AR231058

ART450FE, 41MHz

v1.0 — 8 May 2023

AMPLEON

Application Report

Document information	
Status	General Publication
Abstract	Measurement results of 41MHz Amplifier with the ART450FE

1. Revision History

Table 1: Report revisions

Revision	Date	Description	Author
1.0	2023.05.08	Initial document	Canberk Pay

2. Contents

3. List of figures

4. List of tables

5. Description

This report presents the measurement results of the ART450FE RF amplifier. The device used is ART450FE, Advanced Rugged Technology (ART) LDMOS power transistor. The presented demo is operating at 41 MHz in push-pull class-AB.

Section 6 discusses the results for the demo board that is tuned for 41 MHz.

Table 2: Mechanical characteristics

Parameter	Description	Unit
L x W	130 x 80	mm
PCB assembly height	30	mm

Table 3: Board Specifications

Parameter	Value
Manufacturer	Rogers
Type	RO4350B (signal layer)
Dk	3.48 @ 10GHz
Df	0.0037 @ 10GHz
Total PCB thickness	0.58 mm
Copper thickness	35um (1 oz) on top layer / 35um (1 oz) on bottom layer
Layers	2, top/bottom
Board dimensions	130 x 80mm

6. Demo board

Figure 1 and Figure 2 illustrate the demo board tuned for 41MHz and the corresponding schematic respectively.

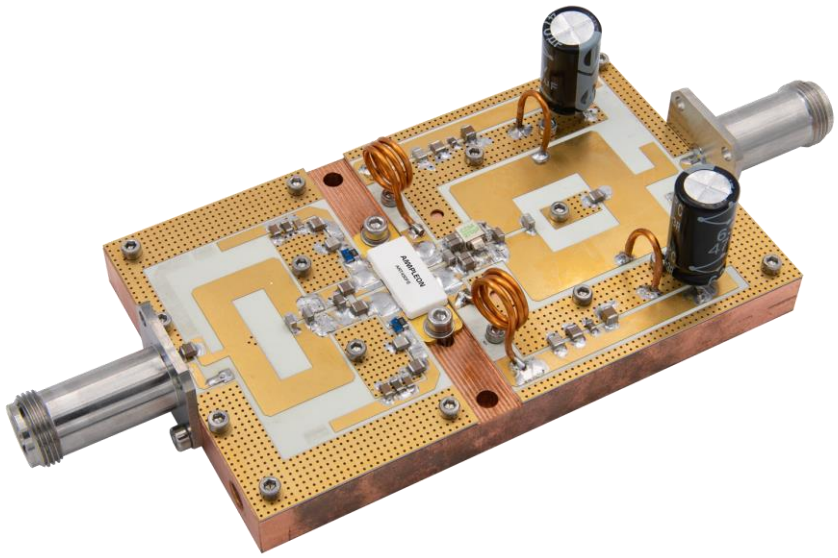

Figure 1 Demo top view, tuned for 41MHz

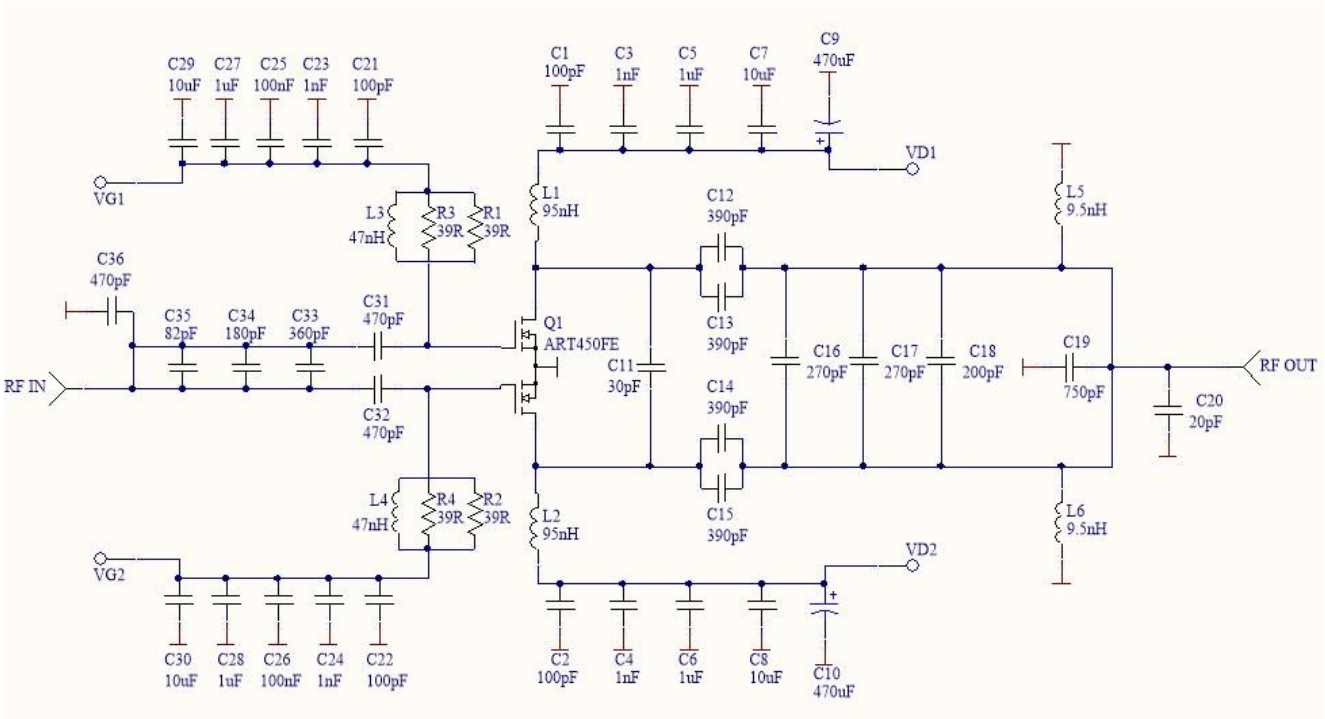

Figure 2 Schematic of the demo, tuned for 41MHz

Table 4: General Specifications[1]

Symbol	Parameter	Unit	Min	Typ	Max
F	Frequency of operation	MHz	-	41	-
V_{DD}	Drain voltage of LDMOS transistor	V	-	-	60[2]
I_{DD}	Current consumption of LDMOS transistor	A	-	9	-
P_{OUT}	Output power[3]	W	-	291.5	-
η_{DRAIN}	Drain efficiency[4]	%	-	76.3	-
H	Level of harmonics	dBc	-	-	- 22

[1] *Please note this is the general specification when the demo is tuned for highest efficiency.*

[2] *Operation at 65V is not recommended and it might affect long-term reliability due to the class of operation. 65V RF and IR data are only shown for indication. Use 60V.*

[3] *Typical output power of 291.5W is achieved with V_{DD} = 48V at 3dB compression point (P_{3dB}).*

[4] *Typical efficiency of 76.3% is achieved with V_{DD} = 48V at 1dB compression point (P_{1dB}).*

6.1 RF characteristics

Test signal: CW; total I_{dq}=10mA (5mA each); water cooling, T_{water} = 25ºC.

Table 5: RF characteristics in CW mode at F = 41MHz, total Idq = 10mA (5mA each)

V_{DD}	Gmax (dB)	P1dB (W)	P3dB (W)	Eff_P1dB (%)	Eff_P3dB (%)	Eff_max (%)
48	25.3	280	291.5	76.3	74.9	76.3
50	25.4	303.2	314.9	76.2	74.8	76.2
55	25.5	361.7	375.4	75.6	74.1	75.6
60	25.5	423.6	437.7	74.6	73.3	74.6
65	25.5	482.4	500	73.4	72.2	73.4

Test signal: CW pulsed, 100us pulse width, 10% duty cycle; total I_{dq}=10mA (5mA each); water cooling, T_{water} = 25ºC.

Table 6: RF characteristics in CW pulsed mode at F = 41MHz, total Idq = 10mA (5mA each)

V_{DD}	Gmax (dB)	P1dB (W)	P3dB (W)	Eff_P1dB (%)	Eff_P3dB (%)	Eff_max (%)
48	25.6	284.9	297.6	78.2	76.8	78.2
50	25.8	308.1	322.3	78.1	76.7	78.1
55	26.1	371	387.7	78	76.6	78
60	26.3	439.1	458.2	77.7	76.3	77.7
65	26.4	513.1	533.2	77.3	75.9	77.3

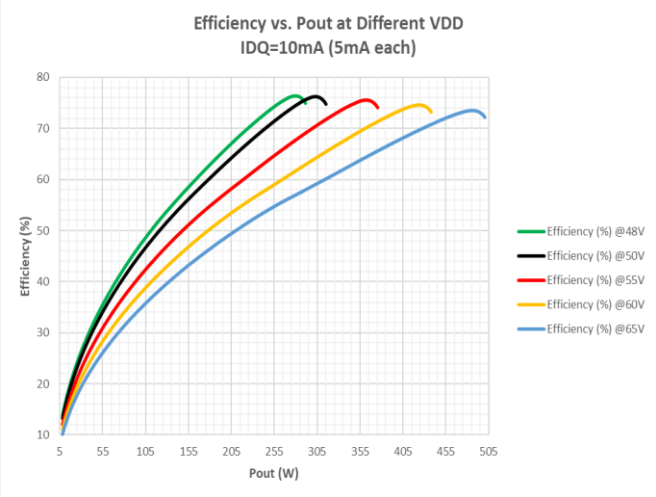

Figure 3 Gain (dB) over output power (W) at 41MHz, CW signal, total Idq=10mA

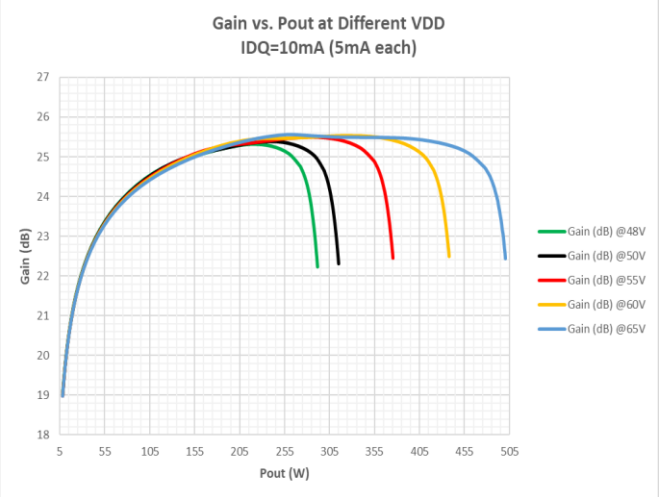

Figure 4 Efficiency (%) over output power (W) at 41MHz, CW signal, total Idq=10mA

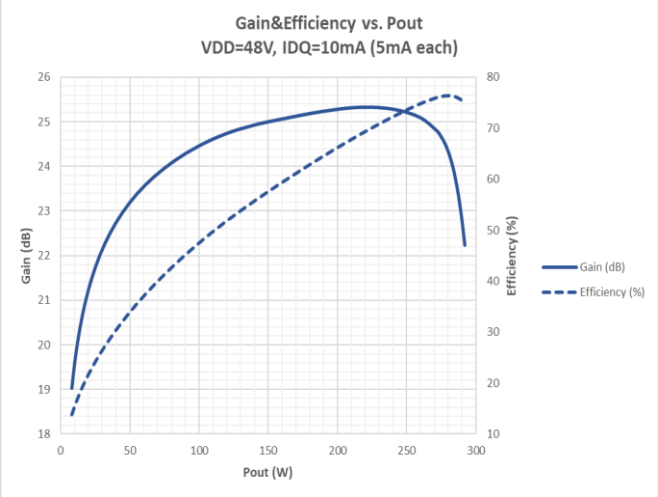

Figure 5 Gain (dB) and Efficiency (%) over output power (W) at 41MHz, CW signal, VDD=48V, total Idq=10mA

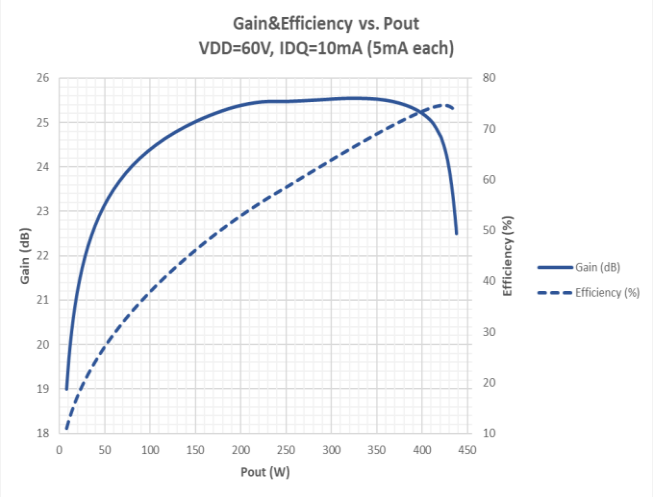

Figure 6 Gain (dB) and Efficiency (%) over output power (W) at 41MHz, CW signal, VDD=60V, total Idq=10mA

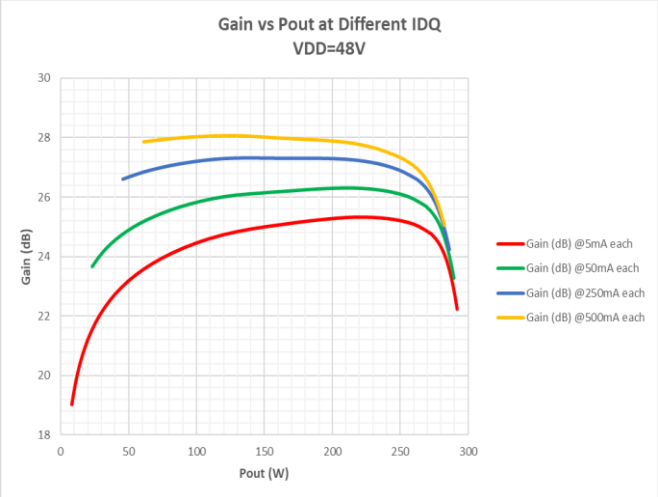

Figure 7 Gain (dB) over output power (W) at different Idq, at 41MHz, CW signal, V_{DD}=48V

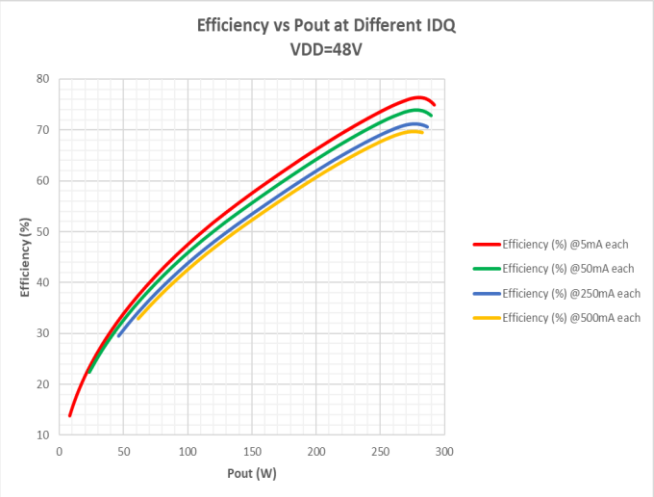

Figure 8 Efficiency (%) over output power (W) at different Idq, at 41 MHz, CW signal, V_{DD}=48V

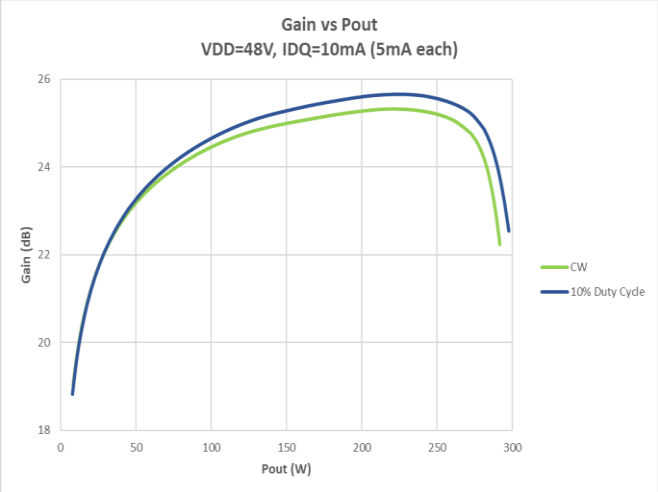

Figure 9 Gain (dB) over output power (W), V_{DD}=48V, total Idq=10mA

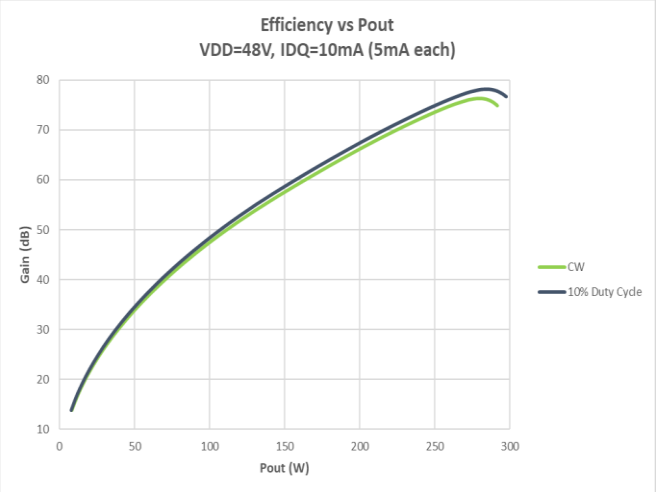

Figure 10 Efficiency (%) over output power (W), V_{DD}=48V, total Idq=10mA

6.2 Thermal characteristics

Figure 8 illustrates the IR image of the demo after reaching thermal equilibrium with water cooling (T_{water}=25^{0}C). The maximum temperature on the device is below 40 ºC.

Figure 11 IR image of the demo after reaching thermal equilibrium and operating at P3dB, V_{DD} = 48V, Idq=10mA (5mA each), water cooling (T_{water}=25^{0}C)

6.3 Bill of materials

Table 7: Bill of Materials

Designator	Group	Value	Tolerance	Name	Manufacturer	Quantity
C1, C2, C21, C22	Capacitor	100pF	±5%	800B101JW500X	AVX	4
C3, C4, C23, C24	Capacitor	1nF	±5%	800B101JW500X	AVX	4
C5, C6	Capacitor	1uF	±10%	C2012X7S2A105K	TDK	2
C7, C8	Capacitor	10uF	±10%	GRM32EC72A106KE05L	Murata	2
C9, C10	Capacitor	470uF	±10%	-	Any	2
C25, C26	Capacitor	100nF	±10%	C1206C104K1RAC	Kemet	2
C27, C28	Capacitor	1uF	±10%	GRM31MR71E105KA01L	Murata	2
C29, C30	Capacitor	10uF	±10%	C3216X5R1E106KAC	TDK	2
R1, R2, R3, R4	Resistor	39R	±1%	CRGCQ1206F39R	TE Connectivity	4
L1, L2	Inductor	95nH		Cu wire d=1.5mm, 3 turns, inner d=9.9mm		2
L3, L4	Inductor	47nH	±5%	1206CS-470XJE	Coilcraft	2
C31, C32, C36	Capacitor	470pF	±5%	800B471JW500X	AVX	3
C11	Capacitor	30pF	±5%	800B471JW500X	AVX	1
C12, C13, C14, C15	Capacitor	390pF	±5%	800B391JW500X	AVX	4
C16	Capacitor	270pF	±5%	MCM01-009EF271J-F	Cornell Dubilier	1
C17	Capacitor	270pF	±5%	800B271JW500X	AVX	1
C18	Capacitor	200pF	±5%	800B201JW500X	AVX	1
C33	Capacitor	360pF	±5%	800B361JW500X	AVX	1
C34	Capacitor	180pF	±5%	800B181JW500X	AVX	1
C35	Capacitor	82pF	±5%	800B820JW500X	AVX	1
C19	Capacitor	750pF	±5%	800B751JW500X	AVX	1
C20	Capacitor	20pF	±5%	800B200JW500X	AVX	1
L5, L6	Inductor	9.5nH		Cu wire d=1.5mm, 1 turn, inner d=9.9mm		2
Q1	Transistor			ART450FE	Ampleon	1

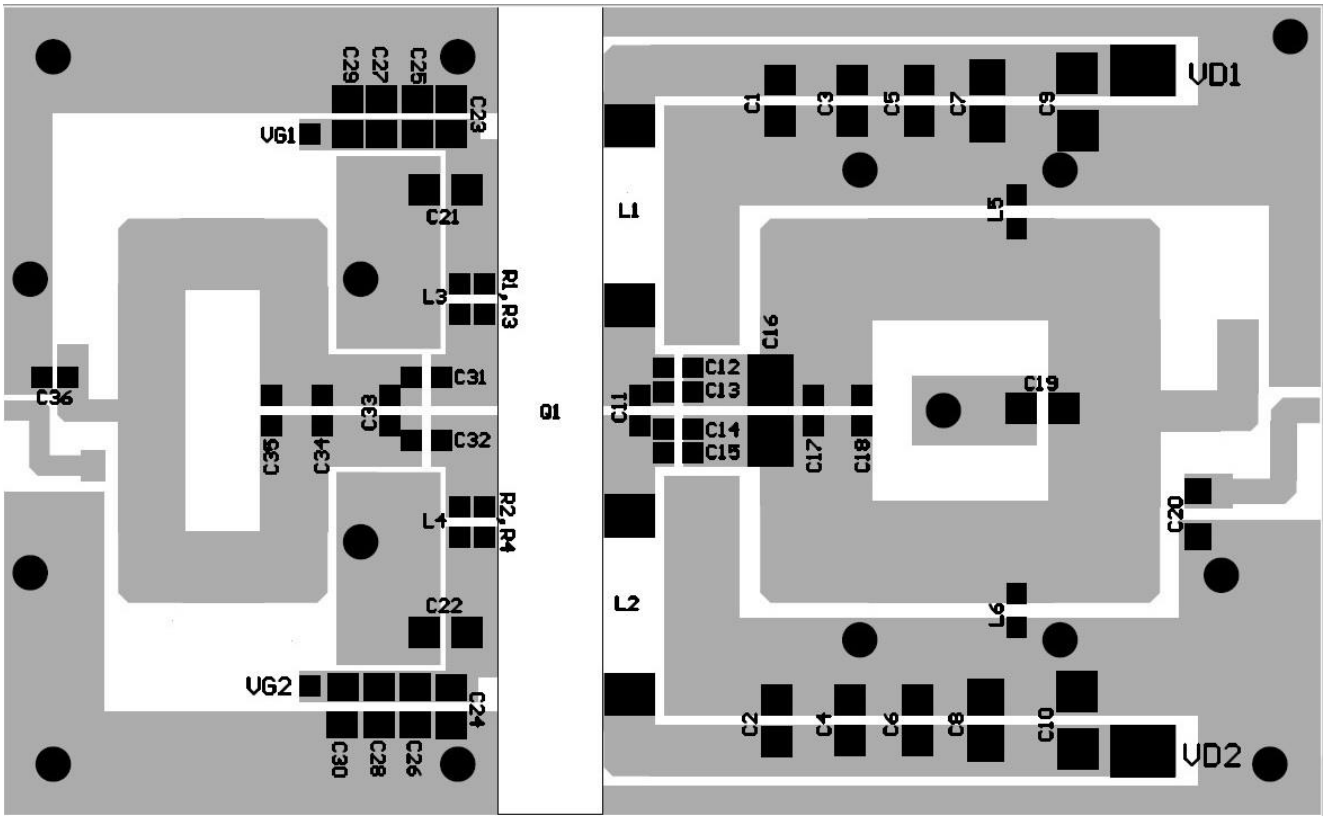

Figure 12 Component Mapping

7. Demo markings

Table 8: Device specifics

Parameter	Value
Manufacturer	Ampleon
Device	ART450FE
PCB marking	ART450FE 41MHz

8. Abbreviations

Table 9: Abbreviations

Parameter	Description
F	Frequency
CW	Continuous Wave
Gmax	Maximum Gain
P1dB	1 dB Compression Point of the Gain
V_{DD}	Drain Voltage
Idq	Drain's Quiescent current = Idq1 + Idq2
η_{DRAIN}	Drain Efficiency
LDMOS	Laterally-Diffused Metal-Oxide Semiconductor
VSWR	Voltage Standing Wave Ratio
δ	Duty Cycle
t_p	Pulse Width
RF	Radio Frequency
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage
P_L	Power Delivered to 50Ω Load at RF OUT Connector
S21	Small Signal Gain (S-parameter measurement in 50Ω System)
Pin	Input Power to the Amplifier at RF IN Connector
Pout	Output Power of Amplifier at RF OUT Connector

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