AR201008

ART2k0FE, 13 - 41MHz

v1.0 — 12022020

AMPLEON

Application Report

Document information	
Status	Company Public
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Abstract	Measurement results of a Class AB amplifier design for the 13 - 41MHz band with the new ART2k0FE transistor

1. Revision History

Table 1: *Report revisions*

Revision	Date	Description	Author
1.0	20200212	Initial document	Hans Kartman

2. Contents

3. List of figures

4. List of tables

5. General description

This report presents the measurement results of the Class AB amplifier demo AR201008. The device used is ART2k0FE, 9th generation LDMOS in a SOT539 ceramic push-pull package. The presented demo is tuned for the frequency band 13 - 41MHz.

The demo circuit is built on two PCB boards, assembled on a full copper baseplate with water cooling channel. The water cooling can be connected to the water connectors on the baseplate.

The transistor is soldered to the copper baseplate for maximum cooling capacity.

The amplifier should be connected to a power supply using large buffer capacitors connected close to the demo board.

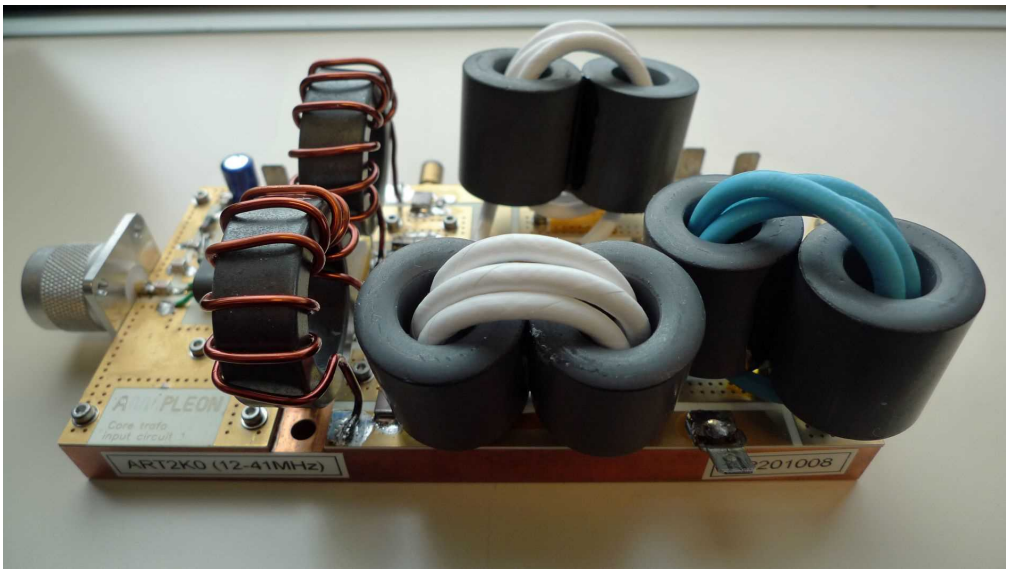

Figure 1 Demo Front view

6. Biasing

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The biasing settings are as follows:

V_{DD} = 65V

V_{GS} = approx 1.9 V, adjusted to I_{DQ}= 200mA

The drain supply connections of this amplifier should be wired with short wires to large buffer capacitors, f.i. 10000uF 100Volts.

After connecting the water cooling and source and load, first the drain voltage is connected. Second the gate bias supply is set to zero volts, then connected to the demo amplifier. Starting at about 1 V the gate bias voltage can be increased slowly to about 1.9Volts, until the desired Idq is reached.

7. Performance Indication

Table 2: *Performance indication, between 13 and 41MHz*

Parameter	Condition	Unit	CW
V_{DD}		V	65
S11 at input connector		dB	>8
$P2_{dB}$[1]	G_{MAX}-2dB	/ W	>1050
Gain	**@P2dB**	dB	>25
Drain Efficiency	**@P_o**	%	53-59
Idq	-	mA	200 total

8. Performance Details

8.1 Power, Gain and Efficiency

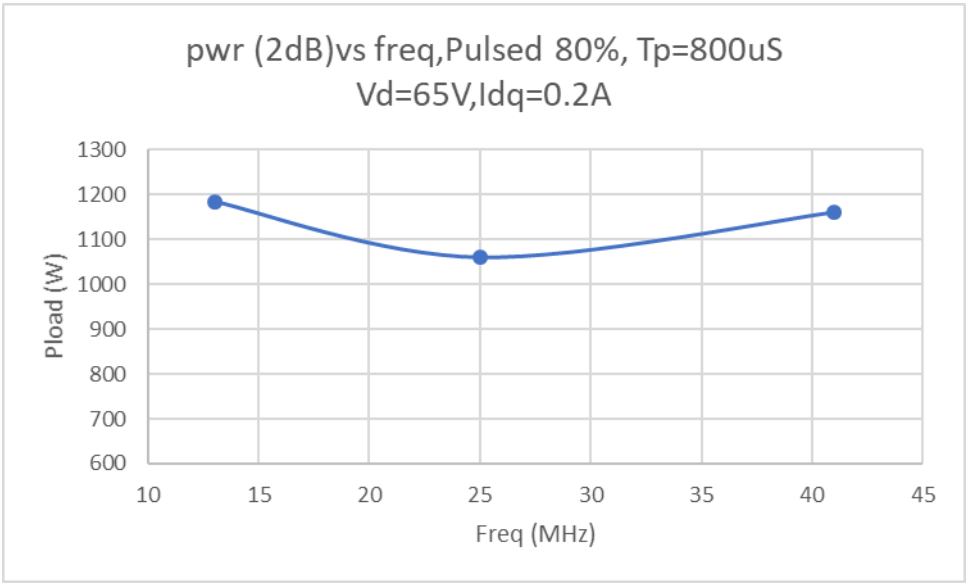


Figure 2 Power vs Frequency

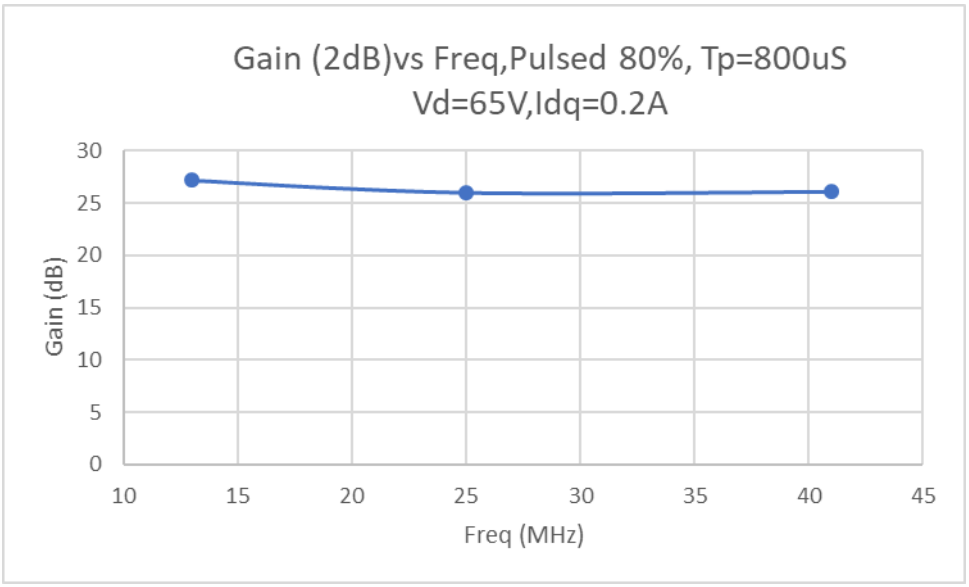


Figure 3 Gain vs Frequency

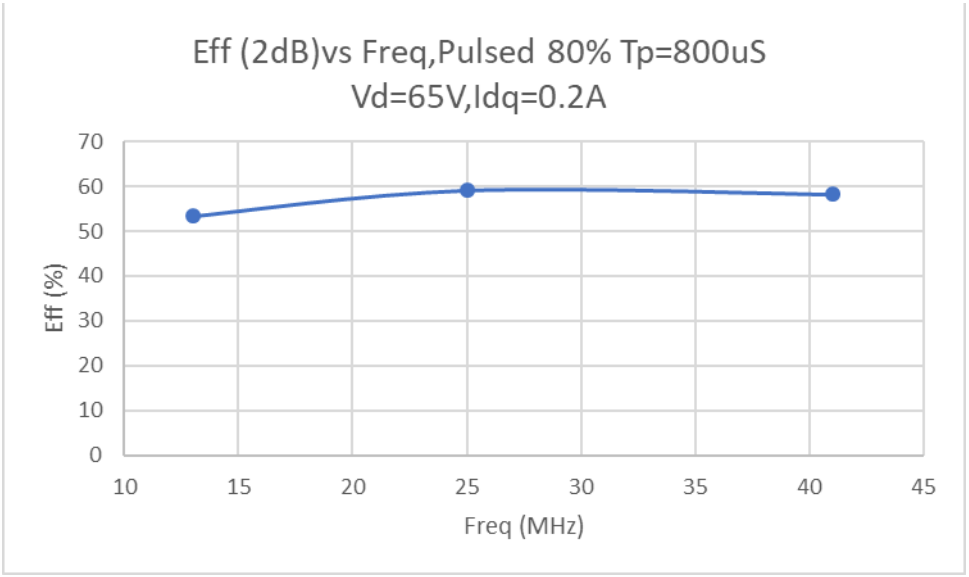
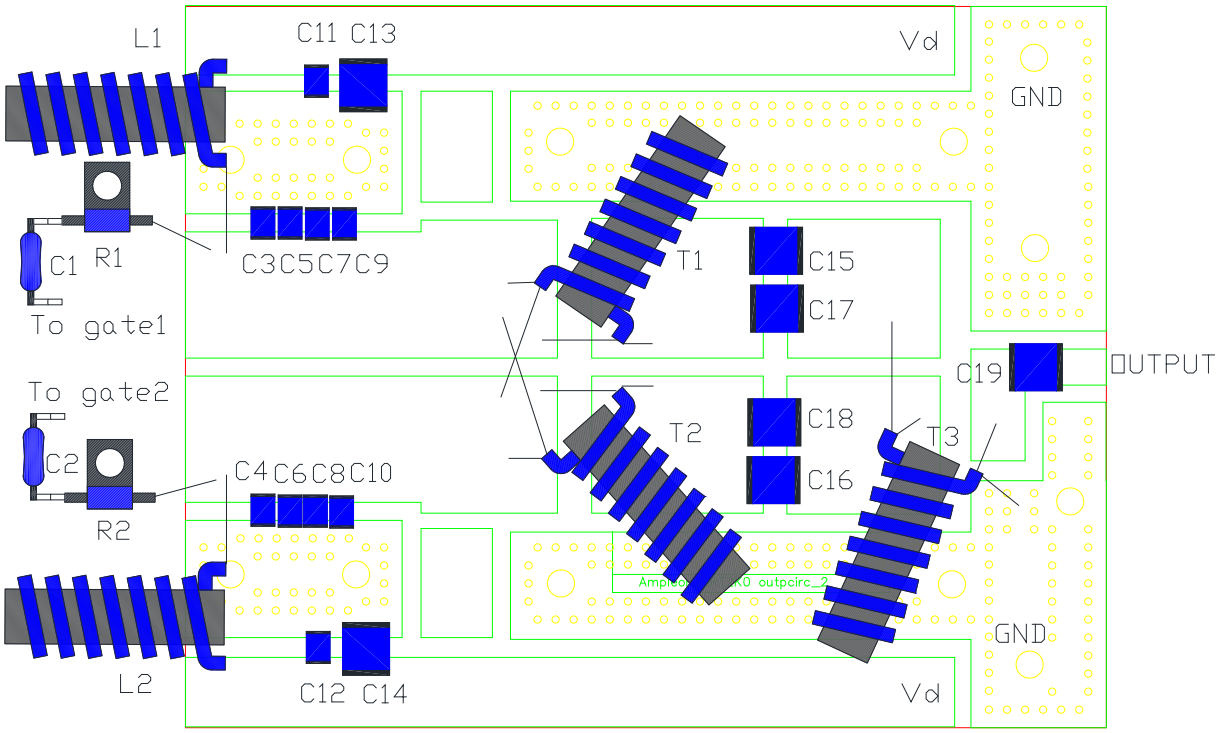


Figure 4 Efficiency vs Frequency

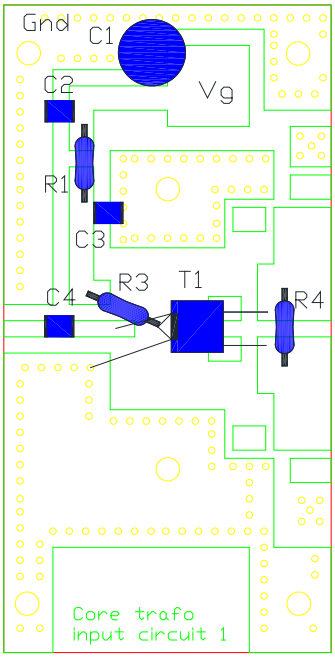
8.2 Layout and Components.



Output board.

List of components output board.

Component	Value	Manufacturer	Remarks
C1,C2,	0.1uF 400V wired	Philips	MKT capacitor
C3,C4	91pF ATC100B	ATC	
C5,C6	82pF ATC100B	ATC	
C7,C8,C9,C10	47pF, ATC100B	ATC	
C11, C12	100nF 100V	TDK GRM188R72A104KA35D	
C13,C14	4.7uF 100V	TDKC575X7R2A475KE11L	
C15,C16,C19	10nF 300V	PPI 2225X103MW301	
C17,C18	6n8F 200V	Syfer 222522000682JQTAF9LM	
R1, R2	200Ohms 20Watts	ATC FR10300N 0200J	Feedback resistor, bolted on cooling plate using thermal grease
L1, L2	7 turns on FT140 -43 1.7mm enamel copper wire	FT140 -43, Amidon	
T1, T2	Coax TC12, 39cm long 3turns on two T61 ferrite cores	Fairite 2661102002 TC12 RF, power systems	Teflon coax
T3	50Ohm Coax 70cm, 3Turns on two T61 ferrite cores	Fairite 2661102002 50Ohms coax	Teflon Coax
Board	Ro 4350	Rogers	Thickness=0.76mm, 70um copper, full copper backside, gold plated, full metal via's
Connector	N Type Female		
Transistor	ART2k0FE	Ampleon	Soldered on baseplate



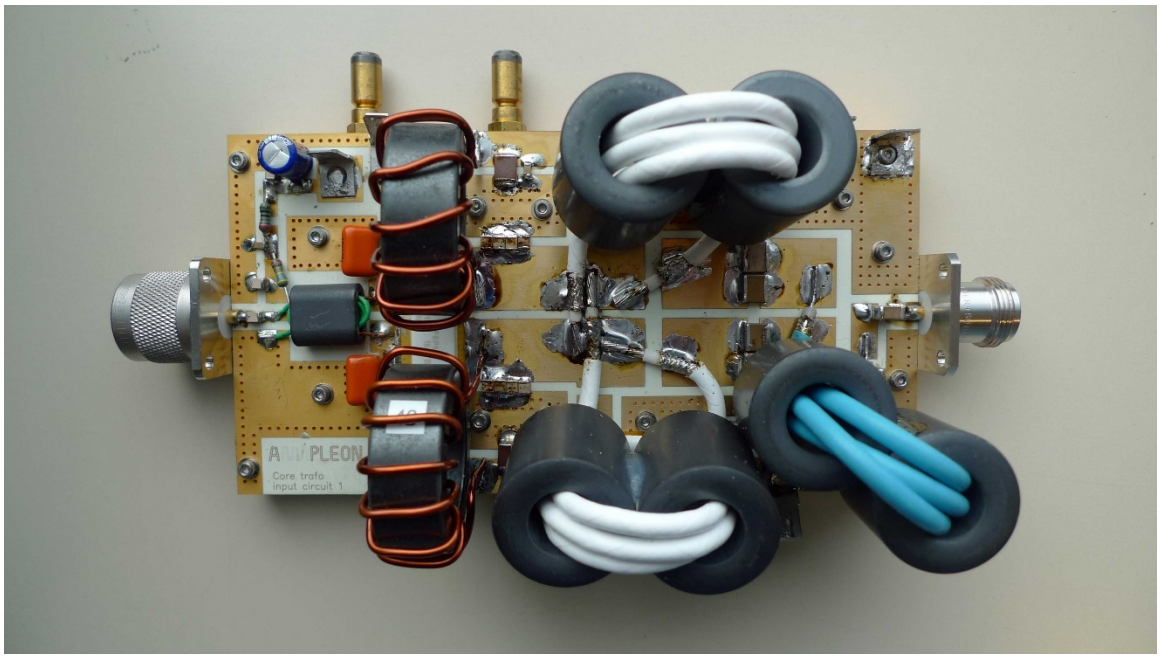
Input board.

List of components input board.

Component	Value	Manufacturer	Remarks
C1	47uF Electrolitic		
C2	10nF	Murata	
C3	1nF 100B	ATC	
C4	1nF 100B	ATC	
R1	56Ohms wired resistor		
R3	22Ohms wired resistor		
R4	100Ohm, 3Watts Not connected		If needed,this resistor can be used to decrease gain
T1	transformer BN61-202 core	Amidon	Primary 1.5 turn Secondary
Board	Ro 4350	Rogers	Thickness=0.76mm, full copper backside, gold plated, full metal via's
Connector	N type male		

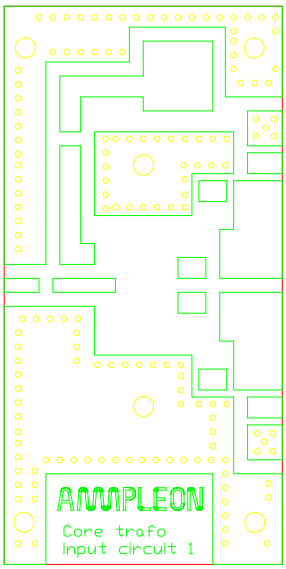
9. Hardware

9.1 Board Image

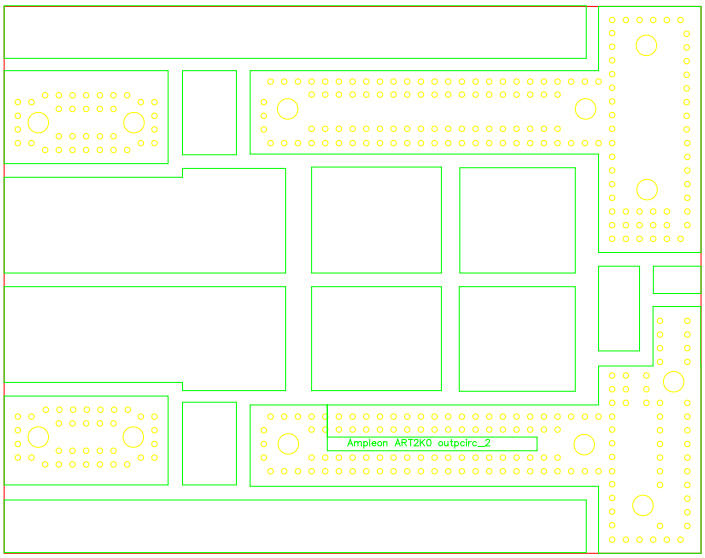


9.2 Copper Layout

Input board:



Output board:



Thermal Considerations.

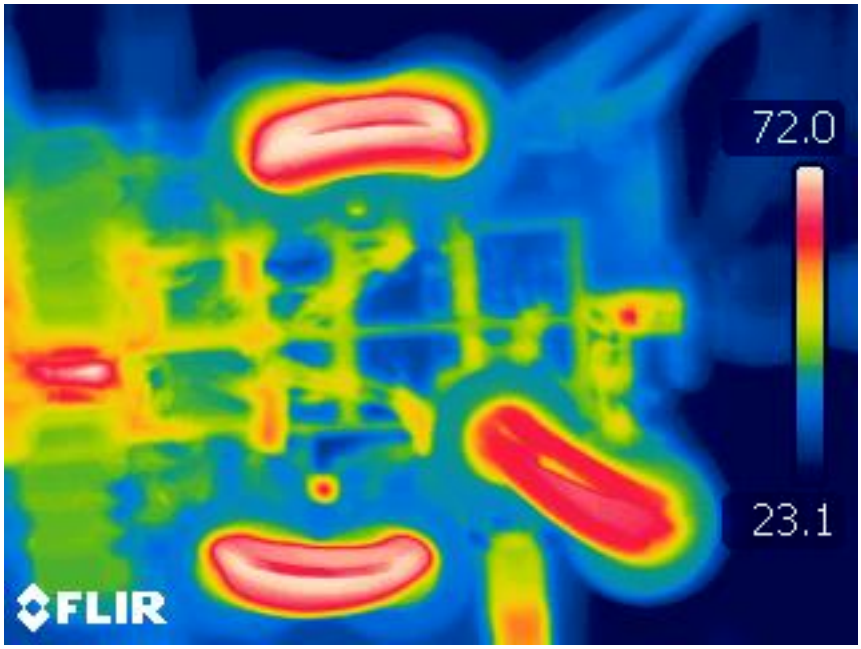
The amplifier is capable of generating >1000 Watts of pulsed RF power at efficiencies 53 - 59%.

The demo was tested up to a dutycycle of 80% with pulsed duration of 800uSec

Because at this output power level the dissipated power is around 1000Watts the temperature of the junction will become around 170degrees Celsius.

Thermal image of the output matching circuit below shows that the maximum temperature of the transformer cables is 72 degrees. Other circuit parts except the transistor are at lower temperature.

It is worthwhile to further improve the efficiency of the amplifier, this could be done as a next step.



In this version of the demo amplifier the transistor is soldered to the copper baseplate for sufficient cooling.

Sufficient cooling is extremely important for performance of the amplifier and lifetime of the transistor.

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