21-27	24	1.00	2.8	12	2:1	8–15	220	SP
ALW/270-2830	21-27	30	1.50	2.8	12	2:1	8–15	350	SP
ALN/300-3525	27-30	25	1.00	3.5	10	1.8	8–15	200	GK4
ALN/300-3530	27-30	30	1.00	3.5	10	1.8	8–15	270	GK5
ALN/350-3525	32-35	25	1.00	3.5	10	1.8	8–15	200	GK4
ALN/350-3530	32-35	30	1.00	3.5	10	1.8	8–15	220	GK5
ALN/360-3525	34-36	25	1.00	3.5	10	1.8	8–15	200	GK4
ALN/360-3530	34-36	30	1.00	3.5	10	1.8	8–15	270	GK5
ALN/380-3525	36-38	25	1.00	3.5	10	1.8	8–15	200	GK4
ALN/380-3530	36-38	30	1.00	3.5	10	1.8	8–15	270	GK5

New Products

Continued on Next Page



Ka-Band Low-Noise Amplifiers
17.0 GHz to 40.0 GHz (continued)

Ka-BAND [AL Series] Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min	Max	Typ	Typ	
ALO/400-5515	18-40	15	1.25	5.5	6	2.5:1	8–15	210	GK4
ALO/400-5520	18-40	20	2.00	5.5	6	2.5:1	8–15	280	GK4
ALO/400-5524	18-40	24	2.25	5.5	6	2.5:1	8–15	350	GK6
ALO/400-5528	18-40	28	2.50	5.5	6	2.5:1	8–15	420	GK6
ALO/400-6010	18-40	10	1.50	6.0	12	2.5:1	8–15	180	GK2
ALO/400-6017	18-40	17	1.50	6.0	12	2.5:1	8–15	280	GK4
ALO/400-6023	18-40	23	2.00	6.0	12	2.5:1	8–15	350	GK6
ALO/400-6029	18-40	29	2.50	6.0	12	2.5:1	8–15	410	GK6
ALO/400-6035	18-40	35	3.00	6.0	12	2.5:1	8–15	470	GK8
ALW/400-5017	26.5-40	17	1.50	5.0	12	2.5:1	8–15	280	GK4
ALW/400-5023	26.5-40	23	2.00	5.0	12	2.5:1	8–15	350	GK6
ALW/400-5029	26.5-40	29	2.50	5.0	12	2.5:1	8–15	410	GK6
ALW/400-5035	26.5-40	35	3.00	5.0	12	2.5:1	8–15	470	GK8
ALW/400-5515	26.5-40	15	1.25	5.5	6	2.5:1	8–15	210	GK4
ALW/400-5520	26.5-40	20	2.00	5.5	6	2.5:1	8–15	280	GK4
ALW/400-5524	26.5-40	24	2.25	5.5	6	2.5:1	8–15	350	GK6
ALW/400-5528	26.5-40	28	2.50	5.5	6	2.5:1	8–15	350	GK6
ALW/400-6010	26.5-40	10	1.50	6.0	12	2.5:1	8–15	180	GK2
ALW/400-6017	26.5-40	17	1.50	6.0	12	2.5:1	8–15	280	GK4
ALW/400-6023	26.5-40	23	2.00	6.0	12	2.5:1	8–15	350	GK6
ALW/400-6029	26.5-40	29	2.50	6.0	12	2.5:1	8–15	410	GK6
ALW/400-6035	26.5-40	35	3.00	6.0	12	2.5:1	8–15	470	GK8
ASW/400-1814	26.5-40	14	1.50	6.5	18*	2.5:1	12	400	GK4
ASW/400-1818	26.5-40	18	2.00	6.5	18*	2.5:1	12	450	GK4
ASW/400-1824	26.5-40	24	2.50	6.5	18*	2.5:1	12	600	GK6
ALN/400-3525	38-40	25	1.00	3.5	10	1.8	8–15	200	GK4
ALN/400-3530	38-40	30	1.00	3.5	10	1.8	8–15	270	GK5

New Products

* = Saturated power.

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CTT's 19-inch rack-mount amplifiers are designed for wide or narrow band linear applications covering UHF through Ka-Band (0.5 to 31 GHz). Solid-state power transistors (Bipolar, GaAs or GaN) are used to achieve high MTBF.

The RP series is designed to operate in the linear region to maximize third order intercept point, while the RS series operate in the saturated mode to achieve maximum output power. The RG series employ GaN devices to achieve higher power, wide bandwidth and efficency.

Cooling fans and heat sinks are built-in to keep the junction temperature of the transistors in a safe operating region. All units have EMI/RFI filter, built in regulator and/or sequential bias circuit for protection. Output power monitor, RF connectors, waveguide input or output, alarm circuitry, attenuator or DC-DC converter are optional.

These units are ideally suitable for commercial and industrial applications which need low maintenance, good performance and high reliability. They are most suitable for TWT replacement, driver amplifier, transmitter, ground stations and point-to-point communication requirements.

Any CTT amplifier can be supplied in a rack-mount configuration. Contact CTT with your specialized application requirements.

Rack-Mount Power Amplifiers
100 MHz to 31 GHz

- **Solid-State Power Amplifiers from 0.5 to 100 Watts**
- **Worldwide Applications: UHF – Ka-Band** (0.5 GHz to 31 GHz)
- **Employing GaN and GaAs Technologies**
- **Custom Engineered Options (CEOs)** (See page 36)
- **MIC Thin-Film Design for High Reliability**
- **TTL Controlled Pulsed Amplifiers Available**

Model Number	Frequency (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	P3dB (+dBm)	Psat (+dBm)	VSWR (In/Out)	CTT Case Dimensions (Inches)
		Min	Max	Max	Min	Min	Min	Max	W x H x D
RPM/020-4040	0.5–2.0	40	2.00	5.0	40	–	–	2.0:1	19 x 5.25 x 17
RPO/020-4040	1.0–2.0	40	1.50	5.0	40	–	–	2.0:1	19 x 5.25 x 17
RGM/020-4444	0.5–2.0	44	2.00	6.0	–	44	–	2.0:1	19 x 5.25 x 17
RGO/020-4747	1.0–2.0	47	2.00	6.0	–	47	–	2.0:1	19 x 5.25 x 17
RGO/030-4747	1.5–3.0	47	2.00	6.0	–	47		2.0:1	19 x 5.25 x 17
RPO/040-4047	2.0–4.0	47	2.00	5.0	40	–	–	2.0:1	19 x 5.25 x 17
RPM/060-3944	2.0–6.0	44	2.00	5.0	39	–	–	2.0:1	19 x 5.25 x 17
RPM/060-4148	2.0–6.0	48	2.00	5.0	41	–	–	2.0:1	19 x 5.25 x 17
RPO/080-3942	4.0–8.0	42	2.00	5.5	39	–	–	2.0:1	19 x 5.25 x 17
RSN/050-5050	4.4–5.0	50	1.00	5.5	–	–	50	2.0:1	19 x 7.00 x 17
RSN/058-4747	5.25–5.8	47	1.50	7.0	–	–	47	2.0:1	19 x 5.25 x 17
RPN/085-4340	7.7–8.5	40	1.00	7.0	43	–	–	2.0:1	19 x 5.25 x 17
RSN/096-4646	8.5–9.6	46	1.25	8.0	–	–	46	2.0:1	19 x 5.25 x 17
RSN/096-4848	9.0–9.6	48	1.25	8.0	–	–	48	2.0:1	19 x 5.25 x 17
RSN/105-4646	9.5–10.5	46	1.25	8.0	–	–	46	2.0:1	19 x 5.25 x 17
RPN/145-4343	14.0–14.5	43	1.25	8.0	43	–	–	2.0:1	19 x 5.25 x 17
RPN/149-4343	14.4–14.9	43	1.50	8.0	43	–	–	2.0:1	19 x 5.25 x 17
RPN/154-4343	14.4–15.4	43	1.50	8.0	43	–	–	2.0:1	19 x 5.25 x 17
RPX/0218/2742	2.0–18.0	42	2.50	7.0	27	–	–	2.0:1	19 x 3.50 x 17
RSM/180-4040	6.0–18.0	40	2.50	8.0	–	–	40	2.0:1	19 x 5.25 x 17
RPW/265-3030	18.0–26.5	30	2.50	8.0	30	–	–	2.0:1	19 x 5.25 x 17
RSN/310-3940	30.0–31.0	40	1.50	8.0	–	–	39	2.0:1	19 x 5.25 x 17

Rack-Mount Power Amplifier Comments:

1. CTT has more models available, please contact the factory for different specifications or options.
2. Industry standard 19-inch rack.
3. For screening options contact the factory.
4. All specifications guaranteed at +25°C. Units will safely operate from -20°C to +60°C.
5. Specifications listed are subject to change without notice.

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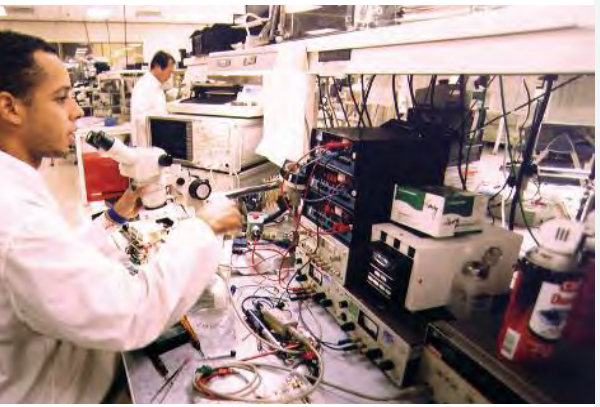
Limiting Amplifiers
100 MHz to 18 GHz

- **Solid-State Designs**
- **Frequency Coverage from 100 MHz to 18 GHz**
- **MIC Thin-Film Design for High Reliability**
- **Custom Designs Available**

Limiting amplifiers operate in the saturated region of their transfer function, thereby, minimizing output power variations and providing constant output over a wide input dynamic range. They are especially effective at minimizing the harmonic content of output power under limiting conditions and reproducing pulsed input signals with high fidelity by minimizing overshoot and recovery times.

Limiting amplifiers are useful in applications, which require tightly controlled power delivered over a wide range of input drive or over wide frequency ranges or even wide temperature ranges. Typical applications include:

- Local oscillator networks
- Microwave phase/frequency discriminators
- Protecting circuitry from overdrive damage
- Removing amplification modulation from FM signals
- Instantaneous frequency measurement (IFM) receivers



Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	Psat (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min	Max	Max	Min-Max	Max	Typ	Typ	
LSM/020-1630	0.5-2	30	1.25	7.0	16-20	2:1	12	180	HC2
LSM/020-1640	0.5-2	40	1.50	6.0	16-20	2:1	12	300	HC4
LSM/020-1670	0.5-2	70	2.00	7.0	16-20	2:1	12	500	HC4/HC4
LSO/040-1640	2-4	40	1.50	3.5	16-20	2:1	12	320	HC4
LSM/060-1627	2-6	27	1.50	7.0	16-20	2:1	12	240	HC2
LSM/060-1635	2-6	35	1.50	6.0	16-20	2:1	12	320	HC2
LSM/060-1660	2-6	60	2.00	7.0	16-20	2:1	12	560	HC2/HC2
LSM/080-1627	2-8	27	1.50	6.0	16-20	2:1	12	240	HC2
LSM/080-1635	2-8	35	1.50	4.0	16-20	2:1	12	320	HC4
LSO/080-1735	4-8	35	1.50	4.5	17-21	2:1	12	320	HC4
LSX/0218-1730	2-18	30	2.00	7.5	17-21	2:1	12	500	HX4
LSX/0218-1740	2-18	40	2.00	7.5	17-21	2:1	12	600	HX6
LSX/0218-1770	2-18	70	3.50	7.5	17-21	2:1	12	1200	HX4/HX6
LSM/180-1435	6-18	35	1.50	7.5	14-18	2:1	12	450	HX4
LSM/180-1445	6-18	45	2.25	7.5	14-18	2:1	12	520	HX6
LSM/180-1480	6-18	80	3.50	7.5	14-18	2:1	12	960	HX4/HX6

Comments:

1. Harmonics: -10 dBc typical at the input power up to +10 dBm.
2. Pulse response:
   - Overshoot: 0.5 dB, max
   - Recovery time: 50 ns, max
   - Settling time: 25 ns, max
   - Rise time: 20 ns, max
3. Temperature compensation, signal suppression and phase matching are optional.
4. All units contain built-in voltage regulator and reverse voltage protection diode.
5. Performance of all Limiting Amplifiers are application-specific. Consult the factory with your requirements.

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For applications where normal amplifier gain variations as a function of environmental temperature range exceed the allowable system limits. CTT offers amplifier designs whose gain variations have been reduced to one half that of uncompensated designs.

CTT Utilizes two techniques for compensating for gain variations:

- Integrating a PIN diode attenuator or FET (field effect transistor)
- Bias current compensation

In the first approach, the control current of a PIN diode attenuator is automatically decreased by means of a thermistor so that at high temperatures there is less attenuation. This compensates for the decreased gain due to an increase in ambient temperature. The attenuator is placed between the gain stages of the amplifiers so that noise figure and output power performance is minimally degraded.

In the second approach, the FET itself is compensated. In regions of low bias current, the FET gain is proportional to the current. The FET bias current is automatically increased by means of a thermistor at high temperatures to increase the gain, in order to compensate for a decrease in gain as a result of the increase in the ambient temperature.

Temperature Compensated Amplifiers
100 MHz to 18 GHz

- **Solid-State Designs**
- **Frequency Coverage from 100 MHz to 18 GHz**
- **-54°C to +85C**
- **MIC Thin-Film Design for High Reliability**
- **Optimum Compensation Techniques**
- **Custom Designs Available**

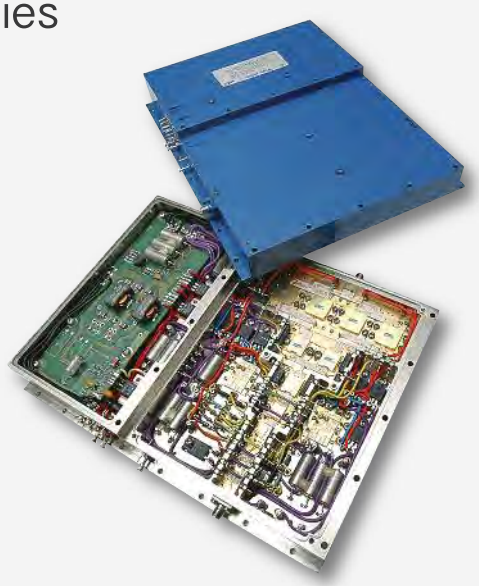
Model Number	Frequency Response (GHz)	Gain (dB)	Gain Flatness (±dB)	Noise Figure (dB)	P1dB (+dBm)	VSWR In/Out	Volts (DC)	DC Current (mA)	CTT Case Outline
	Min	Min-Max	Max	Max	Min	Max	Typ	Typ	
ATM/020-4036	.5-2	36-40	1.25	4.0	15	2:1	12	200	HC4
ATM/020-4033	.5-2	33-37	1.50	4.0	20	2:1	12	320	HC4
ATM/060-4033	2-6	33-37	1.50	4.0	15	2:1	12	240	HC4
ATM/060-4031	2-6	31-35	1.50	4.0	20	2:1	12	350	HC4
ATM/080-5020	2-8	20-24	1.50	5.0	12	2:1	12	250	HC2
ATM/080-7520	2-8	20-24	1.50	7.5	20	2:1	12	280	HC2
ATM/080-5036	2-8	36-40	1.50	5.0	15	2:1	12	300	HC6
ATM/080-5033	2-8	33-37	1.50	5.0	20	2:1	12	350	HC6
ATX/0218-8522	2-18	22-28	2.50	8.5	10	2.2:1	12	450	HX4
ATX/0218-8536	2-18	36-44	2.75	8.5	10	2.2:1	12	600	HX6
ATM/180-5020	6-18	20-24	1.50	5.0	12	2:1	12	250	HX2
ATM/180-6026	6-18	26-30	1.75	6.0	15	2:1	12	300	HX4
ATM/180-7518	6-18	18-22	1.50	7.5	20	2:1	12	320	HX4
ATM/180-6030	6-18	30-35	2.00	6.0	20	2:1	12	450	HX6
ATO/180-6026	8-18	26-30	1.50	6.0	15	2:1	12	300	HX4
ATO/180-6030	8-18	30-35	2.00	6.0	20	2:1	12	450	HX6

Comments:

1. Maximum input power level will be +17 dBm CW. +20 dBm optional.
2. 0.32 inches thick flat package is optional.
3. SMA female connectors are standard.
4. All units contain built-in voltage regulator and reverse voltage protection diode.
5. Consult the factory for any special gain, noise figure, power, voltage, etc.

Multi-Function Subassemblies
100 MHz to 40 GHz

- **Military and Commercial Expertise**
- **Frequency Coverage from 100 MHz to 40 GHz**
- **Complete Subsystem Integration**
- **Proprietary Component Library**
- **MIC Thin-Film Design for High Reliability**
- **Custom Engineered Options (CEOs)** (See page 36)



CTT multi-function integrated subassemblies are designed for flexibility to ensure ease of manufacturing by utilizing thin-film circuits that incorporate the latest in GaN and GaAs FET device technology.

CTT's design approach also provides cost effective methods that limit the customer "investment" as well as development time required during the engineering phase of development. Here CTT can optimize product performance to insure customer objectives are met. A key ingredient in the design of integrated assemblies is the ability to provide optimum component performance. CTT's design staff with the help of analytical software, accomplish in-depth system analysis and provide performance trade-offs that result in quick results and provides customers with data that can be used in their system analysis.

These amplifier-driven assemblies are designed for use in applications that include wideband EW systems, as well as high power, high dynamic range radar systems plus the latest high reliability cost effective commercial communication systems and microwave radios, such as T/R Module and Transceiver.

To meet customer's special needs, such subsystems may consist of integration of the following microwave components:

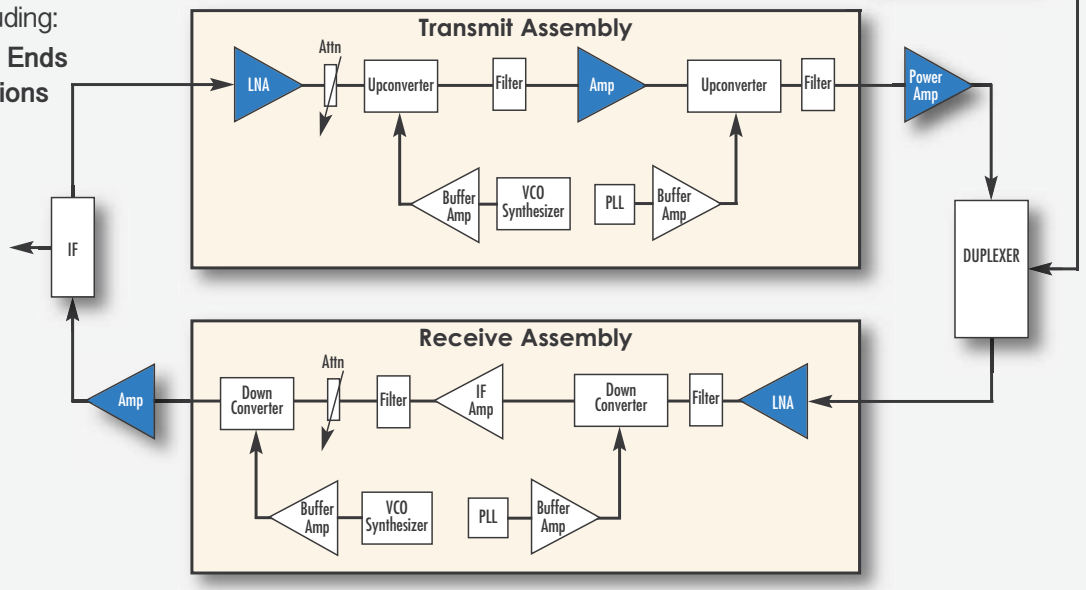
- Detectors • Couplers
- Power Dividers • Attenuators
- Limiters • Switches • Filters
- Mixers • Low-noise amplifiers
- Amplifier gain blocks
- High power amplifiers
- Oscillators • Phase shifters,
- Gain/phase equalizers • etc.

CTT's subassembly operation has been producing complex integrated assemblies including:

- **FM/CW Altimeter Front Ends**
- **Missile Seeker RF Sections**
- **0.5–18 GHz EW RWR MW Front Ends**
- **Datalink Transceivers**

CTT has the in-house design and manufacturing capabilities and has the skills and experience in performing the integration of microwave subsystems in a timely and cost effective manner.

Typical Wireless Transceiver Block Diagram



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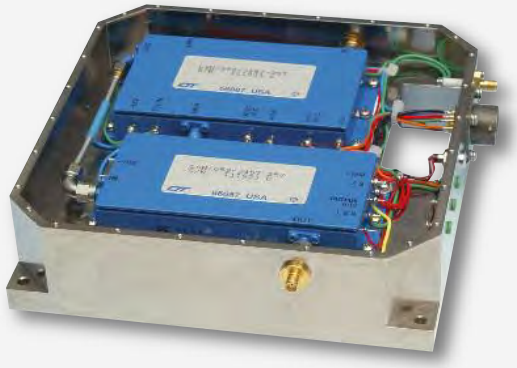
Setting CTT apart from other amplifier manufacturers is our unique spectrum of Custom Engineered Options (CEOs) that can be readily integrated within most package formats. These options are available on all of CTT's standard amplifier products. Contact CTT for your specific application requirements.

CTT has developed a high-rel capability for microwave products. With a product base featuring reliable GaAs and GaN devices, circuits, processes and manufacturing know-how CTT is capable of meeting stringent hi-rel requirements

CTT offers military testing and screening in accordance with MIL-PRF-38534 Class K and Class H.

Unless otherwise specified by the customer CTT builds, tests and inspects its products to commercial/industrial standards.

Custom Engineered Options (CEOs)



- **DC–DC Converters, AC–DC Converters**
- **TTL Control**
- **Samplers, Couplers and Detectors**
- **Heat Exchangers (conduction, convection, forced air or liquid)**
- **Waveguide Inputs / Outputs**
- **Engineering Optimization and Testing for Low Phase Noise** (-160 dBc/Hz @ 10 MHz Offset)
- **Low AM/PM Conversion, Specialized Bandwidths and Specialized Wave Forms**
- **Solid-State Form, Fit, Functional Replacements for Many TWTAs**
- **Block Upconverter (BUC) Configurations**
- **Low-Noise Block (LNB) Downconverter Configurations**

High-Reliability (High-Rel) Capability

- **GaAs Epitaxial Material Based FETs and MMICs**
- **Multi-Level, Thin-Film Circuit Metal Technology**
- **Hermetic Sealing and Laser Welding Technology**
- **SEM and QC/QA Inspection**
- **AS9100 / ISO 9001 Certified Company**
- **Component testing consisting of bond pull and die shear**
- **Fine leak test, temperature cycle, acceleration, burn-in, and radiographic inspection**
- **Complete group A electrical testing**
- **Sample testing consisting of Group B, C and D as specified in MIL-PRF-38534**
- **Customer source inspection throughout the manufacturing process.**
- **Soldering workmanship: Certified IPC-610**

Manufacturing Plus Quality Equals Reliability

Manufacturing Operations

The manufacturing operations at CTT are highly integrated into all facets of the production build.

CTT maintains manufacturing operations within its San Jose, California headquarters. These offices are staffed with engineering and materials support personnel that manage the day-to-day activities.

Having built thousands of products with power levels that range from a few watts to 1 kW, CTT has become a leader in solid-state microwave amplification.

CTT's U.S.-based, 32,200 square-foot manufacturing facility offers a complete solution in the production of microwave integrated circuits.

Moreover, CTT's facility was specifically designed to accommodate the unique requirements of hybrid microwave integrated circuit manufacturing conforming to MIL-PRF-38534.

Another important factor differentiating the CTT facility from other manufacturers is the availability of comprehensive microwave frequency test capabilities. This offers the customer to choose from either "standard" testing procedures or to customize testing to meet stringent system requirements.

CTT's microwave testing utilizes the latest in network analysis tools. One of the primary strengths of CTT's integrated circuit manufacturing is the ability to mix and match technologies to best meet the requirements of a particular application.

Commitment

CTT is committed to provide the highest level of reliability in its products. This is demonstrated by the extremely low number of repairs that the company receives.

Every product that CTT delivers strictly adheres to active de-rating criteria, thermal design consideration and proven manufacturing techniques established by CTT's engineering and quality departments as well as those required by it's suppliers.

During development phase, manufacturing operations perform product planning that includes design verification, supplier selection, manpower analysis, equipment needs and master scheduling.

Once a product is committed to the production department, production control monitors material suppliers and work-in-process to ensure that any issues effecting the delivery commitments are addressed and corrected immediately.

Automation is used extensively all through the manufacturing process wherever possible.

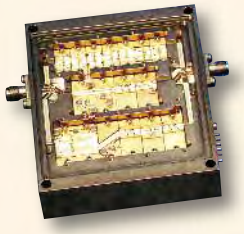
Quality

CTT is committed to the concept that quality must be designed in and not inspected into the product. The quality engineers

Modern 32,200 Square-Foot Facility

Contains Class 1,000 and Class 10,000 Clean Rooms, and houses a computer-controlled, fully automated, robotic manufacturing operation comprising of:

- **Multiple Pick-and-Place Machines whose Capabilities Accommodate:**
  - Hybrid Microwave ICs
  - Surface-Mount Components
  - Leaded Components
- **The Latest Automated Wire Bond Machines Programmed for:**
  - 0.5 to 0.7 mil Wire Bonding
  - 2 to 25 mil Ribbon Bonding
- **Programmable Epoxy Dispensers**
  - Conductive Epoxy Attachment
- **Component Mounting**
  - Batch and Continuous Flow
  - Eutectic Component Attach
  - Lead-Free Solder Available



Inventory Control

- **Full Nitrogen Containment (to Preserve Solderability and Bondability)**
- **Project Stock Accounting**
- **Component and Assembly Lot Number Control**
- **Bonded Customer Storage**

Material Management

- **Project Availability and Yield Analysis**
- **Supplier Delivery, Pricing and Cost Performance Auditing**
- **Standalone Materials Procurement Group**
- **Project Target Goals and Budget Management**

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review all designs for compliance to CTT's quality and workmanship standards and assist design engineering in the selection of suppliers and components.

Inspection points throughout the manufacturing process are maintained and deviations analyzed and controlled through TQM and SPC programs to ensure a consistent manufacturing process.

To assure the highest level of reliability, CTT has implemented its own screening program derived from MIL-PRF-38534. Custom screening procedures are available on special request.

CTT's quality and process control systems are approved to AS9100 / ISO 9001 and JSTDs. Test and measurement equipment is calibrated in accordance with MIL-STD-45662 and ANZI-Z-540.

CTT is an AS9100 / ISO 9001 Registered company and has received numerous supplier excellence awards for quality and performance.

Manufacturing Plus Quality Equals Reliability (continued)

Product Test, Evaluation and Analysis

- Solderability Test and Analysis
- Optical Microscopy
- Electron Scanning Microscopy (10X to 1500X)
- Mechanical Tolerance and Testing
- Thermal and Imaging Analysis
- Surface and Wire Insulation Resistance
- Plating Thickness Measurement
- EMI Testing
- Equipment Calibration Traceability to NIST
- Available Environmental Testing to: MIL-STD-810 / MIL-STD-202 / MIL-E-5400
- Quality System: AS9100 / ISO 9001
- Hybrid Construction Conforms to MIL-PRF-38534

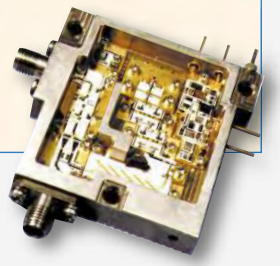
AS9100
ISO 9001

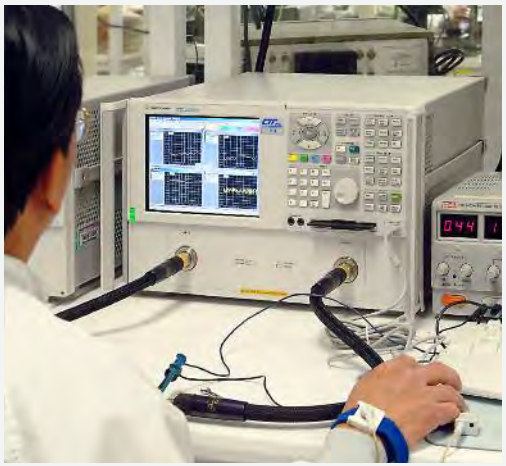
Production Testing

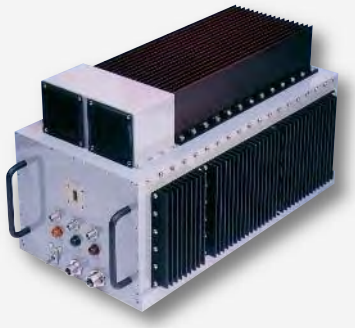
- Analog and Digital Control Electronic Test
- Frequencies to 45 GHz
- Microwave Power to 1 kW

Electrostatic Discharge Protection Area (EPA)

- 3-Dimensional ESD-Controlled Work Areas
- Periodic Monitoring and Testing
- Continuously Monitored Ionization of Air
- Conductive Flooring Materials







CTT Screening Program

Test	Method	Test Condition
Pre-Cap Visual Inspection	2017, 2010	CTT Inspection Procedure #604003002
Stabilization Bake	—	+125°C, 24 hours
Thermal Cycle	101.5	-55°C to +125°C, 5 cycles
Burn-In	1015	C, 24 Hrs @ +85°C
Acceleration	2001.2	C, 5000 Gs Y1 Axis
Seal Test	1014	C (Gross-Leak Only)
Final Electrical	—	CTT Standard ATP #601003024
External Visual; Inspection	2009	Customer Specs, CTT QA Procedure #604006810

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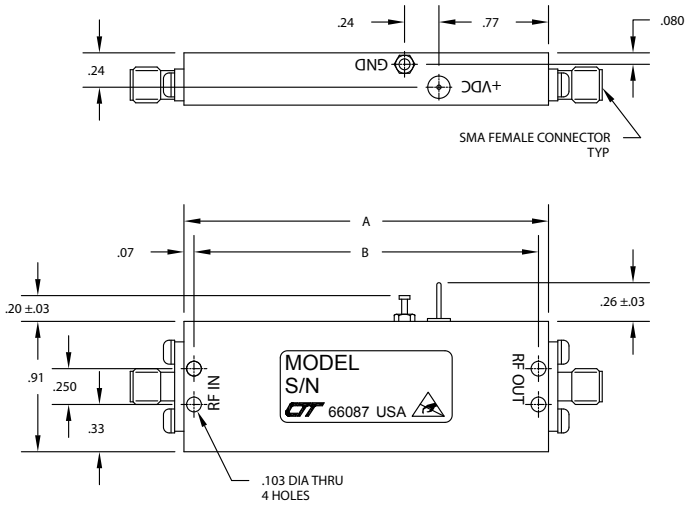
Electromagnetic Spectrum (EMS)

EMS access is a prerequisite for modern military operations. The Department of Defense's (DoD) growing requirements to gather, analyze, and share information rapidly; to control an increasing number of automated Intelligence, Surveillance, and Reconnaissance (ISR) assets; to command geographically dispersed and mobile forces to gain access into denied areas; and to "train as we fight" requires that DoD maintain sufficient spectrum access.

Additionally, we are facing new sophisticated challenges in the EMS due to the explosive growth of spectrum dependent systems (SDS) and consumer demand for spectrum, the global proliferation of highly innovative electronics technology, and the development of advanced cyber capabilities.

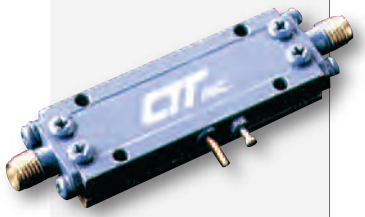
CTT Case Outline Drawings

AB Series

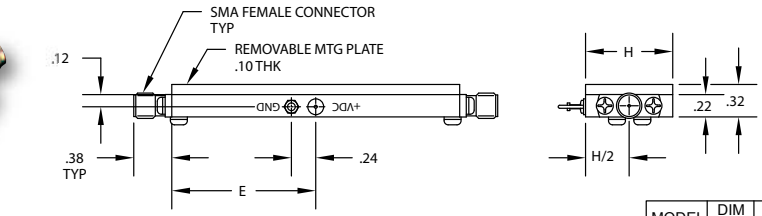


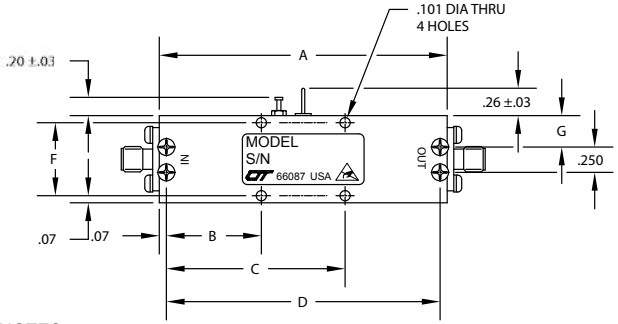
MODEL	DIM A	DIM B
AB2	1.270	1.130
AB3	1.525	1.385
AB4	1.780	1.640
AB5	2.035	1.895
AB6	2.290	2.150
AB7	2.545	2.405

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105018879.



FX/FC/FS Series



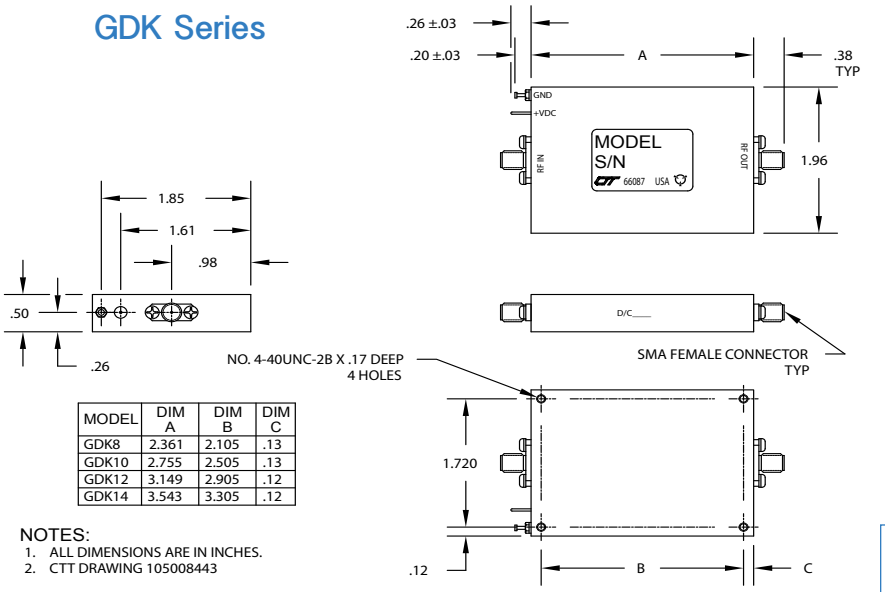


MODEL	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G	DIM H
FX2	1.36	.235	.985	1.22	.68	.520	.20	.66
FX3	1.61	.235	1.235	1.47	.81	.520	.20	.66
FX4	1.85	.235	1.475	1.71	.93	.520	.20	.66
FX5	2.13	.235	1.745	1.98	1.06	.520	.20	.66
FX6	2.34	.235	1.965	2.20	1.17	.520	.20	.66
FX7	2.59	.235	2.215	2.45	1.30	.520	.20	.66
FX8	2.83	.235	2.455	2.69	1.42	.520	.20	.66
FX10	3.34	.235	2.965	3.20	1.67	.520	.20	.66
FC2	1.50	.267	1.093	1.36	.75	.620	.26	.76
FC3	1.84	.380	1.315	1.70	.92	.620	.26	.76
FC4	2.17	.602	1.428	2.03	1.09	.620	.26	.76
FC5	2.50	.767	1.593	2.36	1.25	.620	.26	.76
FC6	2.84	.937	1.763	2.70	1.42	.620	.26	.76
FS2	1.50	.267	1.093	1.36	.75	.720	.31	.86
FS3	1.84	.380	1.315	1.70	.92	.720	.31	.86
FS4	2.17	.602	1.428	2.03	1.09	.720	.31	.86
FS5	2.50	.767	1.593	2.36	1.25	.720	.31	.86
FS6	2.84	.937	1.763	2.70	1.42	.720	.31	.86

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105007879.
3. REMOVABLE BASEPLATE IS ALSO AVAILABLE IN .19 THICKNESS (CTT DRAWING 105007880).

CTT Case Outline Drawings
(continued)

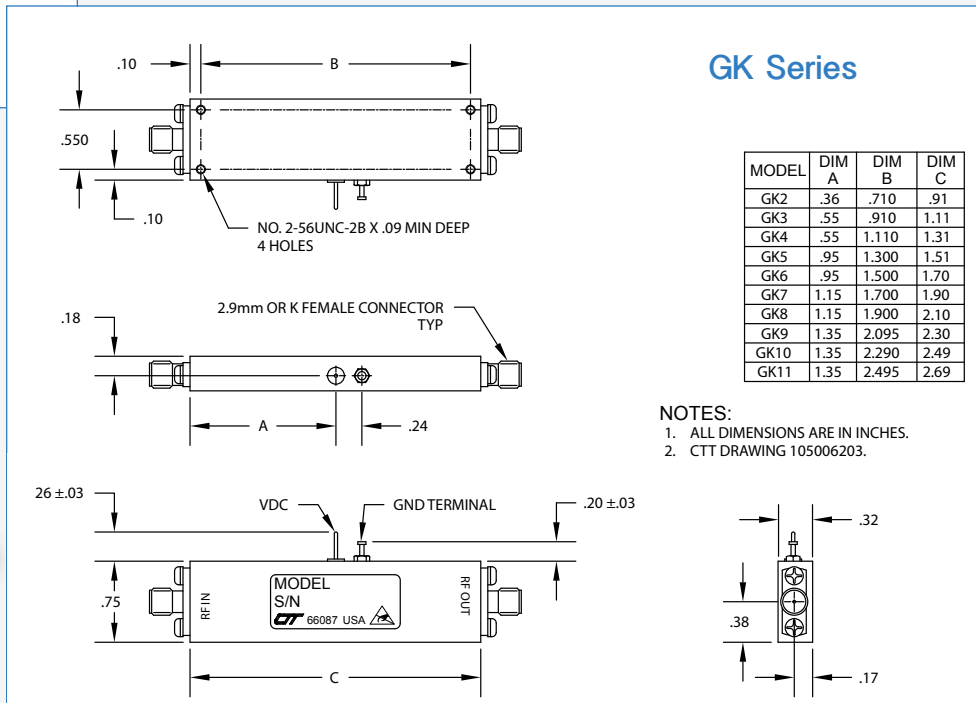
GDK Series



MODEL	DIM A	DIM B	DIM C
GDK8	2.361	2.105	.13
GDK10	2.755	2.505	.13
GDK12	3.149	2.905	.12
GDK14	3.543	3.305	.12

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105008443

GK Series



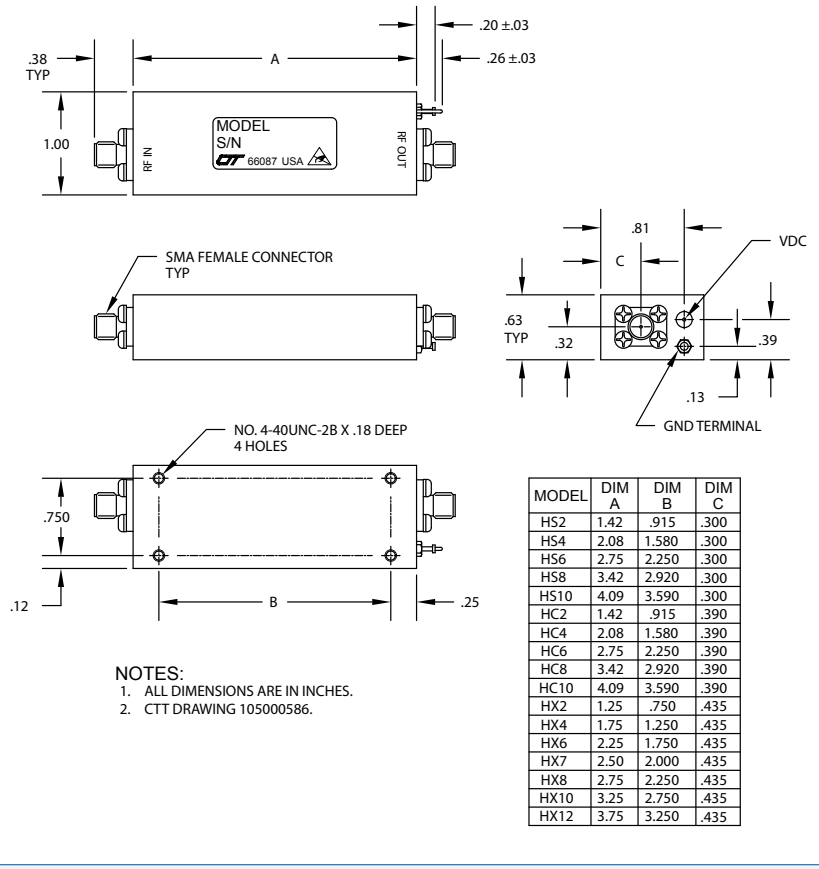
MODEL	DIM A	DIM B	DIM C
GK2	.36	.710	.91
GK3	.55	.910	1.11
GK4	.55	1.110	1.31
GK5	.95	1.300	1.51
GK6	.95	1.500	1.70
GK7	1.15	1.700	1.90
GK8	1.15	1.900	2.10
GK9	1.35	2.095	2.30
GK10	1.35	2.290	2.49
GK11	1.35	2.495	2.69

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105006203.

CTT Case Outline Drawings

(continued)

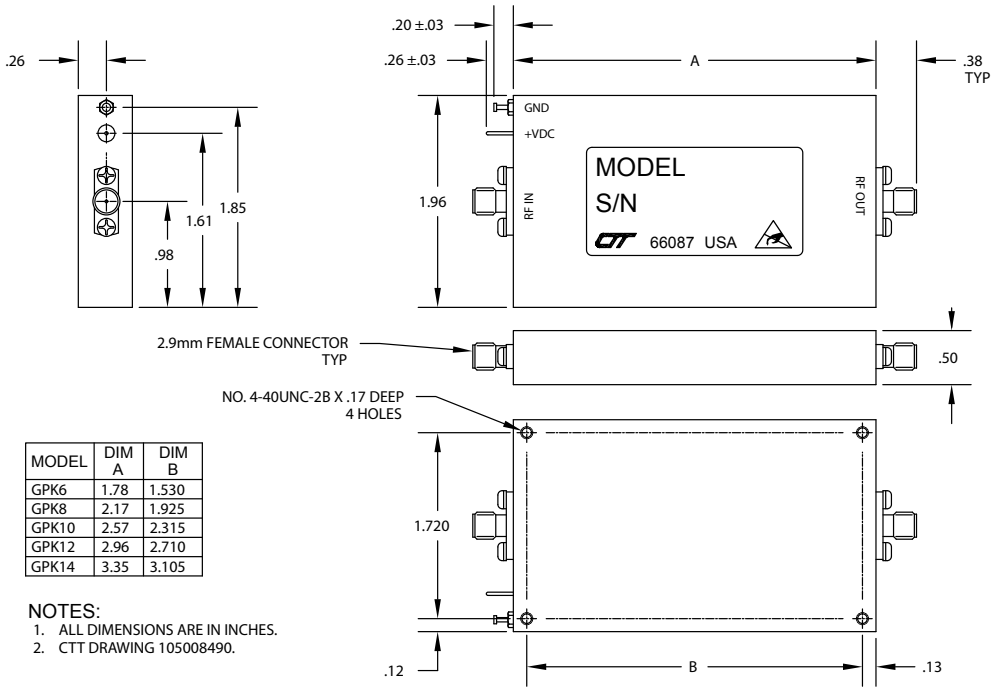
H Series



NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105000586.

MODEL	DIM A	DIM B	DIM C
HS2	1.42	.915	.300
HS4	2.08	1.580	.300
HS6	2.75	2.250	.300
HS8	3.42	2.920	.300
HS10	4.09	3.590	.300
HC2	1.42	.915	.390
HC4	2.08	1.580	.390
HC6	2.75	2.250	.390
HC8	3.42	2.920	.390
HC10	4.09	3.590	.390
HX2	1.25	.750	.435
HX4	1.75	1.250	.435
HX6	2.25	1.750	.435
HX7	2.50	2.000	.435
HX8	2.75	2.250	.435
HX10	3.25	2.750	.435
HX12	3.75	3.250	.435

GPK Series

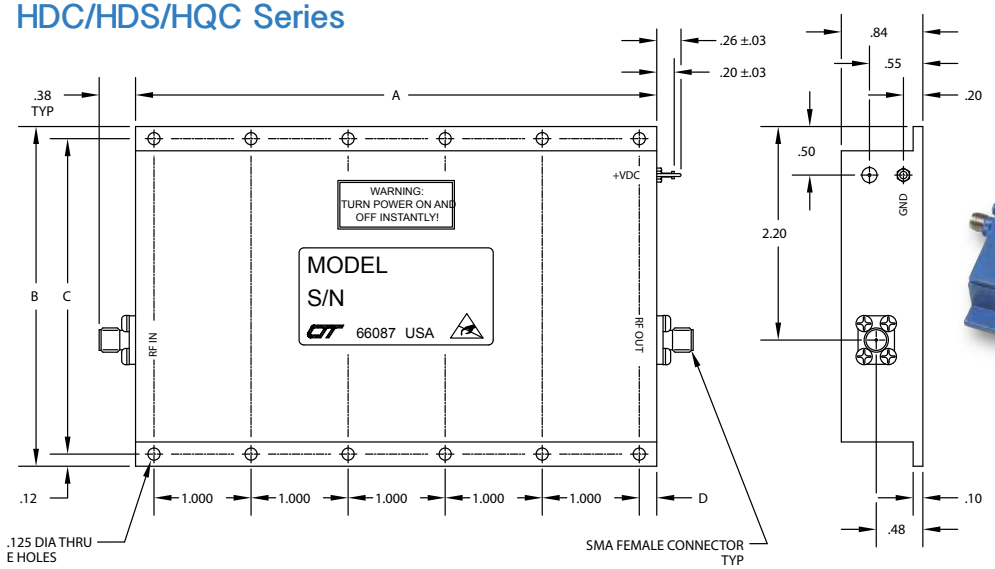


MODEL	DIM A	DIM B
GPK6	1.78	1.530
GPK8	2.17	1.925
GPK10	2.57	2.315
GPK12	2.96	2.710
GPK14	3.35	3.105

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105008490.

CTT Case Outline Drawings
(continued)

HDC/HDS/HQC Series



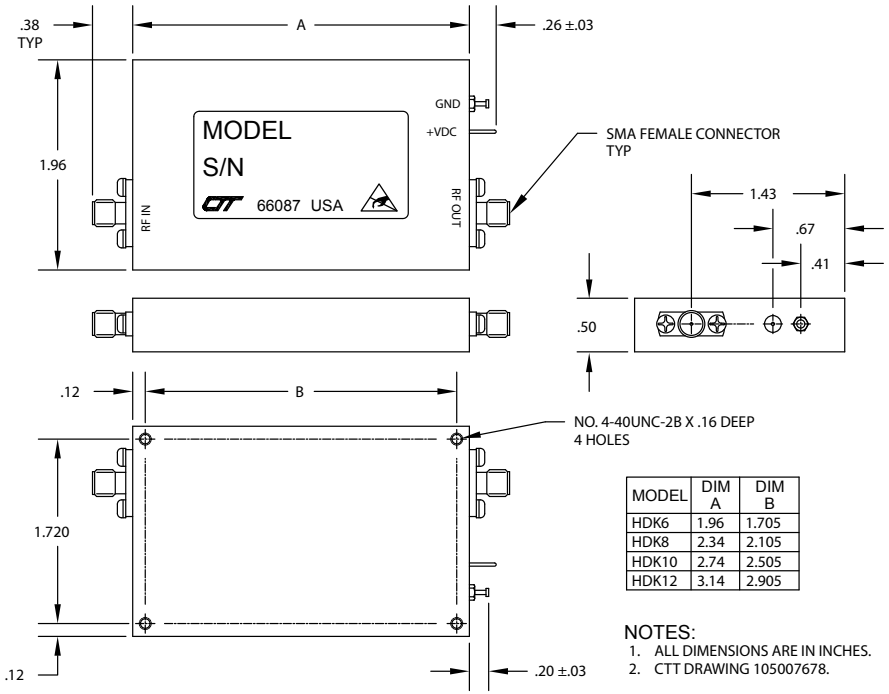
MODEL	DIM A	DIM B	DIM C	DIM D	DIM E
HDC8	3.37	3.50	3.250	.19	8
HDC10	4.04	3.50	3.250	.52	8
HDC12	4.71	3.50	3.250	.35	10
HDC14	5.38	3.50	3.250	.19	12

MODEL	DIM A	DIM B	DIM C	DIM D	DIM E
HDS8	3.37	3.50	3.250	.19	8
HDS10	4.04	3.50	3.250	.52	8
HDS12	4.71	3.50	3.250	.35	10
HDS14	5.37	3.50	3.250	.18	12

MODEL	DIM A	DIM B	DIM C	DIM D	DIM E
HQC10	4.68	4.00	3.750	.34	10
HQC12	5.35	4.00	3.750	.18	12
HQC14	6.02	4.00	3.750	.51	12

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105007580 (HDC/HQC), 105014234 (HDS).

HDK Series

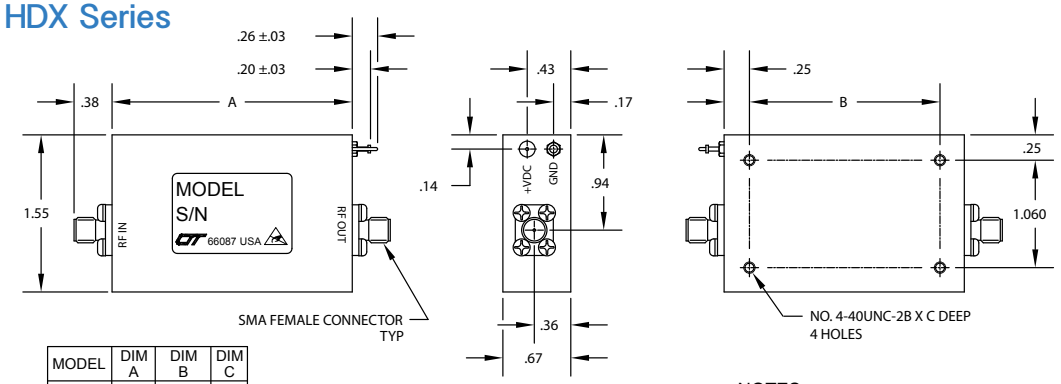


MODEL	DIM A	DIM B
HDK6	1.96	1.705
HDK8	2.34	2.105
HDK10	2.74	2.505
HDK12	3.14	2.905

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105007678.

CTT Case Outline Drawings
(continued)

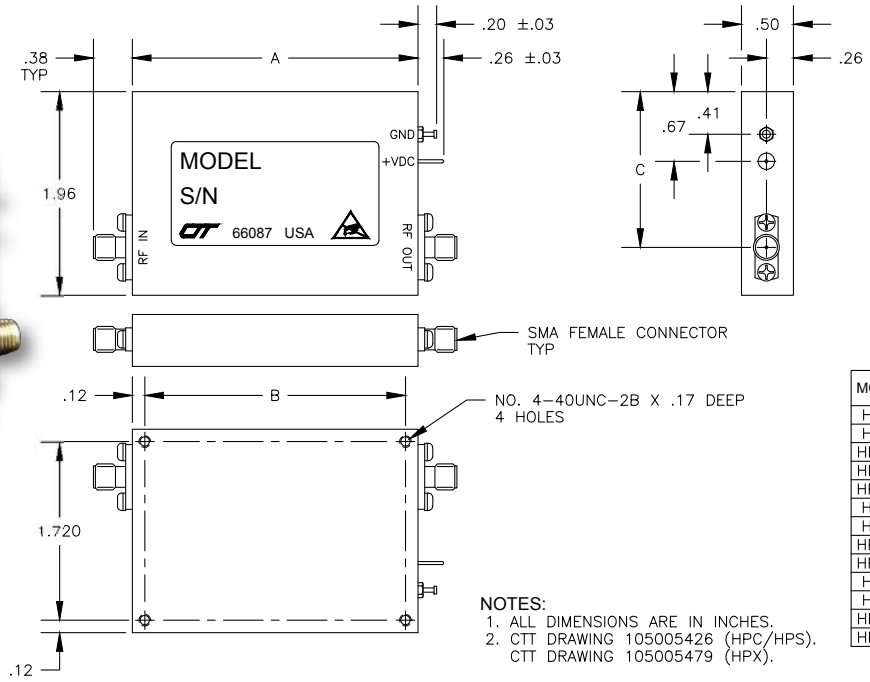
HDX Series



MODEL	DIM A	DIM B	DIM C
HDX6	2.37	1.880	.10
HDX8	2.88	2.390	.15
HDX10	3.39	2.900	.15
HDX12	3.90	3.410	.15

NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105007440

HP Series



NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105005426 (HPC/HPS).
   CTT DRAWING 105005479 (HPX).

MODEL	DIM A	DIM B	DIM C
HPX6	2.24	2.000	1.45
HPX8	2.75	2.510	1.45
HPX10	3.26	3.020	1.45
HPX12	3.77	3.530	1.45
HPX14	4.28	4.040	1.45
HPC6	2.75	2.510	1.50
HPC8	3.42	3.180	1.50
HPC10	4.09	3.850	1.50
HPC12	4.76	4.520	1.50
HPS6	2.75	2.510	1.59
HPS8	3.42	3.180	1.59
HPS10	4.09	3.850	1.59
HPS12	4.76	4.520	1.59

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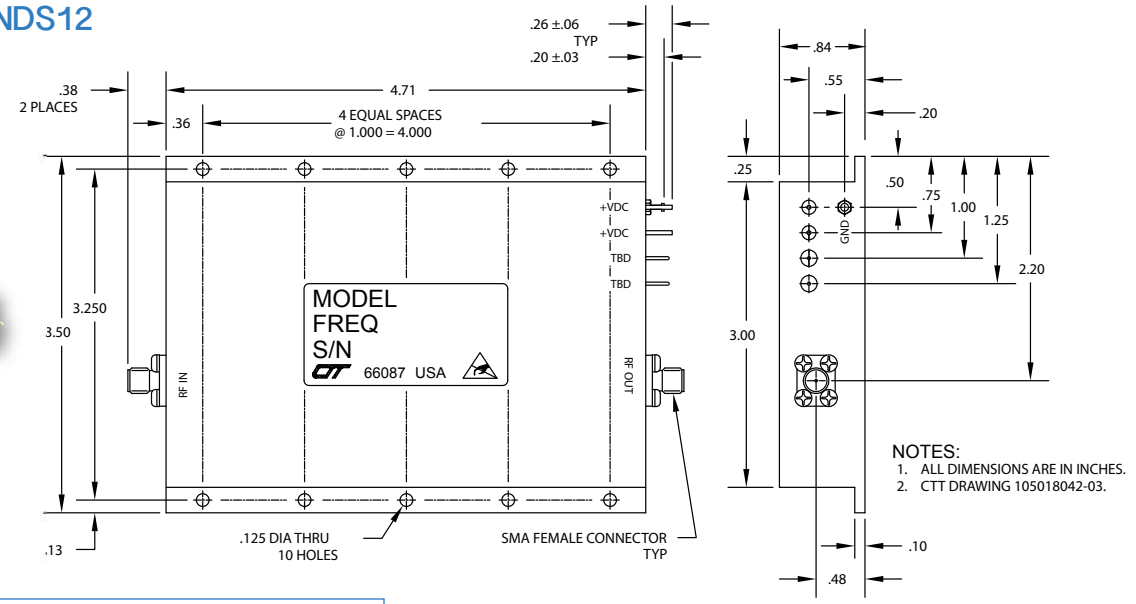
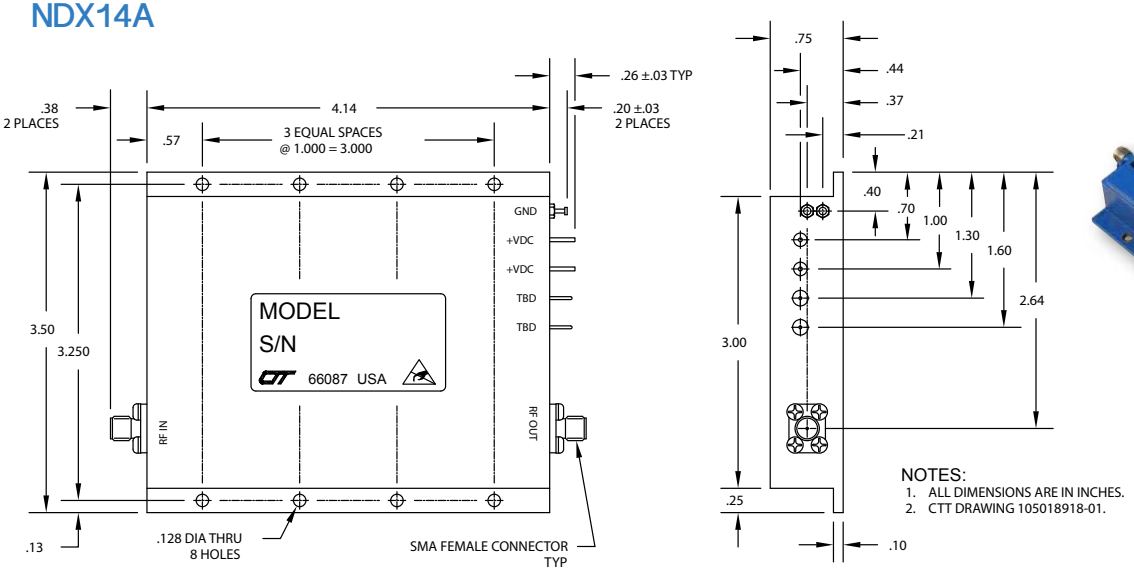
CTT Case Outline Drawings
(continued)

NDS12

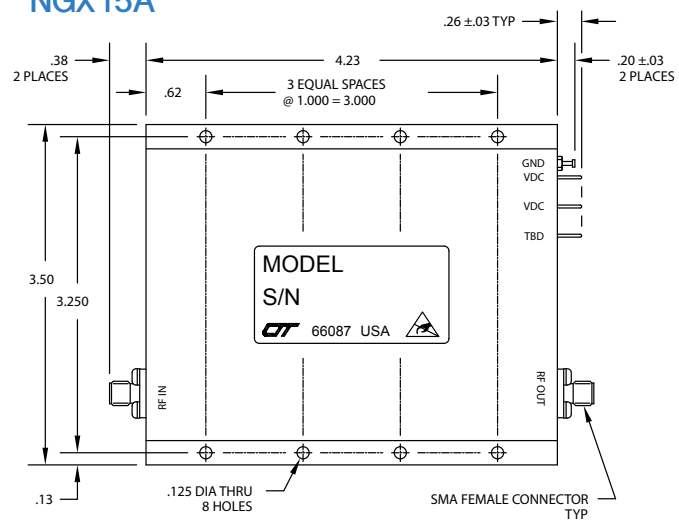


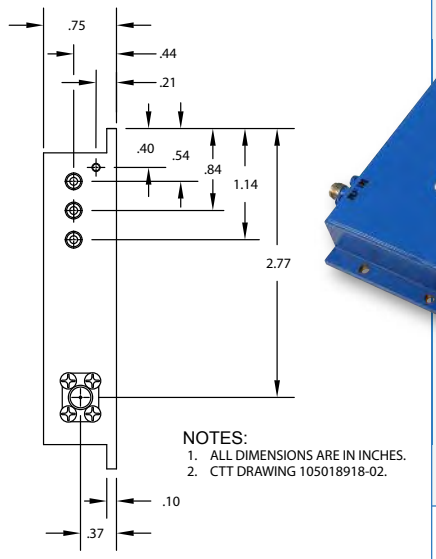
NDX14A



CTT Case Outline Drawings
(continued)

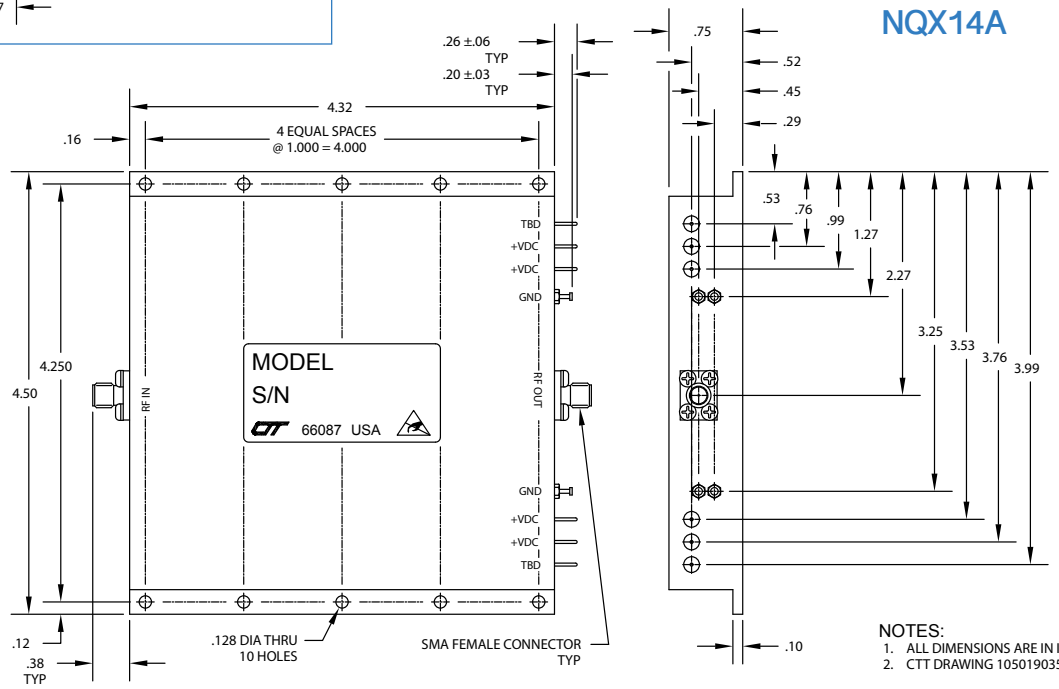
NGX15A





NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105018918-02.

NQX14A



NOTES:
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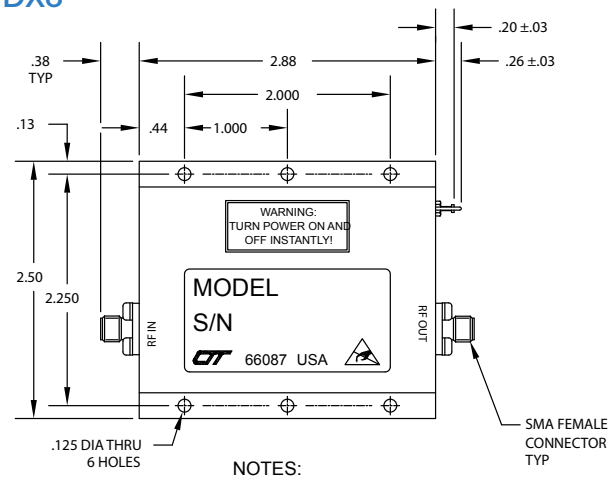
2. CTT DRAWING 105019035.

CTT Case Outline Drawings

(continued)

PDX8



NOTES:
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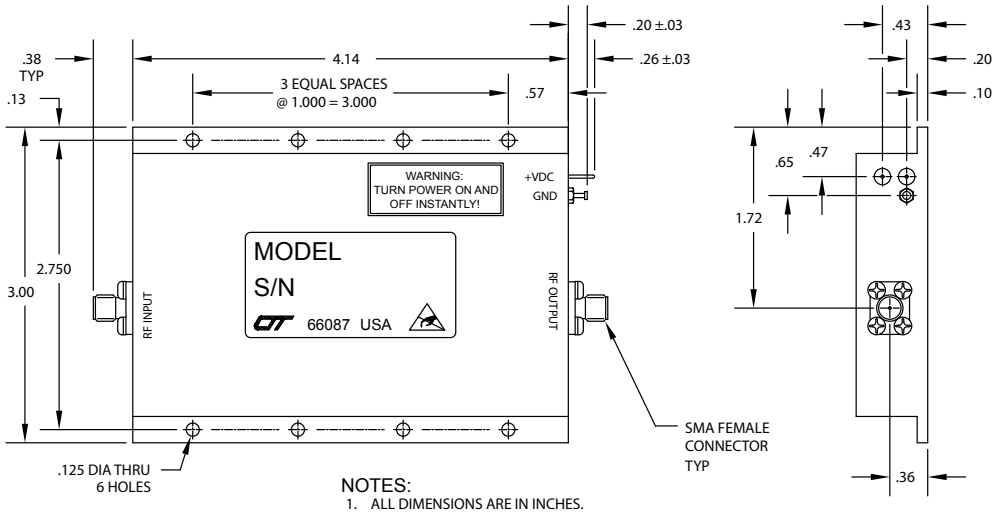
2. CTT DRAWING 105012384.

PQX12



NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. CTT DRAWING 105011657.

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Advancing Through State-of-the-Art Technology

To be a profitable as well as a low-cost producer, requires a company to invest heavily into the design and manufacturing concepts that will be used in its products. These concepts ensure that the very latest state-of-the-art technology is being used in a cost-effective manner.

The design, engineering, and manufacturing personnel at CTT pride themselves as a team that can take a product from concept to production faster than any other company with which CTT competes.

More than thirty-five years ago CTT, Inc. made a strong commitment to serve the microwave/RF market with a simple goal:

Quality, **Performance**, **Reliability**, **Service** and **On-Time Delivery** of our products.

Give us a call to find out how our commitment can support your success.

It's that simple.

Solid-State Amplifier Solutions for Military and Commercial Applications

Total Customer Satisfaction

CTT Inc.
Quality Policy

It shall remain CTT's goal to supply our customer with a reliable on-time product and to maintain this goal through continuous improvement of our quality system.

CTT INC
A KRATOS Company

Over the years, CTT has been the recipient of numerous accolades for excellence including:

Northrop Grumman Corp. Defense Systems Division
- Silver Supplier Award
- Bronze Supplier Award
- Quality Award

Loral Electronic Systems
- Supplier Excellence Award

General Dynamics Electronics Division
- Minority Supplier of the Year Award

Litton Systems Inc. (L3)
- Dependable Vendor Award

Cubic Defense Systems
- Small Subcontractor of the Year Award

Telephonics Corporation
- Certified Supplier Award

Raytheon
- Supplier Excellence Award

AAI
- RQ-7 Shadow TUAV Award

Southern California Regional Purchasing Councils
- Supplier of the Year Award

U.S. Small Business Administration
- Award for Excellence

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