

### Description

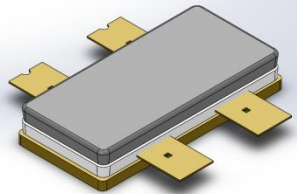
The HTH1D22P700S is an unmatched discrete GaN on SiC Power Amplifier with 700W saturated output power covering frequency range from 1.800 - 2.170 GHz.


### Features

- Operating Frequency Range: 1.800 - 2.170 GHz
- Operating Drain Voltage: +48V
- Saturation Output Power: 700W
- Power Average: 112W
- Device can be used on a single-ended or in a push-pull configuration. Doherty application applicable
- Excellent thermal stability due to low thermal resistance package
- Enhanced robustness design without device degradation
- Efficiency: 58.5%@2.140GHz, WCDMA
- Gain: 15.5dB@2140MHz, WCDMA

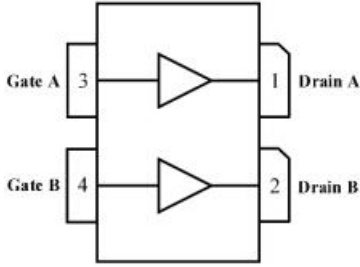
### Applications

- 3GPP 5G NR FR1 n1/2/25/34/39/70
- 4G-LTE B1/2/3/34/37/39/70
- Amplifier for Micro and Macro Base Stations
- Repeaters/DAS
- Mobile Infrastructure



**ACS2110S-4L** 

Earless Flanged  
Air Cavity Spliced Package; 4 Leads  
**HTH1D22P700S**



(Top View)

Note: Exposed backside of the package is the source terminal for the transistor

**Pin Connections**

### Ordering Information

Part Number	Description
HTH1D22P700S	Reel Package
HTH1D22P700SEVB	1.800 - 2.170 GHz EVB

### Typical Performance

#### RF Characteristics (Pulsed CW)

Freq (GHz)	MaxGain (dB)	P1dB (dBm)	P3dB (dBm)	P5dB (dBm)	EffMax (%)	Gain(dB) @50.5dBm	Eff (%) @50.5dBm
2.11	16.2	53.2	58.0	58.8	71.5	16.2	59.5
2.14	16.8	52.5	57.2	58.6	72.3	16.6	62.1
2.17	17.1	52.1	56.6	58.3	72.8	16.7	61.5

*VDD=48Vdc, IDQ=300mA, Vgsp=Vgsm-2.7V, Pavg=50.5 dBm, Pulsed CW, Pulse Width = 100 us, Duty Cycle =10%. Test on WATECH Application Board*

#### RF Characteristics (WCDMA)

Freq (GHz)	Gain (dB)	Eff (%)	ACPR_L* @5MHz (dBc)	ACPR_U* @5MHz (dBc)
2.110	15.3	58.2	-24.1	-24.3
2.140	15.5	58.5	-25.2	-25.6
2.170	15.6	57.7	-26.1	-26.2

*Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ\_Carrier= 300mA, Vgsp =Vgsm-2.7V, PAVG = 50.5 dBm*

*1C-WCDMA 5MHz Signal, 9.9 dB PAR @ 0.01% CCDF test on WATECH Application Board*

*\*Uncorrected DPD*

### Absolute Maximum Ratings

Parameter	Range/Value	Unit
Drain voltage (V <sub>DSS</sub> )	+150	V
Gate voltage (V <sub>GS</sub> )	-10 to +2.0	V
Storage Temperature (T <sub>STG</sub> )	-65 to +150	°C
Junction Temperature (T <sub>J</sub> )	225	°C

### Electrical Specification

#### DC Characteristics (Carrier)

Parameter	Conditions	Min	Typ	Max	Unit
Breakdown Voltage V <sub>(BR)DSS</sub>	Vgs=-8V, Ids=24mA	150	-	-	V
Gate-Source Threshold Voltage V <sub>GS(th)</sub>	Vds=10V, Ids=24mA	-3.6	-2.8	-2.2	V
Drain Leakage Current I <sub>DSS</sub>	Vgs=-8V, Vds=50V	-	7.2	-	mA
Gate Leakage Current I <sub>GSS</sub>	Vgs=-10V, Vds=0V	-	-2.4	-	mA



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### DC Characteristics (Peak)

Parameter	Conditions	Min	Typ	Max	Unit
Breakdown Voltage $V_{(BR)DSS}$	$V_{gs}=-8V, I_{ds}=33.6mA$	150	-	-	V
Gate-Source Threshold Voltage $V_{GS(th)}$	$V_{ds}=10V, I_{ds}=33.6mA$	-3.6	-2.8	-2.2	V
Drain Leakage Current $I_{DSS}$	$V_{gs}=-8V, V_{ds}=50V$	-	10	-	mA
Gate Leakage Current $I_{GSS}$	$V_{gs}=-10V, V_{ds}=0V$	-	-3.6	-	mA

### RF Characteristics (Pulsed CW)

Parameter	Freq (GHz)	Min	Typ.	Max	Unit
P1dB	2.140	51.2	52.5	-	dBm
P5dB	2.140	58.0	58.5	-	dBm
Gain Flatness	2.110 - 2.170 PAVG = 50.5 dBm	-	0.5	1.0	dB

Test conditions unless otherwise noted: 25 °C,  $V_{DD} = +28Vdc$ ,  $IDQ\_Carrier = 300mA$ ,  $V_{gsp} = V_{gsm} - 2.7V$ , Pulse Width = 1ms, Duty Cycle = 10% test on WATECH Production Board

### RF Characteristics (WCDMA)

Parameter	Conditions	Min	Typ.	Max	Unit
Frequency		2.140			GHz
Gain	PAVG = 50.5 dBm	14.5	15.5	-	dB
Eff	PAVG = 50.5 dBm	56	58.0	-	%
ACPR@5MHz*	PAVG = 50.5 dBm	-	-25.3	-24.0	dBc

Test conditions unless otherwise noted: 25 °C,  $V_{VDD} = +48Vdc$ ,  $IDQ\_Carrier = 300mA$ ,  $V_{gsp} = V_{gsm} - 2.6V$ , 1C-WCDMA 5MHz Signal, 9.9 dB PAR @ 0.01% CCDF test on WATECH Application Board

\*Uncorrected DPD, ACPR measured in 3.84MHz Channel Bandwidth @± 5MHz Offset

### Load Mismatch Test

Condition	Test Result
VSWR=10:1, at all Phase Angles, $V_{DD} = +48Vdc$ , $IDQ\_Carrier = 300mA$ , 1C-WCDMA 5MHz Signal, 9.9 dB PAR, PAVG = 50.5 dBm, Frequency 1.800 - 2.170 GHz, test on WATECH Application Board	No Device Degradation

### Thermal Information

Parameter	Condition	Value (Typ)	Unit
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Thermal Resistance Junction to Case ( $R_{TH}$ )	$T_{CASE} = 80^{\circ}C$ , $VDD = +48Vdc$ , IDQ_Carrier = 300mA, 1C-WCDMA 5MHz Signal, 9.9 dB PAR, PAVG = 50.5 dBm	0.47	$^{\circ}C / W$
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## 700W, 1.800 - 2.170 GHz GaN Amplifier

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### Load Pull Performance Carrier

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ= 200mA, PW = 100us, DC= 10%

Max Output Power (Carrier)						
Freq (GHz)	Z_source (Ω)	Z_load [1] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1.800	1.25-j*3.45	7.56-j*7.74	18.4	56.74	472	69.7
1.880	1.7-j*5.07	9.0-j*7.0	18.6	56.78	476	72.4
2.110	2.65-j*6.69	13.35-j*4.48	19.3	56.37	433	65.7
2.170	3.23-j*5.13	13.96-j*2.12	19.4	56.42	438	65.5

[1] Load impedance for optimum P3dB pout

Max Drain Efficiency (Carrier)						
Freq (GHz)	Z_source (Ω)	Z_load [2] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1.800	1.25-j*3.45	3.7-j*6.0	19.9	55.1	323	80.9
1.880	1.7-j*5.07	3.8-j*6.8	20.0	54.7	295	80.5
2.110	2.65-j*6.69	5.38-j*8.0	21.5	54.4	275	77.5
2.170	3.23-j*5.13	6.68-j*9.34	21.4	54.3	269	75.8

[2] Load impedance for optimum P3dB efficiency

### Load Pull Performance Peak

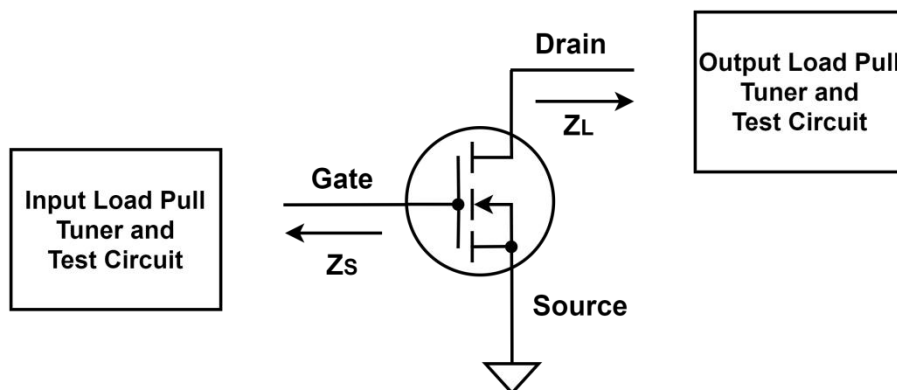
Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ= 200mA, PW = 100us, DC= 10%

Max Output Power (Peak)						
Freq (GHz)	Z_source (Ω)	Z_load [1] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1.800	1.23-j*3.78	10.87-j*10.15	16.8	57.9	616	67.7
1.880	1.72-j*5.79	13.68-j*7.16	17.1	57.6	575	65.3
2.110	2.44-j*7.28	17.9-j*0.3	17.7	57.5	562	65.0
2.170	3.15-j*5.9	15.8-j*3.95	17.8	57.4	549	63.6

[1] Load impedance for optimum P3dB pout

Max Drain Efficiency (Peak)						
Freq (GHz)	Z_source (Ω)	Z_load [2] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1.800	1.23-j*3.78	3.7-j*8.15	18.3	55.4	346	76.9
1.880	1.72-j*5.79	5.23-j*8.9	18.5	55.7	371	76.5
2.110	2.44-j*7.28	11.08-j*10.58	19.4	55.8	380	74.2
2.170	3.15-j*5.9	14.43-j*10.45	19.5	55.4	346	72.9

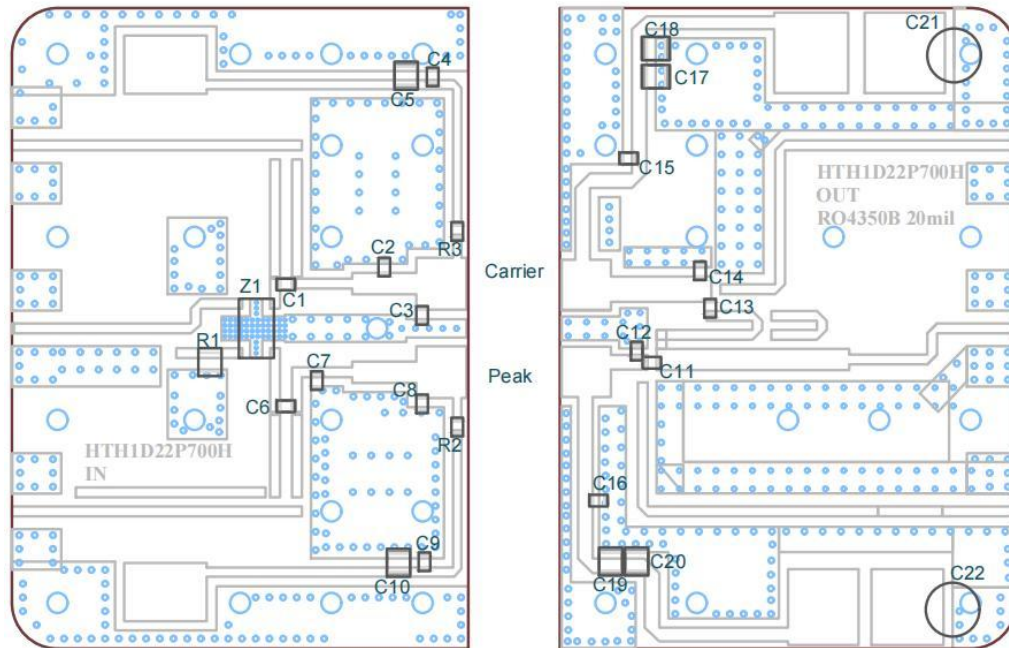
[2] Load impedance for optimum P3dB efficiency



$Z_{source}$  : Measured impedance presented to the input of the device at the package reference plane

$Z_{load}$  : Measured impedance presented to the output of the device at the package reference plane

### HTH1D22P700S 2.110 - 2.170 GHz Reference Design



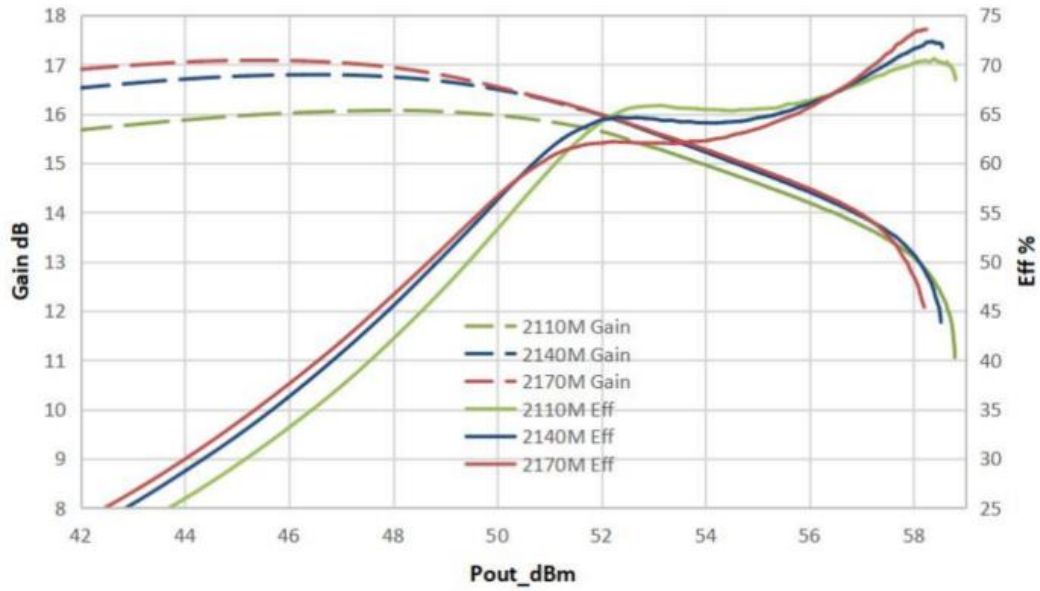
EVB Layout

### Bill of Materials (BoM) - HTH1D22P700S

### 758 - 803 MHz Reference Design

Reference	Value	Description	Manufacturer	P/N
Q1	-	700W, 1.800 - 2.170 GHz GaN on SiC PA	Watech	HTH1D22P700S
C1, C4, C6, C9, C11, C13, C15, C16	15pF	MLCC	Murata	GQM2195C2E150JB12
C2, C14	1p5F	MLCC	Murata	GQM2195G2E1R5BB12
C3	2p2F	MLCC	Murata	GQM2195G2E2R2BB12
C7	0p6F	MLCC	Murata	GQM2195G2ER60BB12
C8	2p4F	MLCC	Murata	GQM2195G2E2R4BB12
C12	1p2F	MLCC	Murata	GQM2195G2E1R2BB12
C5, C10, C17, C18, C19, C20	10uF /100V	MLCC	Murata	GRM32EC72A106KE05L
C1, C22	220uF/100V	Electrolytic Capacitor	Vishay	MAL213669221E3
R1	51Ω	High Frequency/RF Resistors	ANAREN	C8A50Z4B
R1, R3	10Ω	Thick Film Resistor	YAGEO	RC0603FR-0710RL
Z1	-	Hybrid Coupler 3dB, 90°	ANAREN	X3C21P1-03S
PCB	Rogers 4350B (er = 3.66), 20 mil (0.508 mm), 35 μm (1oz)			

### Performance Plots



**Pulsed CW, Gain and Efficiency vs Pout**

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ= 300mA, Vgsp = -5.6V, PW = 1ms, DC= 10% test on WATECH Application Board

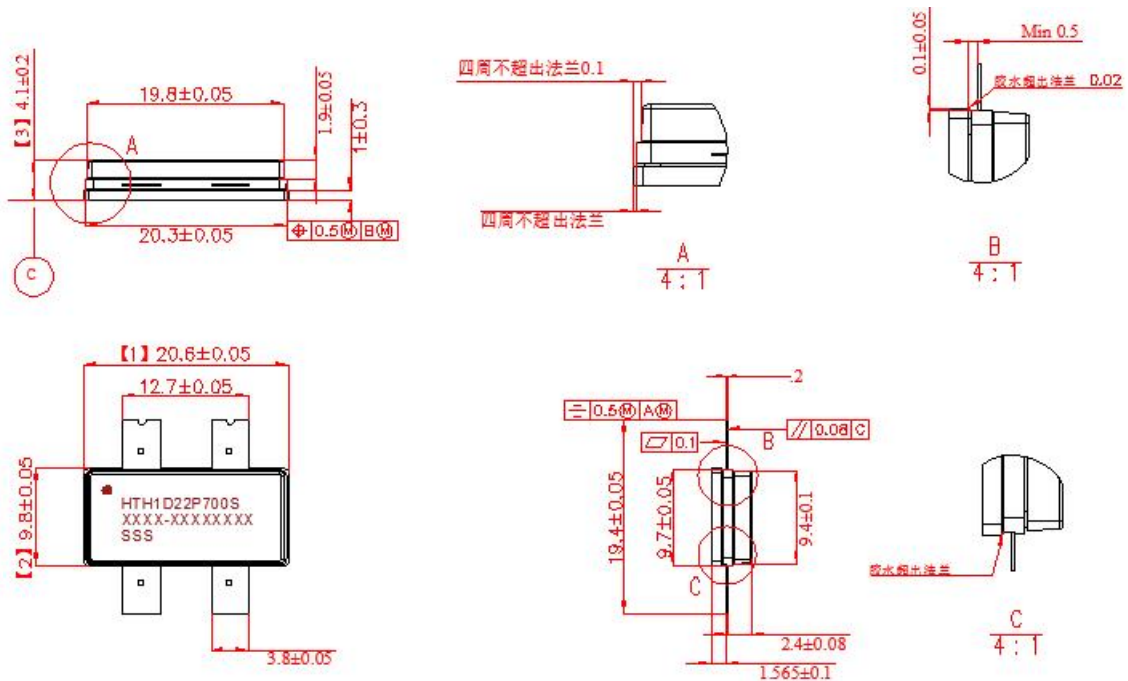


### Package Marking and Dimensions



- Line1 (fixed): Device name in W/O
  - Line2 (unfixed): Marking Lot No in W/O (Sample: E596-20140001)
  - Line3 (unfixed): Date Code + JY
- This Marking SPEC only stipulates the content of Marking. For marking requirements such as font and size, please refer to the latest version of "Watech Product Printing Specification"

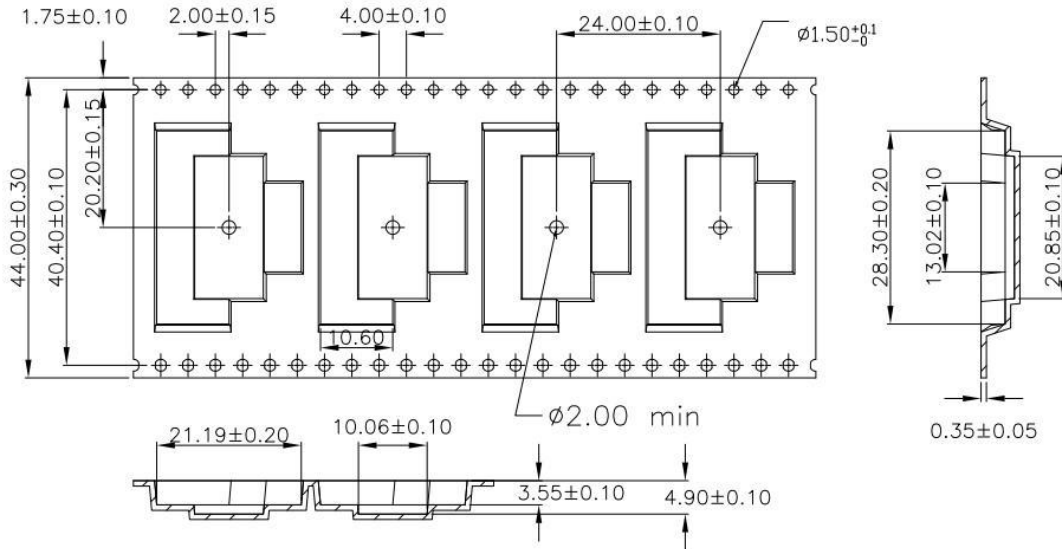
#### Marking



#### Package Dimensions

### Tape and Reel Information

Package Type	Reel Size(inch)	Qty/Reel(pcs)	Qty/Box(pcs)	Qty/Carton(pcs)
ACS2110S-4L	13	480	480	2400



Tape & Reel Packaging Descriptions

### Handling Precautions

Parameter	Grade
Moisture Sensitivity Level MSL	3

Parameter	Rating	Standard	
ESD – Human Body Model (HBM)	Class 1B	JESD22-A114	
ESD – Human Body Model (MM)	Class A	EIA/JESD22-A115	
ESD – Charged Device Model (CDM)	Class III	JESD22-C101	

### RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.

### Datasheet Status

Document status	Product status	Definition
Objective Datasheet	Design simulation	Product objective specification



# HTH1D22P700S

## 700W, 1.800 - 2.170 GHz GaN Amplifier

Product datasheet

Preliminary Datasheet	Customer sample	Engineering samples and first test results
Product Datasheet	Mass production	Final product specification

### Abbreviations

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Acronym	Definition
GaN on SiC	Gallium Nitride on Silicon Carbide
CW	Continuous Waveform



## Revision history

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Document ID	Datasheet Status	Release Date	Revision Version
Rev 0.1	Objective	June. 2022	First draft
Rev 1.0	Preliminary	Nov. 2022	Official Draft
Rev 1.1	Preliminary	March 2023	New format based on English version datasheet
Rev 1.2	Preliminary	March 2024	Update RF characteristics、 package marking and dimensions、 tape and reel information



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## 700W, 1.800 - 2.170 GHz GaN Amplifier

Product datasheet

### Contact Information

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For the latest specifications, additional product information, worldwide sales and distribution locations and information about WATECH:

- Web: [www.watechelectronics.com](http://www.watechelectronics.com)
- Email: [MKT@huatai-elec.com](mailto:MKT@huatai-elec.com)

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