HTH1D22P400S

400W, 1805 - 2170 MHz GaN Amplifier

Product datasheet

Description

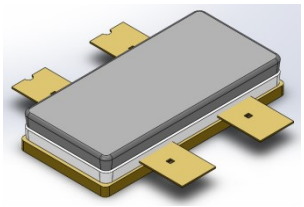
The HTH1D22P400S is a discrete GaN Power Amplifier designed for cellular base station applications with 400W saturated output power covering frequency range from 1805 - 2170 MHz.

Features

- Operating Frequency Range: 1805 - 2170 MHz
- Operating Drain Voltage: +48V
- Saturation Output Power: 400W
- Power Average: 56W
- Asymmetrical Doherty Final Stage
- Excellent thermal stability due to low thermal resistance package
- Enhanced robustness design without device degradation

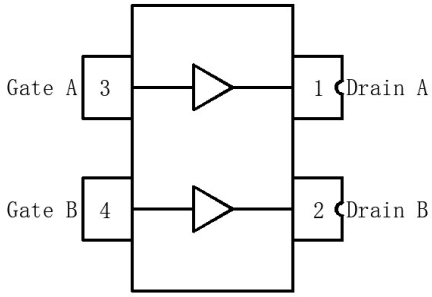
Applications

- 3GPP 5G
- 4G-LTE
- Amplifier for Macro Base Stations
- Repeaters/DAS
- Mobile Infrastructure



ACS2110S-4L RoHS compliant

Earless Flanged
Air Cavity Spliced Package; 4 Leads
HTH1D22P400S



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

Pin Connections

Ordering Information

Part Number	Description
HTH1D22P400S	Reel Package
HTH1D22P400S EVB1	1805-1880MHz EVB
HTH1D22P400S EVB2	2110-2170MHz EVB

Typical Performance

RF Characteristics (Pulsed CW)

Freq (MHz)	P5dB (dBm)	Gain (dB)	Eff (%) @P5dB	Eff (%) @47.5dBm
2110	56.2	17.0	65.7	61.8
2140	56.1	17.1	68.4	62.1
2170	56.1	16.9	70.4	61.6

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ_Carrier = 130mA, Vgsp = -5.3V, PW = 100us,DC = 10%, test on WATECH Application Board

RF Characteristics (WCDMA)

Freq (MHz)	Gain (dB)	Eff (%)	ACPR* @5MHz (dBc)	ACPR* @10MHz (dBc)
2110	15.8	58.3	-28.6	-43.5
2140	15.7	58.3	-28.8	-43.5
2170	15.6	58.0	-30.1	-44.1

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ_Carrier = 130mA, Vgsp = -5.3V, PAVG = 47.5dBm, 1C-WCDMA 5MHz Signal, 9.9 dB PAR @ 0.01% CCDF, test on WATECH Application Board

**Uncorrected DPD*

Absolute Maximum Ratings

Parameter	Range/Value	Units
Drain voltage (VDSS)	0 to +150	V
Gate voltage (VGS)	-10 to +2	V
Storage Temperature (TSTG)	-65 to +150	℃
Case Temperature (TC)	-40 to +140	℃
Junction Temperature (TJ)	+275	℃

Electrical Specification

DC Characteristics(Carrier)

Parameter	Conditions	Min	Typ	Max	Units
Breakdown voltage V(BR)DSS	VGS=-10V;IDS=19.2mA	150	-	-	Vdc
Gate-Source threshold Voltage VGS(th)	VDS=10V; IDS=19.2mA	-3.5	-2.8	-2.3	Vdc
Drain leakage Current IDSS	VDS=50V; VGS=-10V	-	-	0.3	mAdc
Gate leakage Current IGSS	VDS=0V; VGS=-10V	-	-	102	uAdc

DC Characteristics(Peaking)

Parameter	Conditions	Min	Typ	Max	Units
Breakdown voltage V(BR)DSS	VGS=-10V; IDS=33.6mA	150	-	-	Vdc
Gate-Source threshold Voltage VGS(th)	VDS=10V; IDS=33.6mA	-3.5	-2.9	-2.3	Vdc
Drain leakage Current IDSS	VDS=50V; VGS=-8V	-	-	1.5	mAdc
Gate leakage Current IGSS	VDS=0V; VGS=-10V	-	-	203	uAdc

RF Characteristics (Pulsed CW)

Parameter	Conditions	Min	Typ	Max	Units
Frequency Range		2.11	-	2.17	GHz
Gain	Pout=47.5dBm	14.5	15.8	-	dB
IRL	Pout=47.5dBm	8	-	-	dB
P5dB	Pulse CW	55.4	56	-	dBm

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ_Carrier = 100mA, Vgsp = Vgsp(300mA) - 2.36V, PW = 100us, DC= 10% test on WATECH FT Board

RF Characteristics (WCDMA)

Parameter	Conditions	Min	Typ	Max	Units
Frequency Range		2.11	-	2.17	GHz
Gain	Pout=47.5dBm	14.5	15.5	-	dB
Eff	Pout=47.5dBm	53.5	57.5	-	%
IRL	Pout=47.5dBm	8	-	-	dB
ACLR@5MHz	Pout=47.5dBm	-	-28	-25	dBc

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ_Carrier= 100mA, Vgsp = Vgsp(300mA) - 2.36V, PAVG = 47.5 dBm, 1C-WCDMA 5MHz Signal, 9.9 dB PAR @ 0.01% CCDF test on WATECH FT Board

Load Mismatch Test

Condition	Test Result
VSWR = 10:1, at all Phase Angles, VDD = +48Vdc, IDQ_Carrier = 130mA, Vgsp = -5.3V, PW = 100us,DC = 10%, Pout = 56dBm, Frequency = 2140 MHz, test on WATECH Application Board	Pass

Thermal Information

Symbol	Parameter	Condition	Value (Typ)	Units
Rth(s-c)(IR)	Thermal resistance from active die surface to case by Infrared measurement	VDS =48 V; IDq = 130 mA; VGS(amp)peak=-5.3V; TCASE= 80°C, WCDMA single-carrier, PAVG = 47.5 dBm	0.87	C/W
Rth(ch-c)(FEA)	Thermal resistance from active die channel to case by Finite Element Analysis	TCASE= 80°C, WCDMA single-carrier, PAVG = 47.5 dBm	1.37	C/W

Load Pull Performance Carrier

Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ= 200mA, PW = 40us, DC = 4%

Max Output Power (Carrier)						
Freq (MHz)	**Z_source (Ω)**	**Z_load** [1] **(Ω)**	**Gain (dB)**	**P3dB (dBm)**	**P3dB (W)**	**Eff (%)**
1805	2.2-j9.6	3.7-j1.8	18.7	53.7	234.4	68.4
1880	1.9-j8.8	4.5-j1.7	18.9	53.8	239.9	69
2110	5.7-j10.8	3.6-j2.1	18.6	53.6	229.1	68.4
2170	7.8-j10.8	3.1-j1.9	18.4	53.6	229.1	68.2

[1] Load impedance for optimum P3dB pout

Max Drain Efficiency (Carrier)						
Freq (MHz)	**Z_source (Ω)**	**Z_load** [2] **(Ω)**	**Gain (dB)**	**P3dB (dBm)**	**P3dB (W)**	**Eff (%)**
1805	2.2-j9.6	3.8+j1.3	20.6	52.1	162.2	79.3
1880	1.9-j8.8	4.5+j2.2	20.7	52.0	158.5	78.8
2110	5.7-j10.8	2.8+j0.8	20.5	51.7	147.9	79.9
2170	7.8-j10.8	3.2+j0.3	20.0	52.2	166.0	78.2

[2] Load impedance for optimum P3dB efficiency

Load Pull Performance Peaking

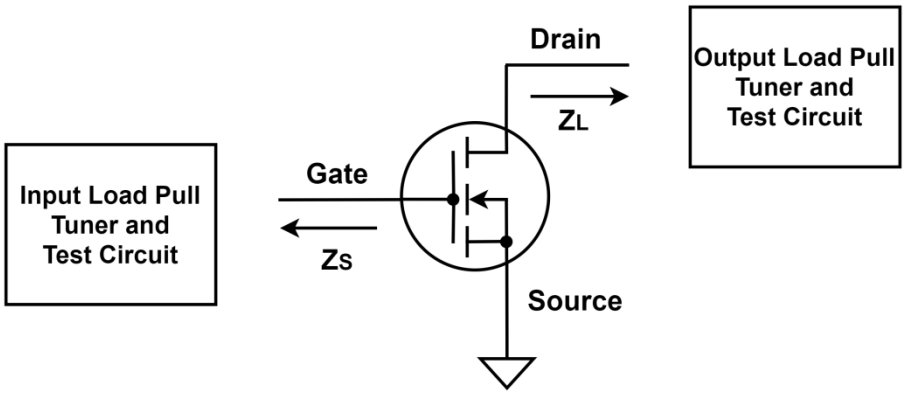
Test conditions unless otherwise noted: 25 °C, VDD = +48Vdc, IDQ= 300mA, PW = 40us, DC = 4%

Max Output Power (Peaking)						
Freq (MHz)	Z_source (Ω)	Z_load [1] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1805	2.2-j10.4	2.0-j1.9	17.7	55.9	389.0	65.3
1880	2.6-j11.4	2.2-j2.0	18.0	55.8	380.2	66.9
2110	4.6-j13.7	2.3-j2.4	18.0	55.6	363.1	66.8
2170	6.7-j14.7	2.4-j2.7	17.7	55.4	346.7	63.1

[1] *Load impedance for optimum P3dB pout*

Max Drain Efficiency (Peaking)						
Freq (MHz)	Z_source (Ω)	Z_load [2] (Ω)	Gain (dB)	P3dB (dBm)	P3dB (W)	Eff (%)
1805	2.2-j10.4	2.1-j0	19.3	54.0	251.2	74.4
1880	2.6-j11.4	2.3-j0.7	19.4	54.8	302.0	74.8
2110	4.6-j13.7	1.6-j0.5	19.5	53.7	234.4	75.9
2170	6.7-j14.7	1.5-j0.1	19.7	53.8	239.9	74.8

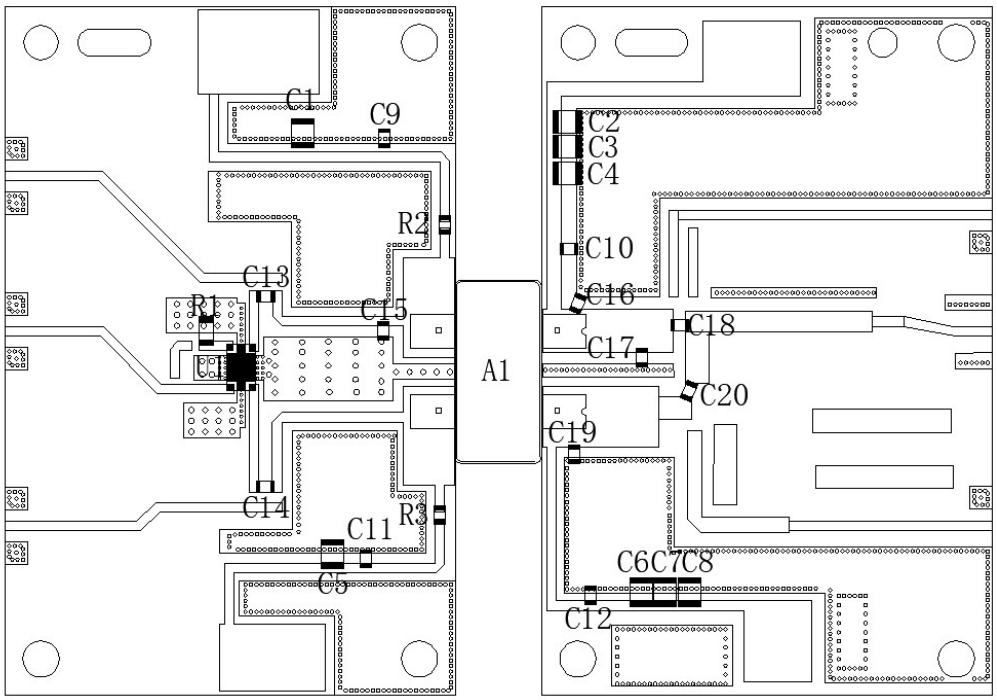
[2] Load impedance for optimum P3dB efficiency



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

HTH1D22P400S 2110- 2170 MHz Reference Design



Rogers 4350B, thickness=20mil

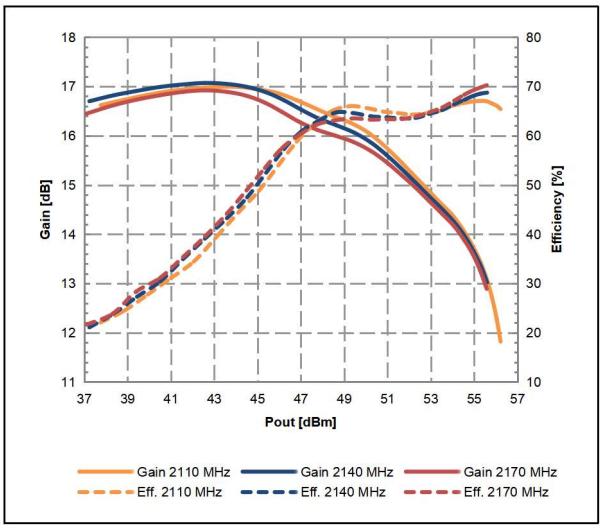
PCB is soldered on a 110 mm by 76 mm copper base plate with 10 mm thickness

EVB Layout

Bill of Materials (BoM) - HTH1D22P400S 2110 - 2170 MHz Reference Design

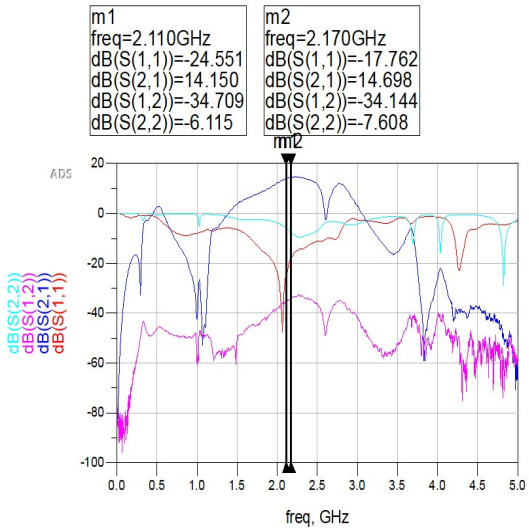
Reference	Value	Description	Manufacturer	P/N
A1	400W	GAN transistor	Watech	HTH1D22P400S
C1-C8	10uF	1210 Chip Capacitor	Murata	GRM32EC72A106KE05L
C9-C14	15pF	0805 Chip Capacitor	Murata	GQM1875G2E15R0BB12D
C15	1.6pF	0805 Chip Capacitor	Murata	GQM1875G2E1R60BB12D
C16	1.5pF	0805 Chip Capacitor	Murata	GQM1875G2E1R50BB12D
C17	1.3pF	0805 Chip Capacitor	Murata	GQM1875G2E1R30BB12D
C18	2.4pF	0805 Chip Capacitor	Murata	GQM1875G2E2R40BB12D
C19	3.3pF	0805 Chip Capacitor	Murata	GQM1875G2E3R30BB12D
C20	12pF	0805 Chip Capacitor	Murata	GQM1875G2E12R00BB12D
R1	50ohm	1206, SMD	Anaren	C16A50Z4
R2,R3	10ohm	0805, SMD		
U1	3dB	3dB, 90°	Anaren	X3C19F1-03S

Performance Plots



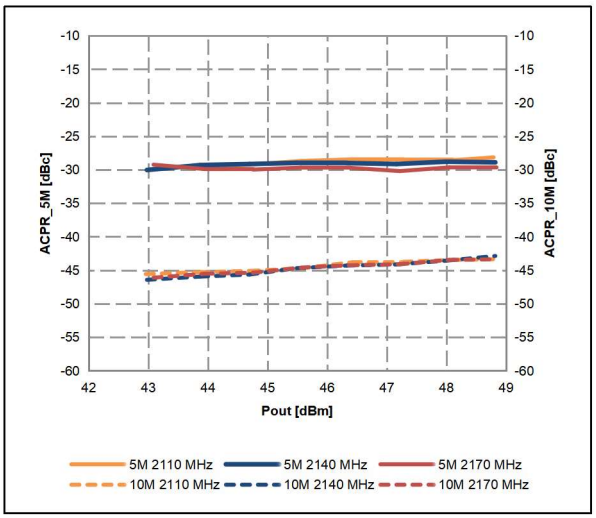
Pulsed-CW performance(Gain+Eff)

Test conditions, unless otherwise noted: 25 °C, VDD=48 Vdc, IDQ = 130mA, Vgsp=-5.3V, Pulse Width = 100us, Duty Cycle = 10%, test on WATECH EVB

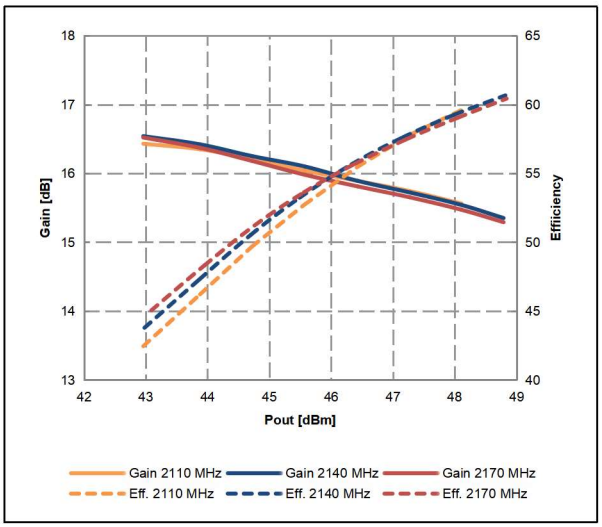


S-Parameter

Test conditions, unless otherwise noted: 25 °C, VDD=48 Vdc, IDQ = 130 mA, Vgsp= -5.3V, test on WATECH EVB



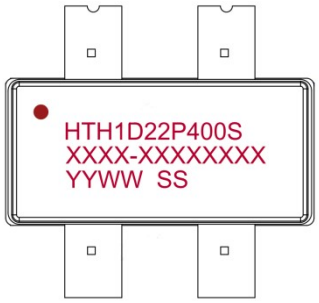
WCDMA performance(ACPR)



WCDMA performance(Gain+Eff)

Test conditions unless otherwise noted: 25 °C, VDD=+48Vdc, IDQ = 130mA, Vgsp = -5.3V, 1C-WCDMA 5MHz Signal, 9.6 dB PAR @ 0.01% CCDF, test on WATECH Application Board

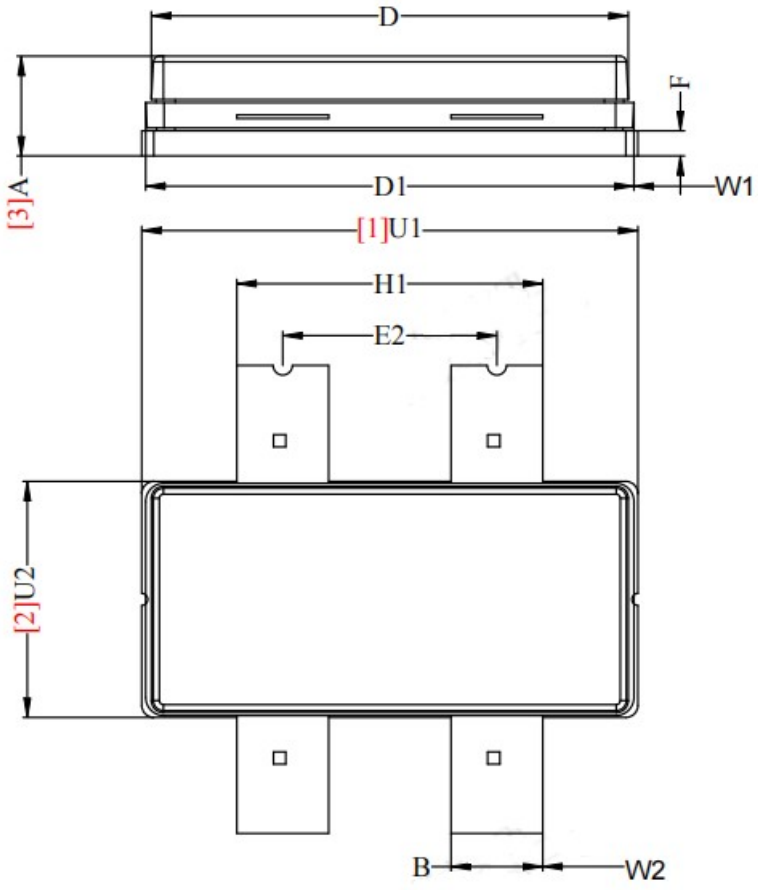
Package Marking and Dimensions



- Line1 (fixed): Device name in W/O
- Line2 (unfixed): Marking Lot No in W/O (Sample: E596-EERA0001)
- Line3 (unfixed): Date Code + SS（last two of LOT No.）

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



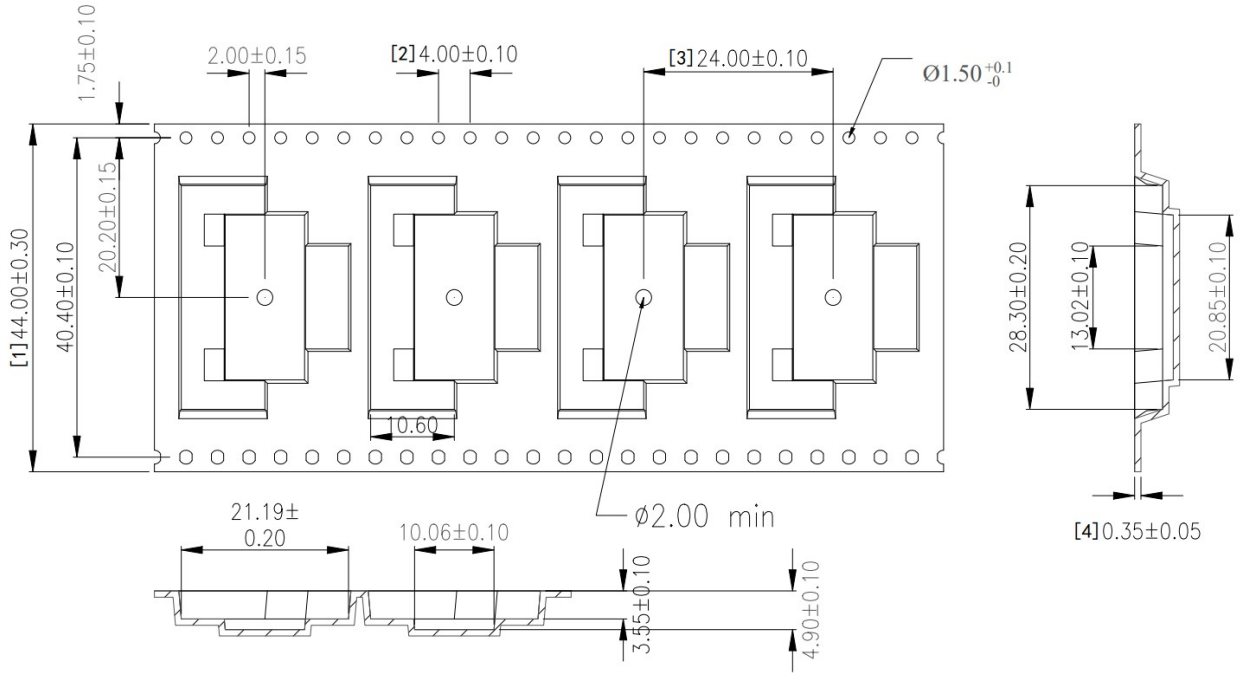
unit: mm

	A	B	C	D	D1	E	E1	E2	F	H	H1	Q	U1	U2	V	W1	W2	Y
max	4.440	3.910	0.175	19.950	20.370	9.550	9.750	/	1.140	19.530	12.830	1.650	20.700	9.900	0.500	0.500	0.500	0.100
nom	4.140	3.810	0.150	19.800	20.270	9.400	9.650	8.890	1.040	19.430	12.700	1.550	20.600	9.800	/	/	/	/
min	3.840	3.710	0.125	19.650	20.170	9.250	9.550	/	0.940	19.330	12.570	1.450	20.500	9.700	/	/	/	/

Package Dimensions

Tape and Reel Information

Package Type	Reel Size(inch)	Qty/Reel(pcs)	Qty/Box(pcs)	Qty/Carton(pcs)
ACS2110S-4L	13	500	5	2500



Tape & Reel Packaging Descriptions

Handling Precautions

Parameter	Grade
Moisture Sensitivity Level MSL	3

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 0B	JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C0b	JEDEC JS-002

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

Abbreviations

Acronym	Definition
GaN	Gallium Nitride
CW	Continuous Waveform
CCDF	Complementary Cumulative Distribution Function
PAR	Peak-to-Average Ratio
RoHS	Restriction of Hazardous Substances
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access

Revision history

Document ID	Datasheet Status	Release Date	Revision Version
Rev 1.0	Preliminary	Oct. 2024	Preliminary
Rev 2.0	Product	Dec. 2024	Product

Contact Information

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