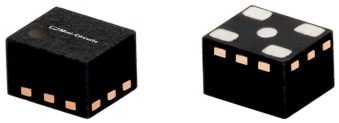
MMIC SURFACE MOUNT

E-PHEMT Transistor TAV1-541NM+

50Ω 45 to 6000 MHz Non-Magnetic Leadframe

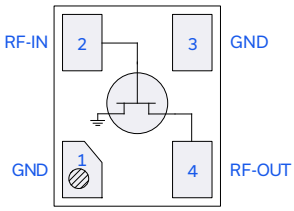
THE BIG DEAL

- Non-Ferrous Package Leadframe
- Low Noise Figure, Typ. 0.4dB
- High Gain, Typ. 24dB
- High Output IP3, Typ. +32dBm
- Output Power at 1dB Compression, Typ. +18dBm
- Single Supply Voltage, 60mA, +3V
- Wide Bandwidth



Generic photo used for illustration purposes only

FUNCTIONAL DIAGRAM



APPLICATIONS

- MRI
- ISM
- 5G MIMO Radio Systems
- Wi-Fi 6
- Tactical Radio

PRODUCT OVERVIEW

Mini-Circuits' TAV1-541NM+ is a MMIC E-pHEMT* transistor with an operating frequency range from 45 to 6000MHz. This model combines high gain with extremely low noise figure, resulting in lower overall system noise. Low noise figure and high IP3 performance make it an ideal choice for sensitive receivers in communications systems. Manufactured using highly repeatable E-pHEMT* technology, the unit comes housed in a tiny 1.4x1.2mm Non-Magnetic package. This model requires external biasing and matching for user-specific applications.

KEY FEATURES

Features	Advantages
Non-Magnetic Package	Ideal for use in MRI and other magnetic sensitive applications.
Wideband, 45 to 6000MHz	Use in multiple applications:UHF, VHF, and Communication Infrastructure. One single high-performance component is effective for use in multiple applications including MRI, Wi-Fi 6, and other communications infrastructure.
High IP3 vs. DC power consumption • +31.4dBm at 2000MHz, 60mA, +3V • +33.9dBm at 2000MHz, 60mA, +4V	Enhanced linearity over a broad frequency range makes the device ideal for use in: • Driver amplifiers for complex waveform up converter paths • Drivers in linearized transmit systems
Combines high Gain (18.6dB) with very low Noise Figure (0.6dB) at 2000MHz, 60mA, +3V	The unique combination of high gain and low noise figure results in lower overall system noise.

* Enhancement mode Pseudomorphic High Electron Mobility Transistor.

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ELECTRICAL SPECIFICATIONS[1] AT 25°C, V_{DS} = +3V/+4V, I_{DS}=60mA, UNLESS NOTED OTHERWISE

Parameter	Condition (MHz)	V_{DS} = +3V; I_{DS} = 60mA			V_{DS} = +4V; I_{DS} = 60mA			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Frequency Range		45		6000	45		6000	MHz
Noise Figure	900		0.4			0.5		dB
	2000		0.6			0.7		
	4000		1			1		
	6000		1.6			1.7		
Gain	900		24.1			24.1		dB
	2000		18.6			18.6		
	4000		13.1			13.1		
	6000		8.9			8.9		
Output Power at 1dB Compression (P1dB)[2]	900		+18.2			+20.4		dBm
	2000		+18.4			+20.7		
	4000		+18.3			+20.8		
	6000		+18.3			+20.3		
Output Third-Order Intercept P_{OUT} = 0dBm/Tone	900		+32			+32.8		dBm
	2000		+31.4			+33.9		
	4000		+31.9			+34.1		
	6000		31.8			+34.9		
Isolation	900		27.7			27.8		dB
	2000		25.5			25.6		
	4000		22.9			23.1		
	6000		21.6			21.8		
Output Return Loss	900		9.8			9.8		dB
	2000		13.1			13.5		
	4000		14.4			15.3		
	6000		11.2			12		

DC SPECIFICATIONS[1] AT 25°C, V_{DS} = +3V, I_{DS} = 60mA, UNLESS NOTED OTHERWISE

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Device Operating Gate Voltage (V_{GS})	V_{DS} = +3V, I_{DS} = 60mA	+0.37	+0.48	+0.69	V
Threshold Voltage (V_{TH})	V_{DS} = +3V, I_{DS} = 4mA	+0.18	+0.26	+0.38	V
Saturated Drain Current (I_{DSS})	V_{DS} = +3V, V_{GS} = 0V		1	5	µA
Transconductance (G_M)	V_{DS} = +3V, $G_M = \Delta I_{DS}/\Delta V_{GS}$ $\Delta V_{GS} = V_{GS2} - V_{GS1}$ $V_{GS1} = V_{GS}$ at I_{DS} = 60mA $V_{GS2} = V_{GS1}$ + 50mV	230	392	560	mS
Gate Leakage Current (I_{GSS})	$V_{GD} = V_{GS}$ = -3V			200	µA

1. Tested on Mini-Circuits Characterization Test/Evaluation Board TB-TAV1-541NMC+. See Figure 2. No matching components have been used on RF input and RF output.
2. Drain current bias is allowed to increase during compression measurement.

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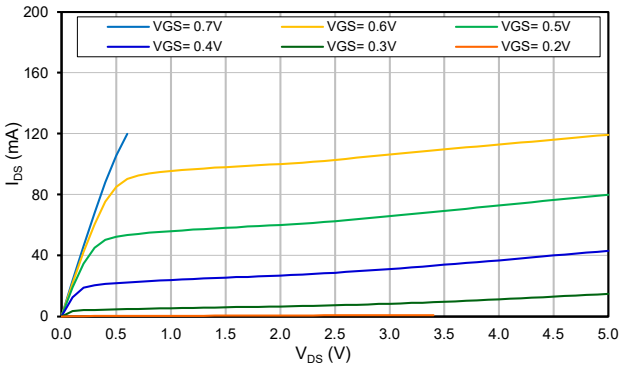
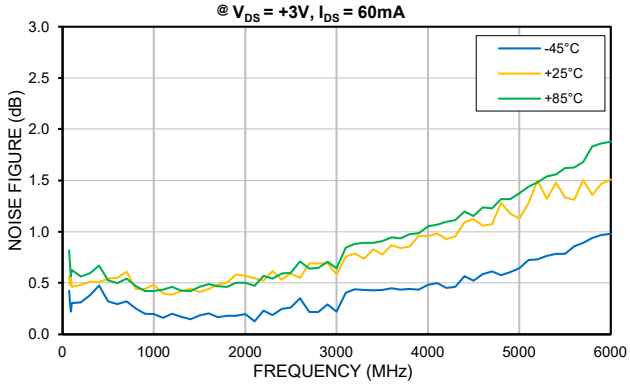
TYPICAL PERFORMANCE GRAPHS

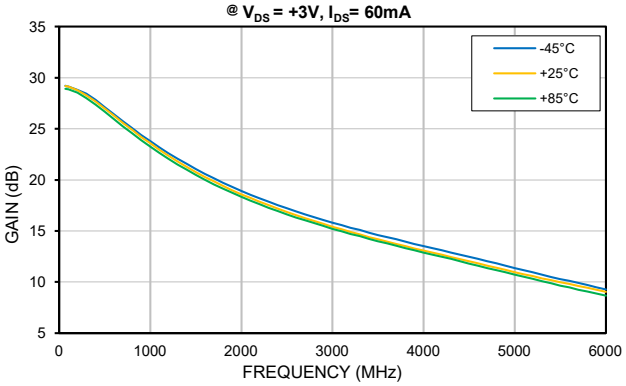
DRAIN CURRENT vs. GATE-SOURCE Voltage[4]



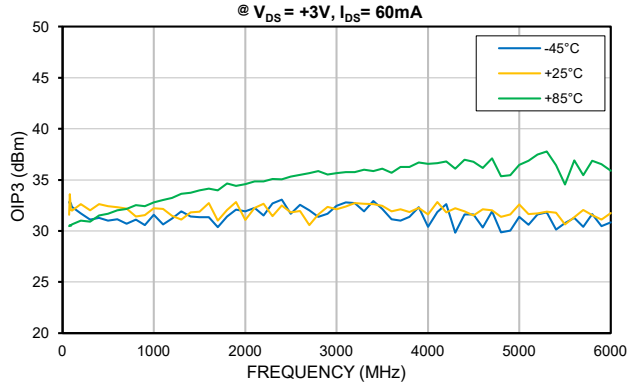
NOISE FIGURE vs. TEMPERATURE[3]
@ V_{DS} = +3V, I_{DS} = 60mA



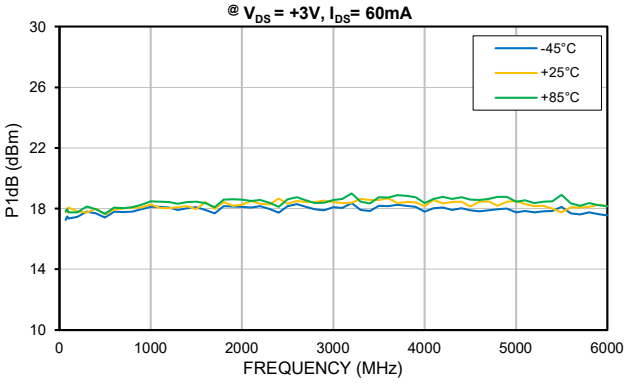
GAIN vs. TEMPERATURE[3]
@ V_{DS} = +3V, I_{DS}= 60mA



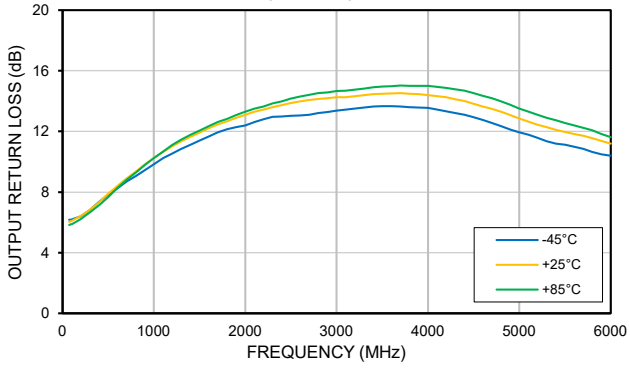
OUTPUT IP3 vs. TEMPERATURE[3]
@ V_{DS} = +3V, I_{DS}= 60mA



P1dB vs. TEMPERATURE[3]
@ V_{DS} = +3V, I_{DS}= 60mA



OUTPUT RETURN LOSS vs. TEMPERATURE[3]
@ V_{DS} = +3V, I_{DS}= 60mA



3. Includes test board loss
4. Drain current was allowed to increase during compression measurement

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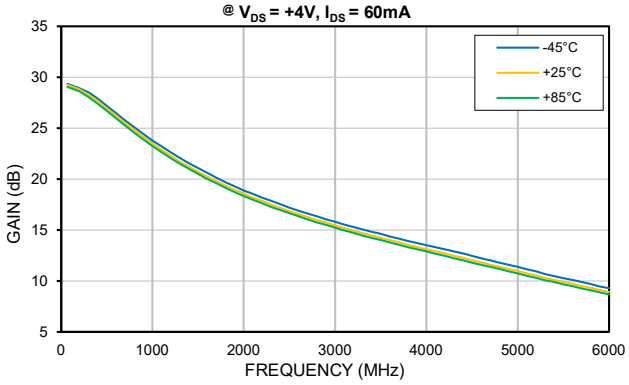
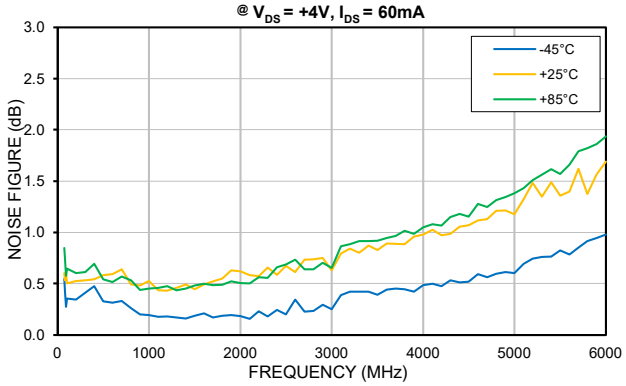
TYPICAL PERFORMANCE GRAPHS

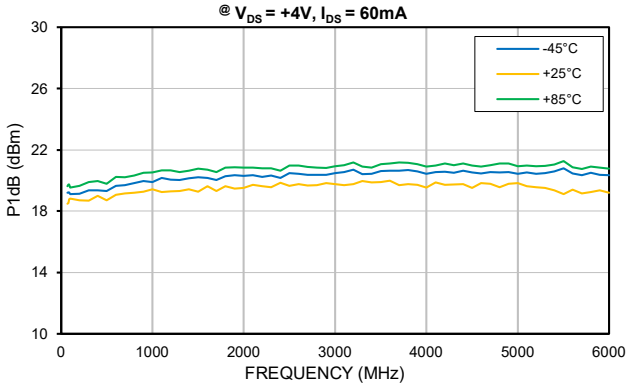
GAIN vs. TEMPERATURE[3]
@ V_{DS} = +4V, I_{DS} = 60mA



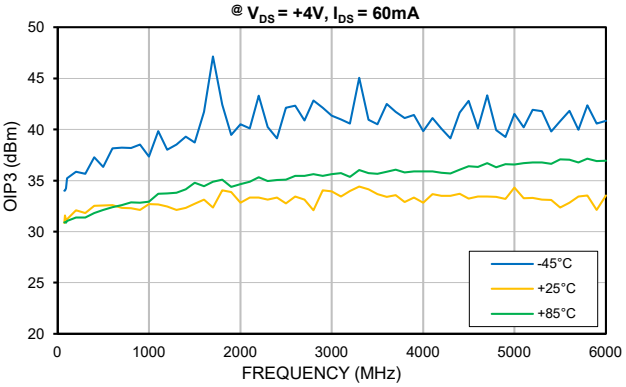
NOISE FIGURE vs. TEMPERATURE[3]
@ V_{DS} = +4V, I_{DS} = 60mA



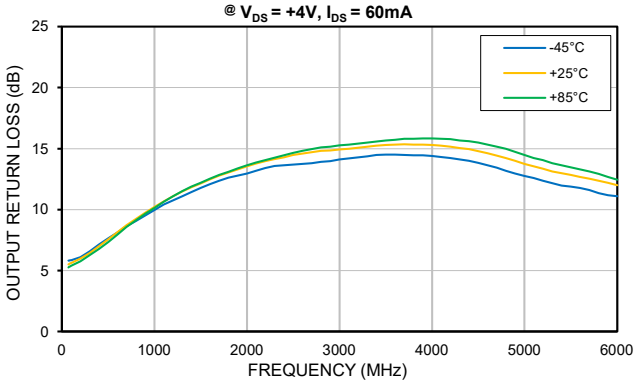
P1dB vs. TEMPERATURE[3]
@ V_{DS} = +4V, I_{DS} = 60mA



OUTPUT IP3 vs. TEMPERATURE[3]
@ V_{DS} = +4V, I_{DS} = 60mA



OUTPUT RETURN LOSS vs. TEMPERATURE[3]
@ V_{DS} = +4V, I_{DS} = 60mA



3. Includes test board loss
4. Drain current was allowed to increase during compression measurement

ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
Junction Temperature[6]	+150°C
Total Power Dissipation (P_{DISS})	360mW
Input Power (P_{IN})[7]	+17dBm
Drain-Source Voltage (V_{DS})[8]	+5V
Gate-Source Voltage (V_{GS})[8]	-5V to +0.7V
Gate-Drain Voltage (V_{GD})[8]	-5V to +0.7 V
Drain Current (I_{DS})[8]	120mA
Gate Current (I_{GS})	2mA

5. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.
6. Peak temperature on top of Die.
7. I_{GS} is limited to 2mA during test.
8. Assumes DC quiescent condition.

THERMAL RESISTANCE

Parameter	Ratings
Thermal Resistance (Θ_{jc})[9]	160°C/W

9. Θ_{jc}= (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1A	250 V to <500 V	ANSI/ESDA/JEDEC JS-001-2017

ESD HANDLING PRECAUTION: This device is designed to be Class 1A for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C

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FUNCTIONAL DIAGRAM

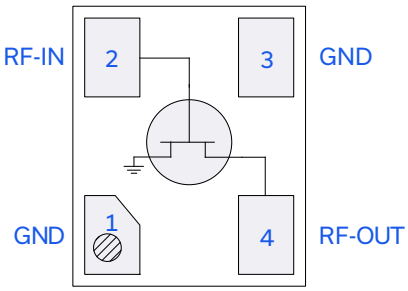

Figure 1. TAV1-541NM+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description (Refer to Figure 2)
RF-IN	2	RF-IN Pad connects to Gate
RF-OUT	4	RF-OUT Pad connects to Drain
GND	1, 3, and Paddle	Connects to ground

CHARACTERIZATION TEST BOARD

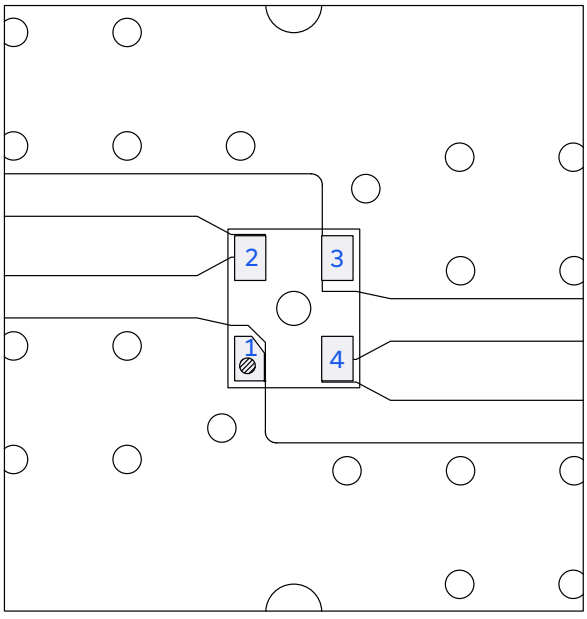

Figure 2. DUT soldered on Mini-Circuits Characterization Test Board: TB-TAV1-541NMC+

Electrical Parameters and Conditions
Gain, Output Power at 1dB Compression (P1dB), Output IP3 (OIP3), and Noise Figure measured using N5247B PNA-X microwave network analyzer.

Conditions:
1. Drain Voltage (with reference to source, V_{DS}) = +3V or +4V as shown
2. Gate Voltage (with reference to source, V_{GS}) is set to obtain desired Drain-Source current (I_{DS}) as shown in Specification Table
3. Gain: P_{IN} = -25dBm
4. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0dBm/tone at output.
5. No external matching components used on test board; internal PNA-X bias tees used to provide bias voltages.

Caution: Permanent damage to the device will occur if the Power ON and Power OFF Sequences are not followed.

Power ON Sequence:
1) Set V_{GS} = 0V. Apply V_{GS}.
2) Set V_{DS} = +3V or +4V. Apply V_{DS}.
3) Increase V_{GS} to obtain desired I_{DS} as shown in specification table.
4) Apply RF Signal.

Power OFF Sequence:
1) Turn off RF Signal.
2) Adjust V_{GS} down to 0V.
3) Turn off V_{DS}.
4) Turn off V_{GS}.

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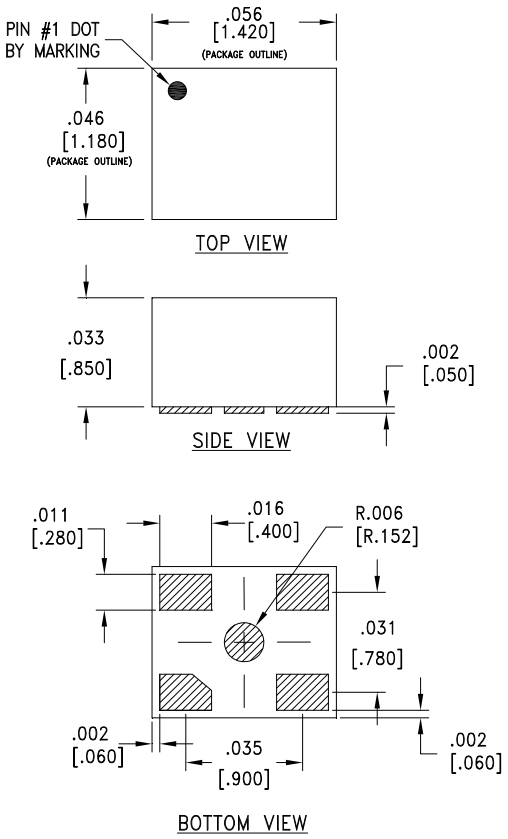
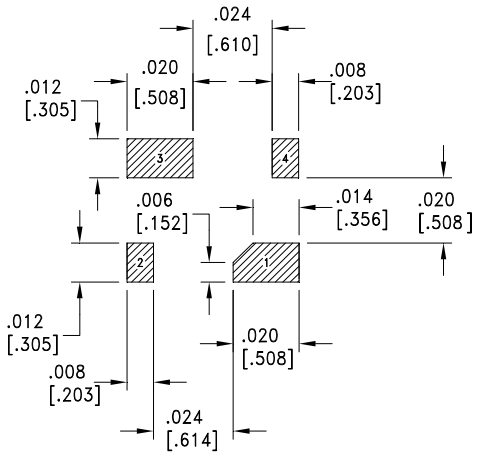
CASE STYLE DRAWING



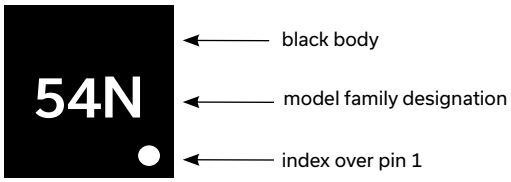
PCB Land Pattern



Suggested Layout,
Tolerance to be within ±.002

Weight: .0047 grams
Dimensions are in inches [mm]. Tolerances: 2 Pl. + .01; 3 Pl. + .005

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	TE2769 Plastic package, exposed paddle, Lead Finish: Matte-Tin
RoHS Status	Compliant
Tape & Reel **Standard quantities available on reel**	F90 7" reels with 20, 50, 100, 200, 500,1K, 2K or 3K devices
Suggested Layout for PCB Design	PL-758
Evaluation Board	TB-TAV1-541NMC+ Gerber File
Environmental Ratings	ENV08T2

NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

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