Solid-State Amplifier Solutions for Military and Commercial Applications

CTT INC
A KRATOS Company

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.

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Microwave Power Modules

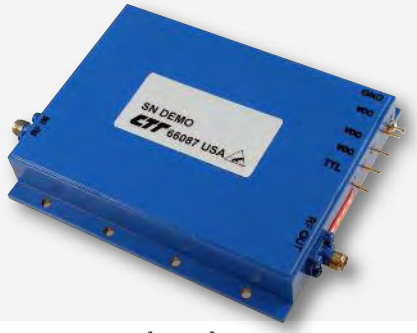
Microwave Power Modules (MPMs) typically consist of a low-noise, high-gain solid-state power amplifier (SSPA) driving a relatively low-gain, high-efficiency Helix traveling-wave tube (TWT) with a control and protection module providing electrical power to both the SSPA and TWT. Many of CTT's high power 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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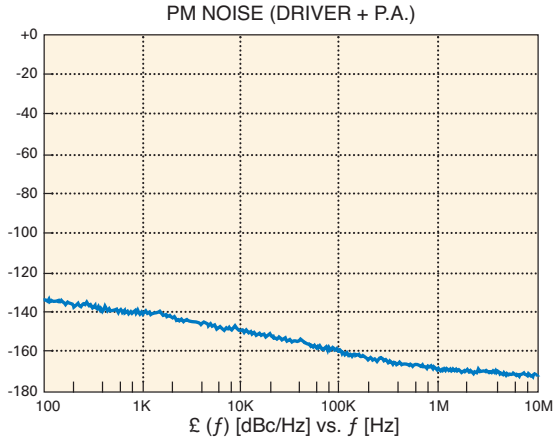
GaN Power Amplifiers
Narrowband Power Amplifiers (CW) up to 1kW

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

Continued on Next Page

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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.