

## 1. Product profile

### 1.1 General description

400 W GaN packaged asymmetric Doherty power transistor for base station applications at frequencies from 2300 MHz to 2700 MHz.

**Table 1. Typical performance**

Typical RF performance at  $T_{case} = 25\text{ °C}$  in an asymmetrical Doherty application demo circuit.  
 $V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 200\text{ mA}$  (main);  $V_{GS(amp)peak} = -4.3\text{ V}$ ; unless otherwise specified.

Test signal	f	$I_{Dq}$	$V_{DS}$	$P_{L(AV)}$	$G_p$	$\eta_D$	ACPR	$P_{L(5dB)}$
	(MHz)	(mA)	(V)	(dBm)	(dB)	(%)	(dBc)	(dBm)
1-carrier W-CDMA [1]	2496 to 2690	200	50	47.2	15.4	53.7	-27.0	-
pulsed CW [2]	2496 to 2690	200	50	-	-	-	-	55.8

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 10.5 dB at 0.01 % probability on CCDF.

[2] Test signal: pulsed CW;  $t_p = 30\text{ }\mu\text{s}$ ;  $\delta = 35\text{ }\%$ .

**Table 2. Typical performance**

Typical RF performance at  $T_{case} = 25\text{ °C}$  in an asymmetrical Doherty application demo circuit.  
 $V_{DS} = 50\text{ V}$ ;  $I_{Dq} = 270\text{ mA}$  (main);  $V_{GS(amp)peak} = -5.2\text{ V}$ ; unless otherwise specified.

Test signal	f	$I_{Dq}$	$V_{DS}$	$P_{L(AV)}$	$G_p$	$\eta_D$	ACPR	$P_{L(5dB)}$
	(MHz)	(mA)	(V)	(dBm)	(dB)	(%)	(dBc)	(dBm)
1-carrier W-CDMA [1]	2300 to 2400	270	50	47.2	14.7	51.5	-23.9	-
pulsed CW [2]	2300 to 2400	270	50	-	-	-	-	55.7

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 10.5 dB at 0.01 % probability on CCDF.

[2] Test signal: pulsed CW;  $t_p = 30\text{ }\mu\text{s}$ ;  $\delta = 35\text{ }\%$ .

### 1.2 Features and benefits

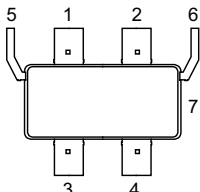
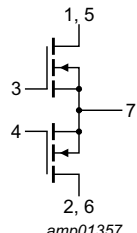
- Excellent digital pre-distortion capability
- High efficiency
- Designed for broadband operation
- Lower output capacitance for improved performance in Doherty applications
- Internally matched for ease of use
- For RoHS compliance see the product details on the Ampleon website

### 1.3 Applications

- RF power amplifier for base stations and multi carrier applications in the 2300 MHz to 2700 MHz frequency range

## 2. Pinning information

Table 3. Pinning

Pin	Description	Simplified outline	Graphic symbol
1	drain1 (main)		
2	drain2 (peak)		
3	gate1 (main)		
4	gate2 (peak)		
5	video decoupling (main)		
6	video decoupling (peak)		
7	source <sup>[1]</sup>		

[1] Connected to flange.

## 3. Ordering information

Table 4. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
SOT1275-1	C4H27W400AVZ	9349 604 85517	Tray; 20-fold; dry pack	60
	C4H27W400AVY	9349 604 85518	TR13; 100-fold; 44 mm; dry pack	100

## 4. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DD}$	supply voltage	operating	-	52	V
$V_{DS}$	drain-source voltage	$V_{GS} = -8$ V	-	150	V
$V_{GS(amp)main}$	main amplifier gate-source voltage		-15	+2	V
$V_{GS(amp)peak}$	peak amplifier gate-source voltage		-15	+2	V
$I_{GF(amp)main}$	main amplifier forward gate current		-	21.6	mA
$I_{GF(amp)peak}$	peak amplifier forward gate current		-	35.1	mA
$T_{stg}$	storage temperature		-65	+150	°C
$T_{ch}$	active die channel temperature	<sup>[1]</sup>	-	275	°C
$T_{case}$	case temperature	operating <sup>[1]</sup>	-40	+130	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the online MTF calculator.

## 5. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(s-c)(IR)}$ [1][3]	thermal resistance from active die surface to case by Infrared measurement	$V_{DS} = 48\text{ V}$ ; $I_{Dq} = 300\text{ mA}$ ; $V_{GS(amp)peak} = -4.8\text{ V}$ ; $T_{case} = 80\text{ °C}$ ; CW; $P_L = 55\text{ W}$ ; $P_{dis} = 60\text{ W}$	0.84	K/W
$R_{th(ch-c)(FEA)}$ [2][3][4]	thermal resistance from active die channel to case by Finite Element Analysis	$T_{case} = 80\text{ °C}$ ; $P_{dis} = 59\text{ W}$	1.40	K/W

[1] Infrared (IR) thermal values are for reference only and cannot be used to determine performance or reliability.

[2] Finite Element Analysis (FEA) thermal values have been used for the online MTF calculator.

[3]  $P_{dis}$  is total Doherty dissipation power which includes main and peak amplifier.

[4] Peak amplifier is actually contributing to 15.3 % Doherty dissipation power.

## 6. Characteristics

Table 7. DC characteristics

$T_j = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Main device</b>						
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$ ; $I_D = 21.6\text{ mA}$	-3.10	-2.70	-2.30	V
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 50\text{ V}$ ; $I_D = 432\text{ mA}$	-3.01	-2.61	-2.21	V
$I_{D(leak)}$	drain leakage current	$V_{GS} = -10\text{ V}$ ; $V_{DS} = 50\text{ V}$	-	-	5.23	mA
$I_{GSS}$	gate leakage current	$V_{GS} = -8\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	1.05	mA
<b>Peak device</b>						
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = 10\text{ V}$ ; $I_D = 35.1\text{ mA}$	-3.16	-2.76	-2.36	V
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 50\text{ V}$ ; $I_D = 702\text{ mA}$	-3.05	-2.65	-2.25	V
$I_{D(leak)}$	drain leakage current	$V_{GS} = -10\text{ V}$ ; $V_{DS} = 50\text{ V}$	-	-	8.49	mA
$I_{GSS}$	gate leakage current	$V_{GS} = -8\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	1.70	mA

Table 8. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 7.2 dB at 0.01 % probability on the CCDF;  
3GPP test model 1; 64 DPCH;  $f_1 = 2498.5\text{ MHz}$ ;  $f_2 = 2687.5\text{ MHz}$ ; RF performance at  $V_{DS} = 48\text{ V}$ ;  
 $I_{Dq} = 340\text{ mA}$ ;  $V_{GS(amp)peak} = -4.6\text{ V}$  (typical);  $T_{case} = 25\text{ °C}$ ; unless otherwise specified; in a Doherty production RF test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$G_p$	power gain	$P_{L(AV)} = 50\text{ W}$	14.0	15.0	-	dB
$\eta_D$	drain efficiency	$P_{L(AV)} = 50\text{ W}$	47.0	51.5	-	%
$RL_{in}$	input return loss	$P_{L(AV)} = 50\text{ W}$	-	-12	-8	dB
ACPR	adjacent channel power ratio	$P_{L(AV)} = 50\text{ W}$	-	-27.0	-24.0	dBc

**Table 9. RF characteristics**

Test signal: pulsed CW;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ;  $f = 2690 \text{ MHz}$ ; RF performance at  $V_{DS} = 48 \text{ V}$ ;  $I_{DQ} = 340 \text{ mA}$ ;  $V_{GS(amp)peak} = -4.6 \text{ V (typical)}$ ;  $T_{case} = 25 \text{ }^\circ\text{C}$ ; unless otherwise specified; in a Doherty production RF test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(3dB)}$	output power at 3 dB gain compression	-	200	255	-	W

## 7. Test information

### 7.1 Ruggedness in Doherty operation

#### 7.1.1 At $f = 2300 \text{ MHz}$

The C4H27W400AV is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 10 : 1$  through all phases under the following conditions:  $V_{DS} = 48 \text{ V}$ ;  $I_{DQ} = 300 \text{ mA}$ ;  $V_{GS(amp)peak} = -5.2 \text{ V}$ ;  $P_L = 350 \text{ W}$  (pulsed CW;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ); tested on the Doherty application demo circuit.

#### 7.1.2 At $f = 2500 \text{ MHz}$

The C4H27W400AV is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 10 : 1$  through all phases under the following conditions:  $V_{DS} = 48 \text{ V}$ ;  $I_{DQ} = 300 \text{ mA}$ ;  $V_{GS(amp)peak} = -4.0 \text{ V}$ ;  $P_L = 260 \text{ W}$  (pulsed CW;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ); tested on the Doherty development RF test circuit.

### 7.2 Impedance information

**Table 10. Typical impedance of main device**

Measured load-pull data of main device; all data measured on a harmonic impedance non-optimized load-pull fixture;  $I_{DQ} = 400 \text{ mA (main)}$ ;  $V_{DS} = 48 \text{ V}$ ; test signal: pulsed CW;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ ; typical values unless otherwise specified.

f	$Z_S$ [1]	$Z_L$ [1]	$P_L$ [2]	$P_L$ [2]	$\eta_D$ [2]	$G_p$ [2]
(MHz)	( $\Omega$ )	( $\Omega$ )	(dBm)	(W)	(%)	(dB)
<b>Maximum power load</b>						
2300	$1.8 - j9.0$	$5.2 - j9.0$	52.8	190	67.5	15.7
2400	$2.2 - j9.9$	$4.9 - j10.8$	52.9	195	66.8	16.1
2500	$3.5 - j10.1$	$3.9 - j10.1$	53.0	199	66.0	16.1
2600	$6.4 - j10.4$	$3.9 - j10.8$	53.0	198	68.9	16.0
2700	$5.4 - j6.5$	$3.6 - j11.3$	52.7	188	65.4	16.3
<b>Maximum drain efficiency load</b>						
2300	$1.8 - j9.0$	$7.9 - j7.6$	51.8	151	73.4	16.9
2400	$2.2 - j9.9$	$6.8 - j6.1$	51.3	133	74.9	17.6
2500	$3.5 - j10.1$	$6.5 - j7.7$	51.4	137	76.8	17.6
2600	$6.4 - j10.4$	$5.6 - j8.0$	51.3	136	77.7	17.0
2700	$5.4 - j6.5$	$4.9 - j9.1$	51.4	138	76.2	18.3

[1]  $Z_S$  and  $Z_L$  defined in [Figure 1](#).

[2] At 3 dB gain compression.

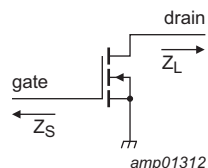
**Table 11. Typical impedance of peak device**

Measured load-pull data of peak device; all data measured on a harmonic impedance non-optimized load-pull fixture;  $I_{DQ} = 650$  mA (peak);  $V_{DS} = 48$  V; test signal: pulsed CW;  $t_p = 100$   $\mu$ s;  $\delta = 10$  %; typical values unless otherwise specified.

f	Z <sub>S</sub> [1]	Z <sub>L</sub> [1]	P <sub>L</sub> [2]	P <sub>L</sub> [2]	$\eta_D$ [2]	G <sub>p</sub> [2]
(MHz)	( $\Omega$ )	( $\Omega$ )	(dBm)	(W)	(%)	(dB)
<b>Maximum power load</b>						
2300	2.8 – j8.0	2.6 – j8.3	55.1	324	62.8	13.3
2400	3.1 – j8.6	2.7 – j8.4	55.4	344	68.1	13.5
2500	3.1 – j9.8	2.6 – j7.6	55.5	354	68.1	13.8
2600	4.9 – j10.0	2.6 – j7.6	55.4	347	70.1	13.5
2700	4.3 – j9.2	2.6 – j8.3	55.1	326	67.2	13.8
<b>Maximum drain efficiency load</b>						
2300	2.8 – j8.0	4.4 – j5.6	53.2	209	71.2	14.6
2400	3.1 – j8.6	3.3 – j6.5	54.3	267	74.5	14.6
2500	3.1 – j9.8	3.4 – j5.8	54.1	259	75.4	14.9
2600	4.9 – j10.0	3.5 – j5.8	53.6	231	74.9	14.3
2700	4.3 – j9.2	3.1 – j6.5	53.6	229	72.5	15.0

[1] Z<sub>S</sub> and Z<sub>L</sub> defined in [Figure 1](#).

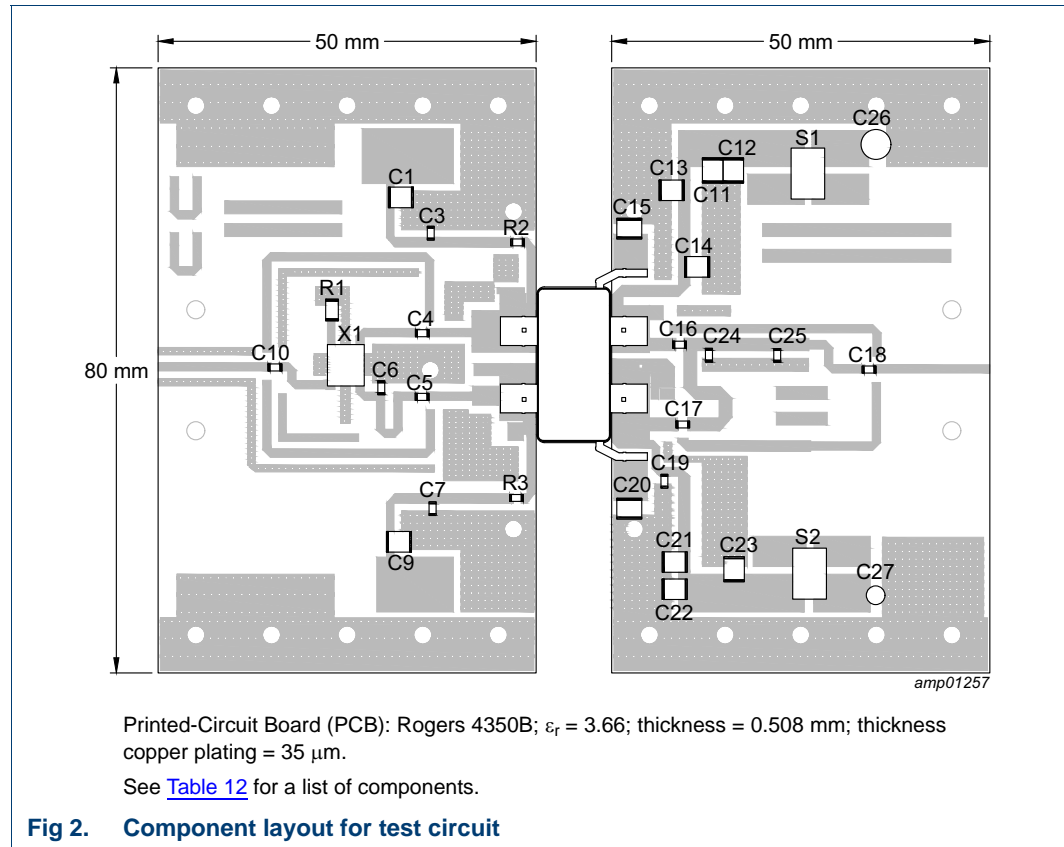
[2] At 3 dB gain compression.



**Fig 1. Definition of transistor impedance**

### 7.3 Test circuit

The RF test circuit is used in the 2496 MHz to 2690 MHz frequency range.



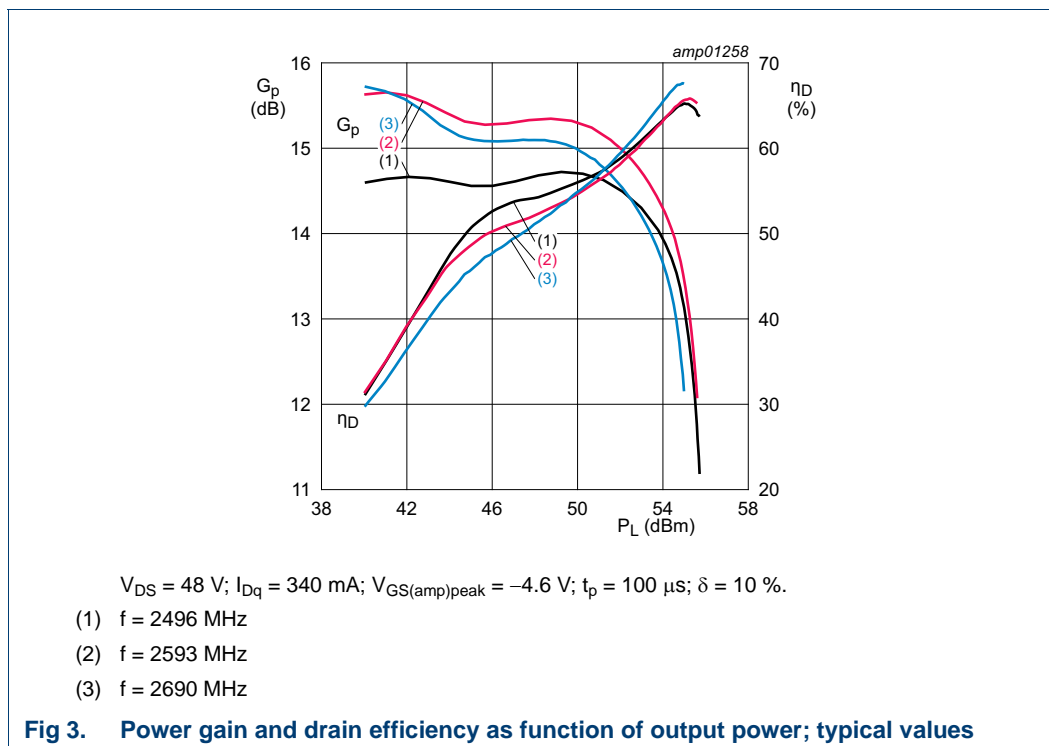
**Table 12. List of components**

See [Figure 2](#) for component layout.

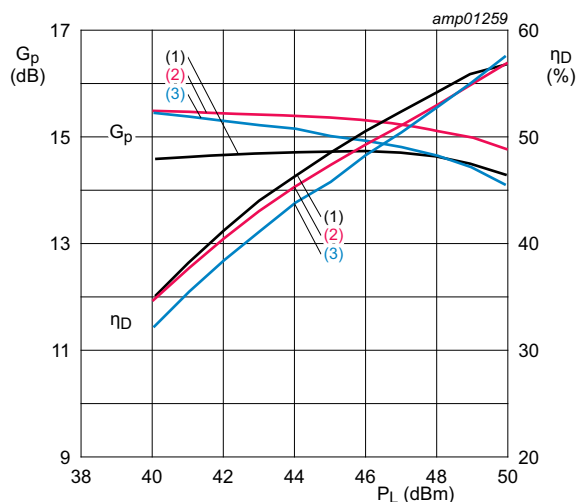
Component	Description	Value	Remarks
C1, C9, C11, C12, C22, C23	multilayer ceramic chip capacitor	10 $\mu\text{F}$ , 100 V	Murata
C3, C4, C5, C7, C10, C18, C19	multilayer ceramic chip capacitor	12 pF	ATC 600F
C6, C25	multilayer ceramic chip capacitor	0.3 pF	ATC 600F
C13, C21	multilayer ceramic chip capacitor	1000 pF	ATC 800B
C14	multilayer ceramic chip capacitor	10 pF	ATC 800B
C15, C20	multilayer ceramic chip capacitor	4.7 $\mu\text{F}$ , 100 V	Murata
C16	multilayer ceramic chip capacitor	2.7 pF	ATC 600F
C17	multilayer ceramic chip capacitor	2.0 pF	ATC 600F
C24	multilayer ceramic chip capacitor	0.1 pF	ATC 600F
C26, C27	multilayer ceramic chip capacitor	1000 $\mu\text{F}$ , 100 V	Murata
R1	resistor	51 $\Omega$	SMD 0603
R2, R3	resistor	10 $\Omega$	SMD 0603
S1, S2	current sensor resistor	10 m $\Omega$	LVK25 SMD1224
X1	coupler		RN2: CMX25Q02

## 7.4 Graphical data

### 7.4.1 Pulsed CW



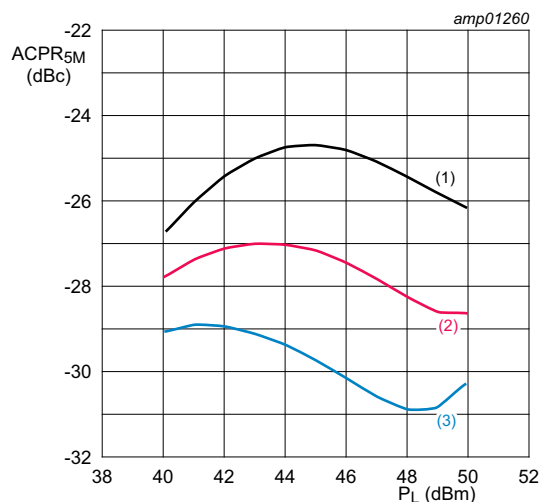
## 7.4.2 1-Carrier W-CDMA



$V_{DS} = 48 \text{ V}$ ;  $I_{Dq} = 340 \text{ mA}$ ;  $V_{GS(amp)peak} = -4.6 \text{ V}$ .

- (1)  $f = 2498.5 \text{ MHz}$
- (2)  $f = 2593 \text{ MHz}$
- (3)  $f = 2687.5 \text{ MHz}$

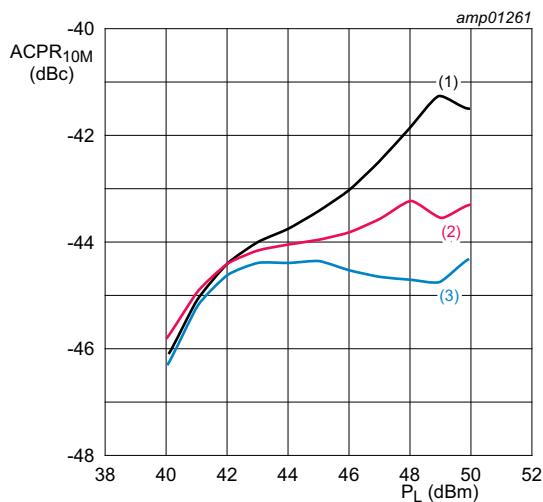
**Fig 4. Power gain and drain efficiency as function of output power; typical values**



$V_{DS} = 48 \text{ V}$ ;  $I_{Dq} = 340 \text{ mA}$ ;  $V_{GS(amp)peak} = -4.6 \text{ V}$ .

- (1)  $f = 2498.5 \text{ MHz}$
- (2)  $f = 2593 \text{ MHz}$
- (3)  $f = 2687.5 \text{ MHz}$

**Fig 5. Adjacent channel power ratio (5 MHz) as a function of output power; typical values**



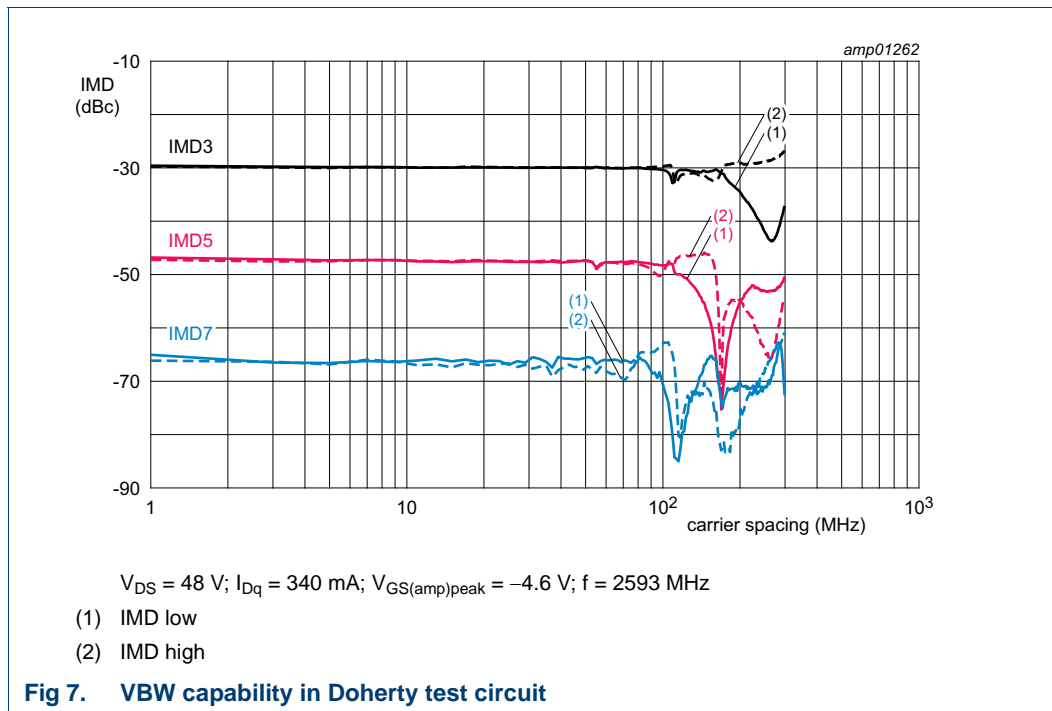
$V_{DS} = 48 \text{ V}$ ;  $I_{Dq} = 340 \text{ mA}$ ;  $V_{GS(amp)peak} = -4.6 \text{ V}$ .

- (1)  $f = 2498.5 \text{ MHz}$
- (2)  $f = 2593 \text{ MHz}$
- (3)  $f = 2687.5 \text{ MHz}$

**Fig 6. Adjacent channel power ratio (10 MHz) as a function of output power; typical values**



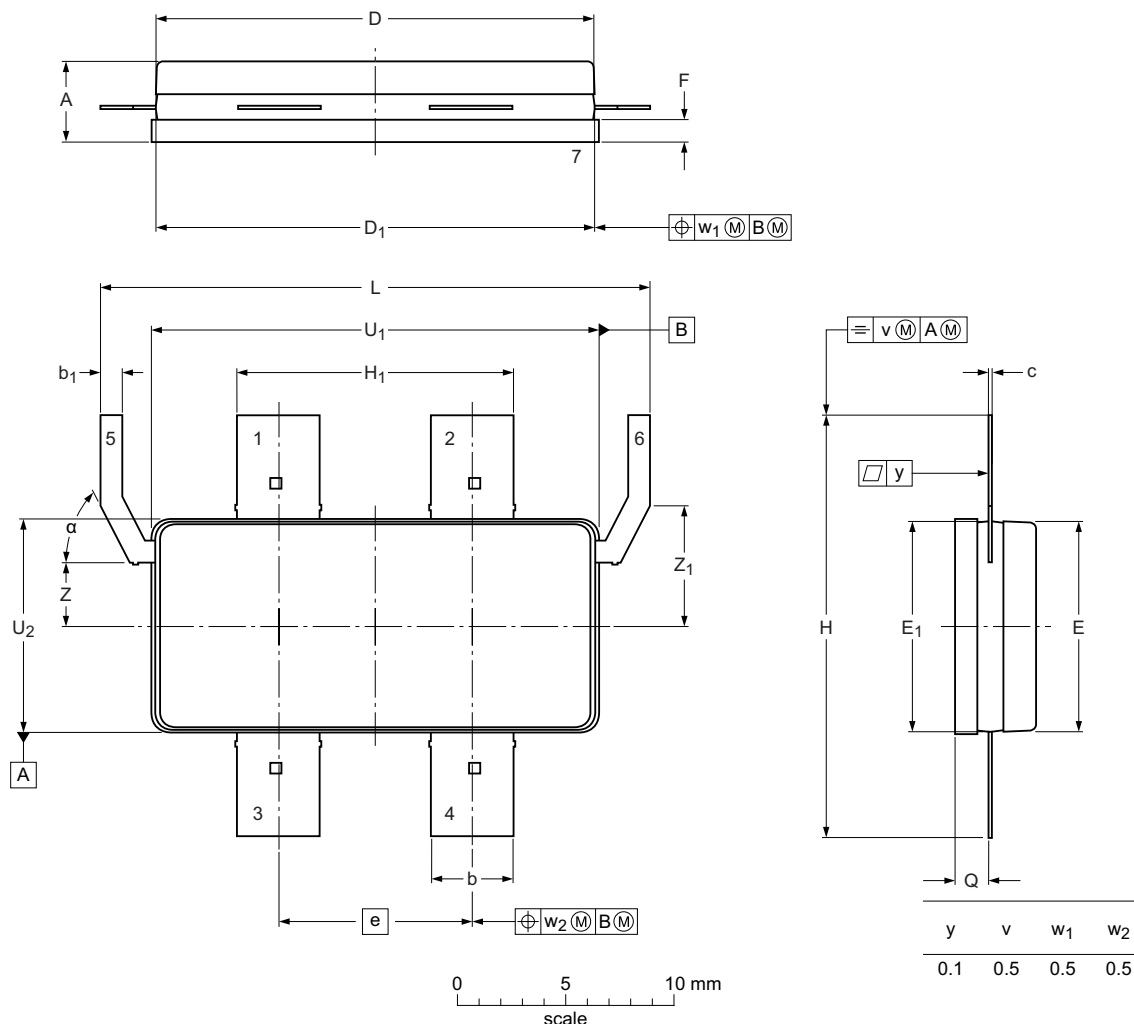
### 7.4.3 2-Tone VBW



## 8. Package outline

Air cavity plastic earless flanged package; 6 leads

SOT1275-1



Dimensions

Unit	A	b	b <sub>1</sub>	c	D	D <sub>1</sub>	E	E <sub>1</sub>	e	F	H	H <sub>1</sub>	L	Q <sup>(1)</sup>	U <sub>1</sub>	U <sub>2</sub>	Z	Z <sub>1</sub>	α
max	4.01	3.94	1.14	0.178	20.42	20.37	9.80	9.75		1.14	19.53	12.80	25.40	1.68	20.70	9.91	3.17	5.79	65°
nom									8.89										
min	3.40	3.68	0.89	0.127	20.12	20.17	9.50	9.55		0.94	19.33	12.60	25.20	1.45	20.50	9.70	2.67	5.29	61°

Note

1. Dimension Q is measured 0.1 mm away from the flange.
2. Ringframe and/or ringframe glue shall not overhang at the side of the flange.

sot1275-1\_po


Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1275-1						16-11-15 17-04-13

Fig 8. Package outline SOT1275-1

## 9. Handling information

### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

**Table 13. ESD sensitivity**

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C3 <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1C <a href="#">[2]</a>

[1] CDM classification C3 is granted to any part that passes after exposure to an ESD pulse of 1000 V.

[2] HBM classification 1C is granted to any part that passes after exposure to an ESD pulse of 1000 V.

## 10. Abbreviations

**Table 14. Abbreviations**

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
GaN	Gallium Nitride
MTF	Median Time to Failure
PAR	Peak-to-Average Ratio
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
VBW	Video Bandwidth
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

## 11. Revision history

**Table 15. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
C4H27W400AV v.1	20210924	Product data sheet	-	-

## 12. Legal information

### 12.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.ampleon.com>.

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