

# AR181056

BLF989, 470 to 700 Mhz

v1.0 — 11 July 2018

**AMPLEON**

Application Report

## Document information

**Status** Company public

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**Abstract** Measurement results of a Class AB broadband amplifier design with BLF989 for 470 to 700 Mhz

## 1. Revision History

Table 1: Report revisions

Revision	Date	Description	Author
1.0	20180711	final version	Walter Sneijers

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**5. General description**

This report presents the measurement results of the Class AB broadband amplifier demo AR181056. The device BLF989 used is 150Wavg DVB-T, 9<sup>th</sup> generation LDMOS in a SOT539 package. BLF989 is a symmetrical push-pull power transistor. The presented demo is tuned for the frequency band 470 to 700 Mhz.

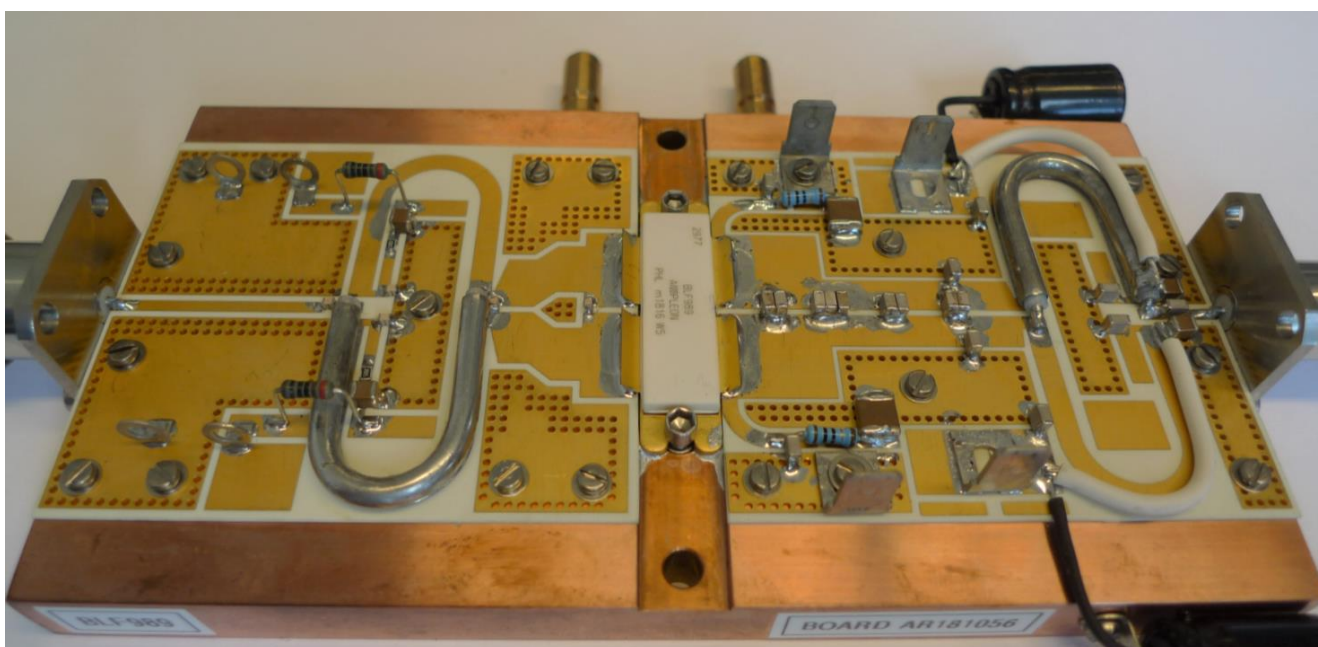


Figure 1 AR181056, 470-700Mhz demo

## 6. Biasing and practical aspects

The efficiencies presented are based on the currents of the drain feeds only. I.e. the biasing currents for the gate circuitry have not been included.

The biasing is as follows:

$$\begin{aligned} V_{DD} &= 50V \\ V_{GS} &= \text{approx. } 2V, \text{ leading to an } I_{DQ}=600mA \end{aligned}$$

The application is built on a copper heatsink and is water cooled.

## 7. Performance Summary

Table 2: Performance summary, in band 470-700Mhz

Parameter	Condition-1	Condition-2	Unit	Pulsed CW	DVB-T
Power		$I_{dq\_}=2x\ 0.6A$	W		150
Gain		$I_{dq\_}=2x\ 0.6A$	dB		20
Efficiency		$I_{dq\_}=2x\ 0.6A$	%		>32
$P_{6dB}$	100µs/10%	$I_{dq\_}=2x\ 0.6A$	W	>850	-
PAR output signal	CCDF0.01%	$I_{dq\_}=2x\ 0.6A$	dB		> 8
PAR output signal -c	Pre-corrected <sup>2</sup> CCDF0.01%	$I_{dq\_}=2x\ 0.6A$	dB		> 8.5
Shoulder distance <sup>1</sup>		$I_{dq\_}=2x\ 0.6A$	dBc		< -38

Note 1: Input PAR DVB-T signal 9.5dB @ CCDF0.01%

Note 2: Pre-distorter: ProTelevision PT3000

The amplifier can deliver 150W average DVB-T power or pulsed CW 900W ( $P_{6dB}$ ) in the frequency range 470-700Mhz. The trade-off between peak power and efficiency can also be chosen differently by a small modification in the output matching.

All RF measurements were performed with a 750Mhz LPF coupled towards the power meter. This avoids any harmonic content in the measured output power.

Pre-correction:

The pre-corrected measurements were performed with a ProTelevision PT3000 exciter. MER, shoulder and ccdf measurements were done with a R&S ETL TV analyzer.

### 8. Performance Details

The amplifier was measured with a DVB-T 8K signal (8Mhz signal bandwidth) and with a pulsed CW signal. Shoulder distance is measured at 4.3Mhz from center frequency.

#### 8.1 DVB-T measurement of AR181056

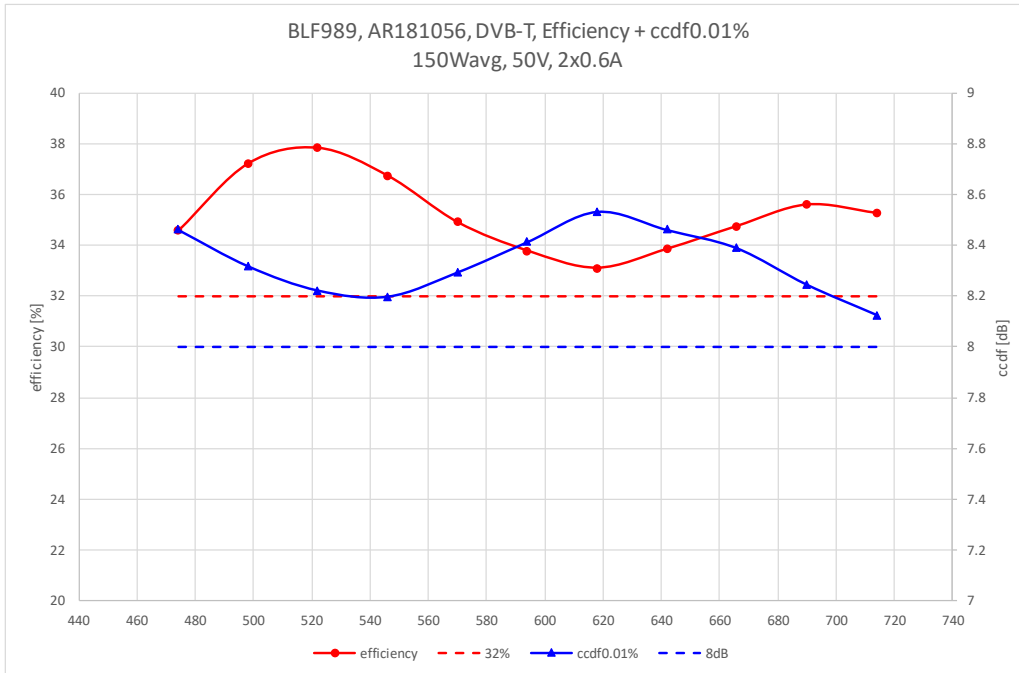


Figure 2 DVB-T, Efficiency, ccdf0.01% @ 150Wavg (uncorrected)

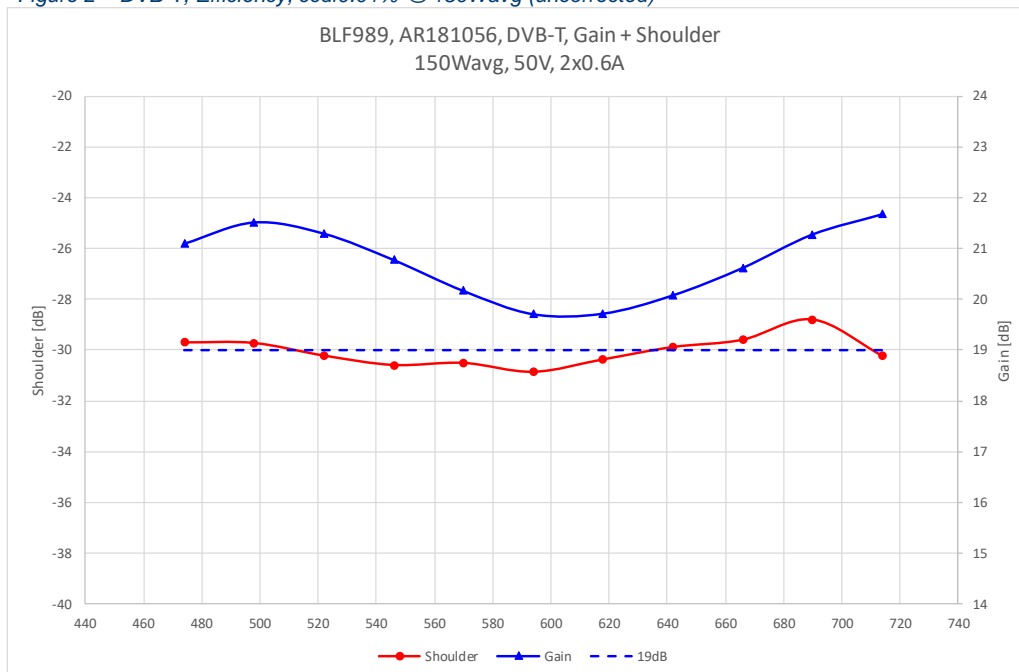


Figure 3 DVB-T, Gain, Shoulder @150Wavg (uncorrected)

### 8.2 Comparison DVB-T clamped / soldered Transistor

Below, 2 boards have been compared with slightly different output matching where the transistor is respectively clamped (AR181042) or soldered (AR181056). It shows the performance degradation when the transistor is clamped (AR181042: heatsink paste Austerlitz WPS-2).

Note: AR181042 was measured at 140Wavg, AR181056 at 150Wavg,  
(c=clamped, s = soldered)

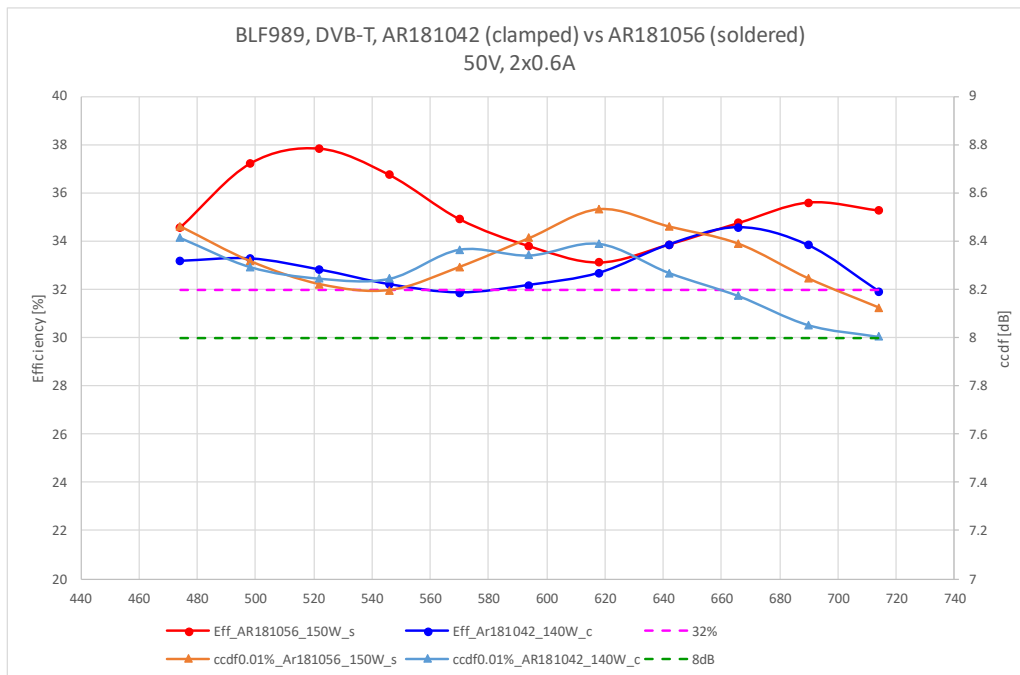


Figure 4 DVB-T, Efficiency, cdf0.01% comparison (uncorrected)

### 8.3 DVB-T measurement of AR181056 (pre-corrected)

Pre-corrector: ProTelevision PT3000.

In figures below: *\_c* = corrected data

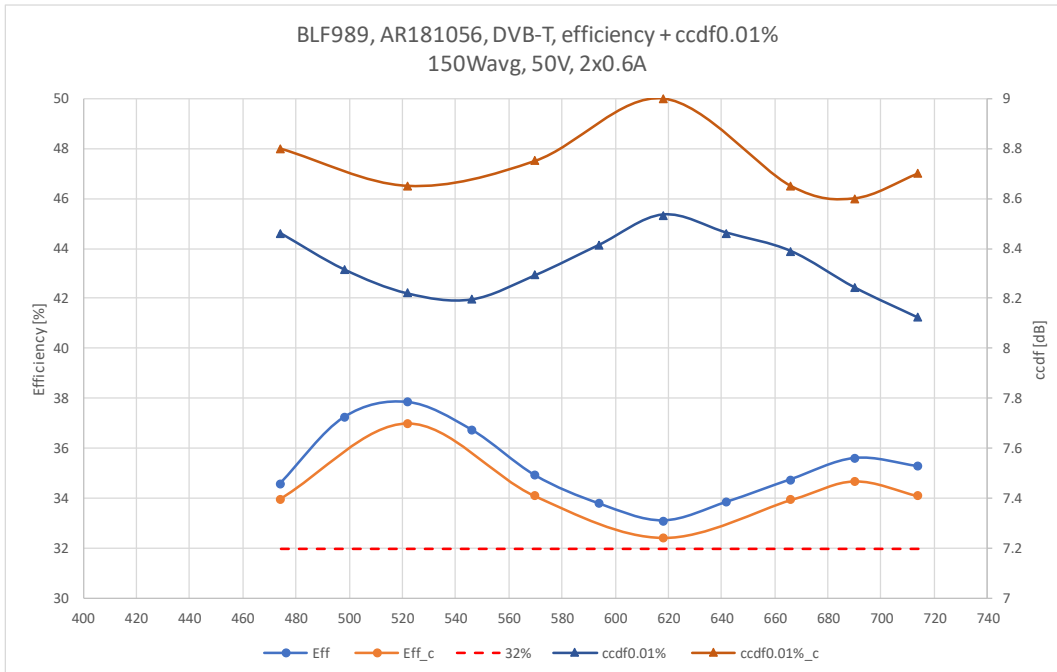


Figure 5 DVB-T, Efficiency, ccdf0.01% (corrected / uncorrected)

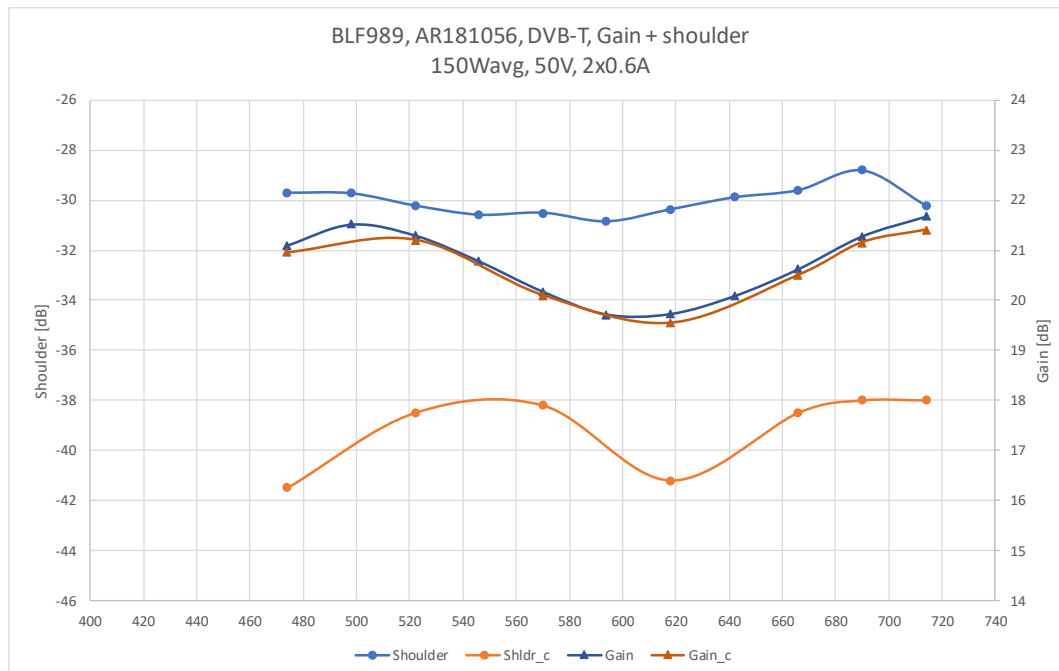


Figure 6 DVB-T, Gain, Shoulder (corrected / uncorrected)

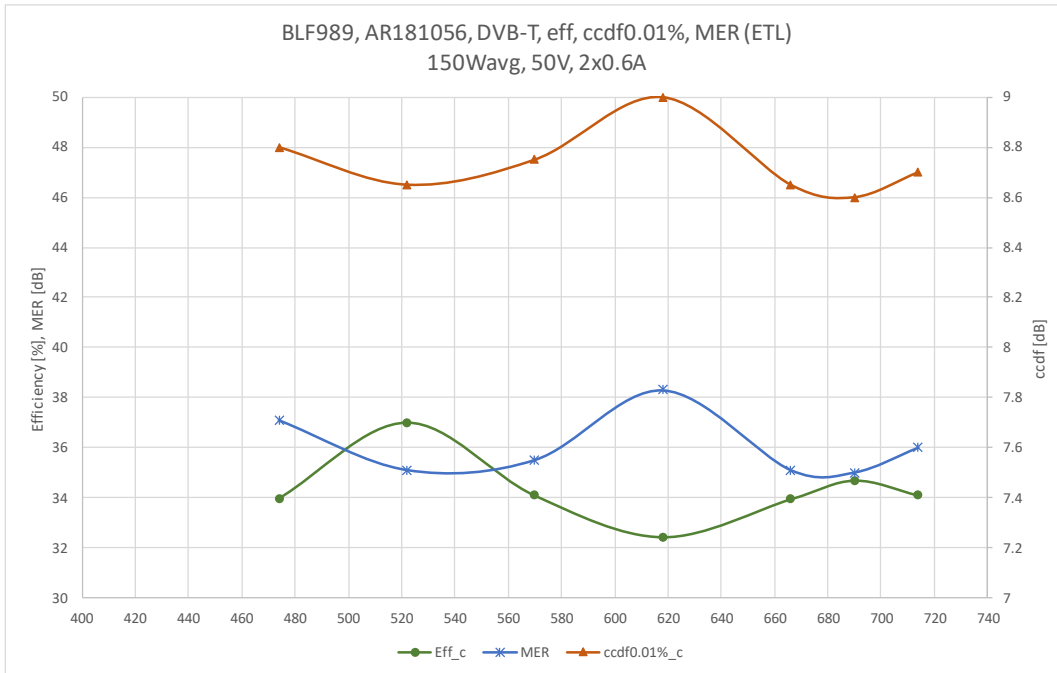


Figure 7 DVB-T, Efficiency, MER, ccdf0.01% (corrected)

ProTelevision DVB-T (AR181056, soldered Transistor)												
Sample	freq	Po	Vdd	Gain_c	Idc	Eff_c	Shldr_c	ccdf0.01% MER	iter	mode	REMARK	
	[Mhz]	[W]	[V]	[dB]	[A]	[%]	[dBc]	[dB]	#			
	474	150	50	20.95	8.83	33.98	-41.5	8.8	37.1	6	adaptive	
	522	150	50	21.2	8.11	36.99	-38.5	8.65	35.1	8	adaptive	
	570	150	50	20.1	8.8	34.09	-38.2	8.75	35.5	10	adaptive	
	618	150	50	19.55	9.25	32.43	-41.2	9	38.3	6	adaptive	
	666	150	50	20.5	8.84	33.94	-38.5	8.65	35.1	6	adaptive	
	690	150	50	21.15	8.65	34.68	-38	8.6	35	7	adaptive	
	714	150	50	21.4	8.8	34.09	-38	8.7	36	5	adaptive	

Table 3: AR181056 Precorrection data

Note: MER, shoulder and ccdf were measured with ETL TV analyzer.



### 8.4 Pulsed CW measurements

Pulse condition: 100µs/10%. P1dB – P6dB.

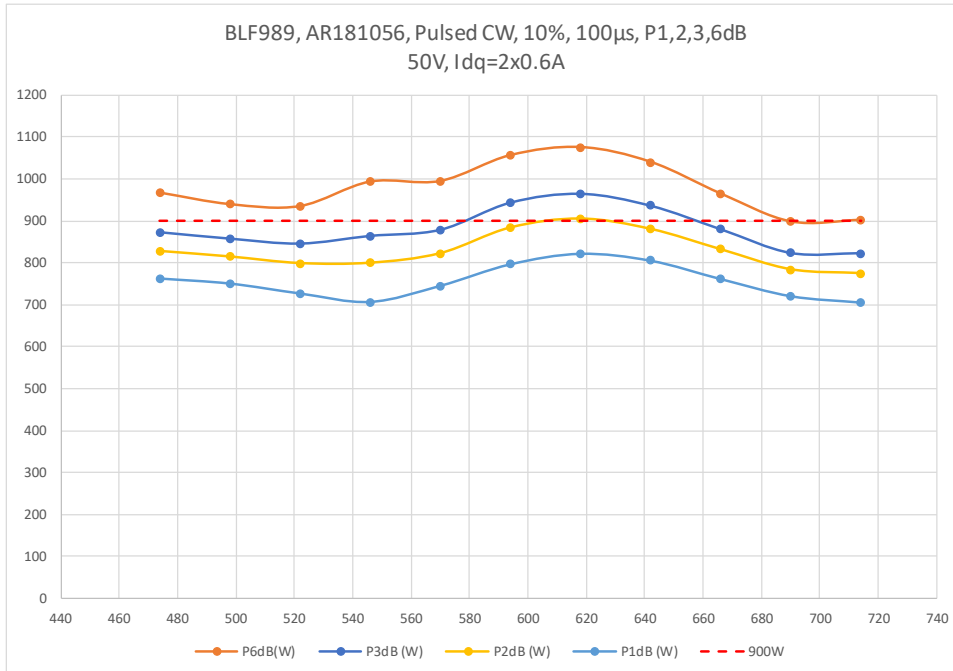


Figure 8 Pulsed CW, P1-2-3-6 dB [W]

### 8.5 Comparison Pulsed CW clamped / soldered Transistor

Below, 2 boards have been compared (P3dB) with slightly different output matching where the transistor is respectively clamped (AR181042) or soldered (AR181056). See also chapter 8.2.

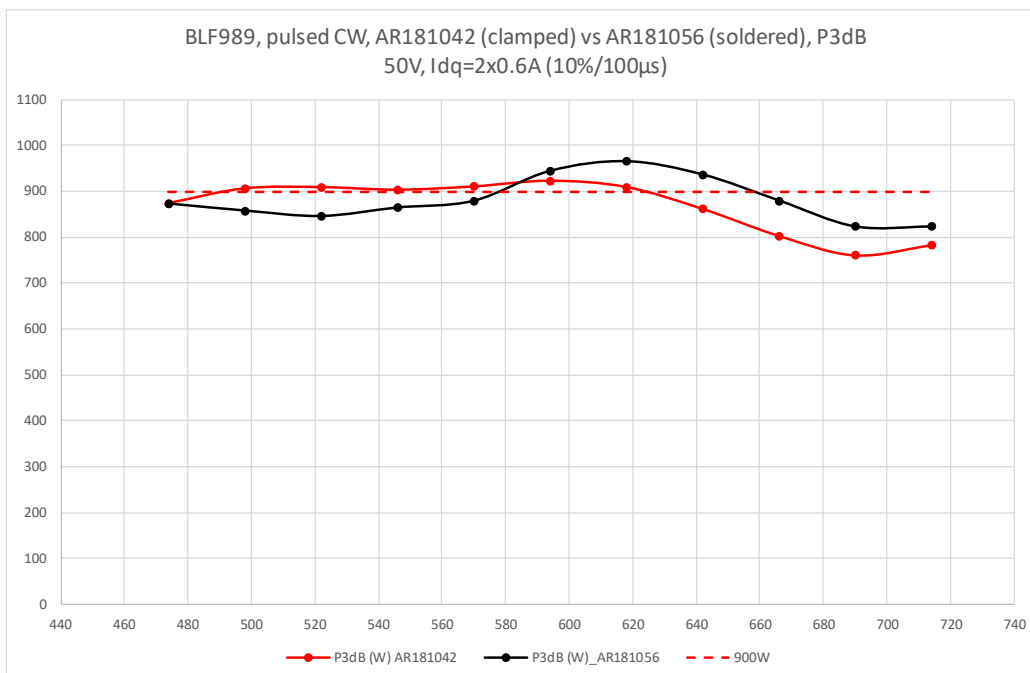


Figure 9 Pulsed CW, P3dB comparison

8.6 Pulsed CW power sweep data:

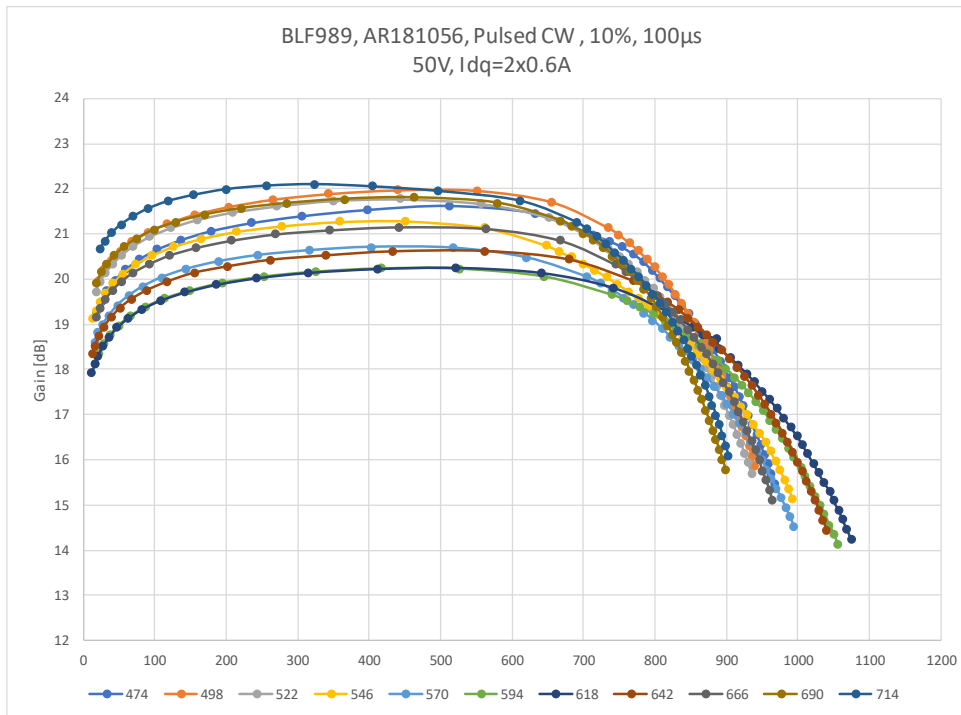


Figure 10 Pulsed CW, Gain [dB] as function of power [W]

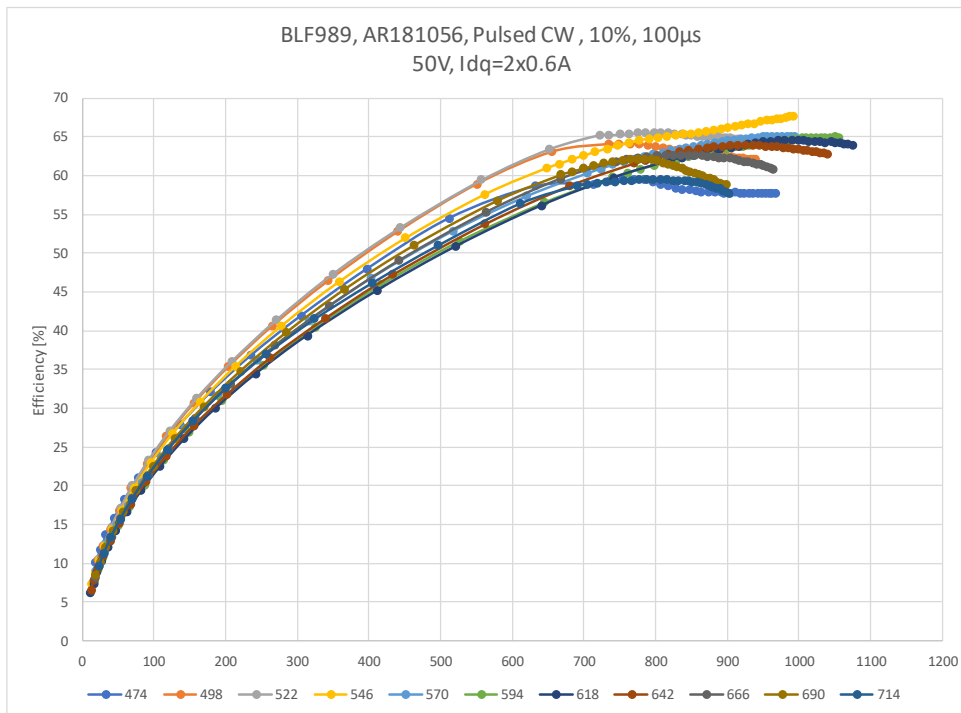


Figure 11 Pulsed CW, Efficiency [%] as function of power [W]

**9. Hardware**

**9.1 Board Image**

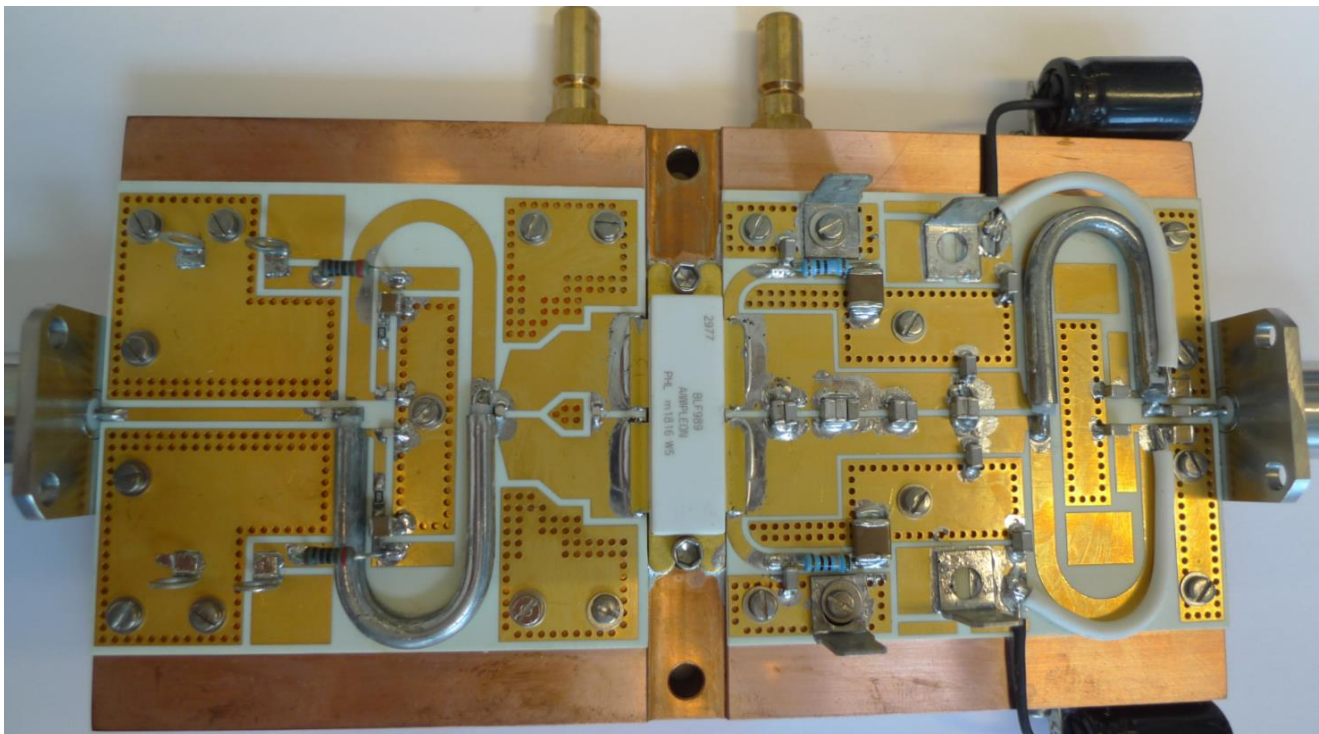


Figure 12 Picture of AR181056, 470-700Mhz board

Dimensions: 150 x 80mm.

### 9.2 Copper Layout

Layout including dimensions.

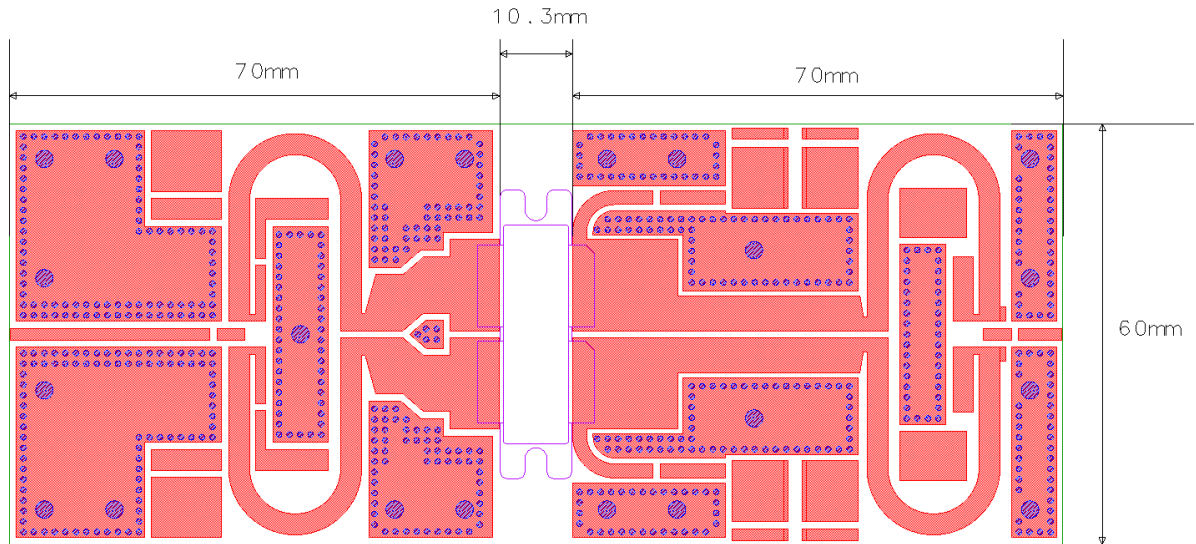


Figure 13 Layout drawing

### 9.3 Component Mapping

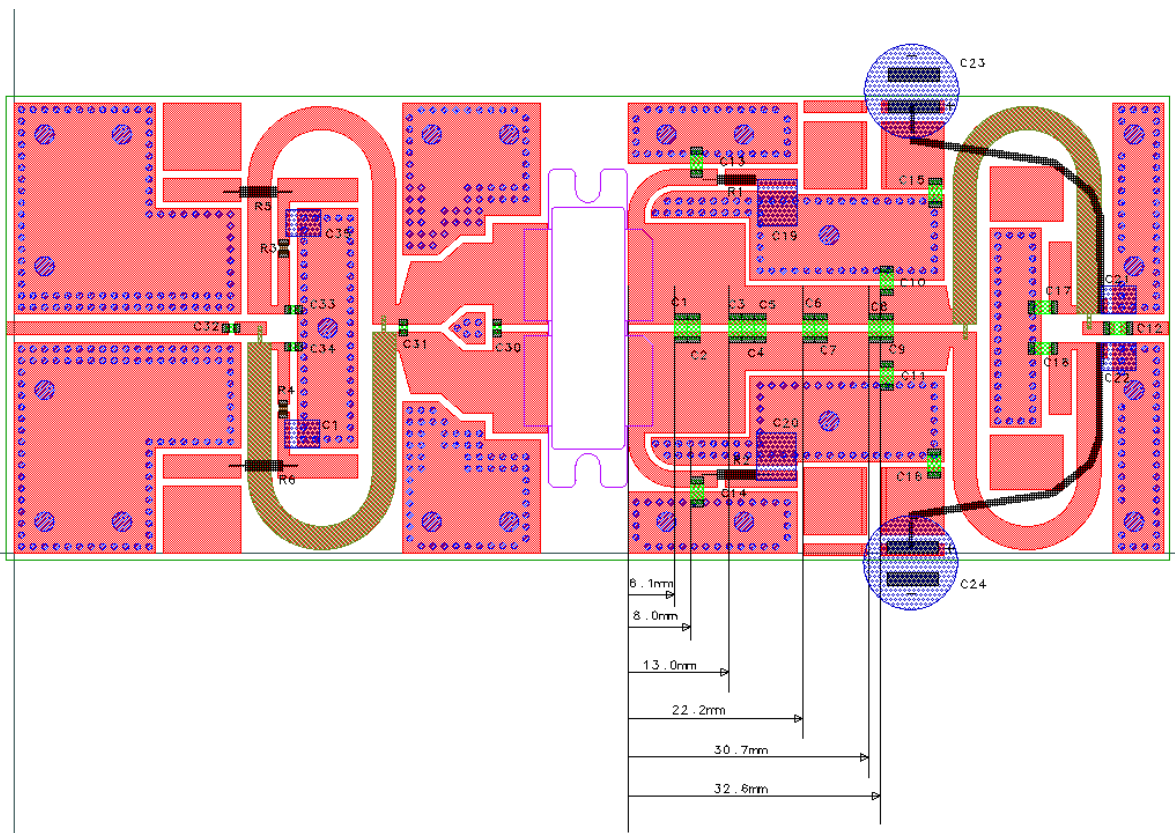


Figure 14 Component drawing

**9.4 Bill of materials**

*Table 4: Bill of Materials*

Description	Value	Case	Supplier	Remark
C1	12pF	ATC800B	ATC	
C2	12pF	ATC800B	ATC	
C3,C4,C5,C6	8p2	ATC800B	ATC	
C7	2p2	ATC800B	ATC	
C8	6p2	ATC800B	ATC	
C9	5p6	ATC800B	ATC	
C10,C11	10pF	ATC800B	ATC	
C12,C13,C14,C15,C16,C17,C18	100pF	ATC800B	ATC	
C19,C20	4.7µF/63V		TDK	
C21,C22	4.7µF/63V		TDK	
R1,R2	10Ω	Wire resistor		
C23,24	470µF/63V			
C30	18pF	ATC100A	ATC	
C31	13pF	ATC100A	ATC	
C32,C33,C34	100pF	ATC100A	ATC	
C35,C36	4.7µF/63V		TDK	
R3,R4	5.6Ω	0805		
R5,R6	100Ω	Wire resistor		
Input/output balun	25 ohm		Micro-Coax	UT-141C-25

**9.5 Board material**

*Table 5: Board specifications*

Parameter	Value	thickness	metallisation
<b>Manufacturer</b>	Rogers		
<b>Input pcb</b>	RO4350B	30 mil	35µ Cu, ground layer full Cu
<b>Output pcb</b>	RO4350B	30 mil	35µ Cu, ground layer full Cu

*Figure 15 PCB definition*

**9.6 Device markings**

*Table 6: Device specifics*

Parameter	Value
<b>Manufacturer</b>	Ampleon
<b>Device</b>	BLF989
<b>Marking</b>	M1816 , 2977
<b>Comments</b>	

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