

# 12.0-16.0 GHz Power Amplifier QFN, 4x4mm

Mimix  
BROADBAND™

January 2009 - Rev 26-Jan-09

X P1043-QH  
X RoHS

## Features

- X 32 dBm Saturated RF Power
- X 41 dBm Output IP3 Linearity
- X 17 dB Gain Control
- X On-Chip Power Detector
- X 4x4mm Standard QFN Package
- X 100% RF Testing



## General Description

The XP1043-QH is a packaged linear power amplifier that operates over the 12.0-16.0 GHz frequency band. The device provides 21.5 dB gain and 41 dBm Output Third Order Intercept Point (OIP3) across the band and is offered in an industry standard, fully molded 4x4mm QFN package. The packaged amplifier is comprised of a three stage power amplifier with an integrated, temperature compensated on-chip power detector. The device includes on-chip ESD protection structures and DC by-pass capacitors to ease the implementation and volume assembly of the packaged part. The device is manufactured in GaAs PHEMT device technology with BCB wafer coating to enhance ruggedness and repeatability of performance. XP1043-QH is well suited for Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

## Absolute Maximum Ratings<sup>1</sup>

Supply Voltage (Vd1,2,3)	+10.0V
Supply Current (Id1,2,3)	1500 mA
Gate Bias Voltage (Vg1,2,3)	-3V
Max Power Dissipation (Pdiss)	5.5W
RF Input Power	+19 dBm
Operating Temperature (Ta)	-55 to +85 °C
Storage Temperature (Tstg)	-65 to +150 °C
Channel Temperature (Tch)	-40 to MTTF Graph <sup>2</sup>

(1) Minimum specifications are set under nominal (typ.) bias conditions. Bias can be adjusted higher to achieve greater linearity and power; however, maximum total power dissipated is specified at 5.5 W

(2) Channel temperature directly affects a device's MTTF. Channel temperature should be kept as low as possible to maximize lifetime.

## Electrical Characteristics (Ambient Temperature T = 25 °C)

Parameter	Units	Min. <sup>1</sup>	Typ.	Max.
Frequency Range (f)	GHz	12.0	-	16.0
Small Signal Gain (S21)	dB	19.0	21.5	
Input Return Loss (S11)	dB	10.0	15.0	
Output Return Loss (S22)	dB	10.0	10.0	
Reverse Isolation (S12)	dB		55.0	
P1dB	dBm		30.0	
Psat	dBm	31.0	32.0	
OIP3 at Pout = 18 dBm per Tone	dBm	40.0	41.0	
Power Detector Range	dB	-	37.0	-
Drain Bias Voltage (Vd1,2,3)	VDC		7.0	9.0
Detector Bias Voltage (Vdet,ref)	VDC		5.0	
Gate Bias Voltage (Vg1,2,3)	VDC	-2	-1.0	0.0
Supply Current (Id1)	mA		100	200
Supply Current (Id2)	mA		200	400
Supply Current (Id3)	mA		400	800

(1) Note: Minimum specifications are set under nominal (typ.) bias conditions. Bias can be adjusted higher to achieve greater linearity and power.

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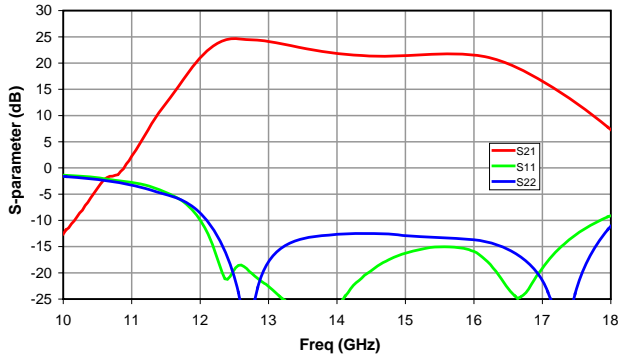
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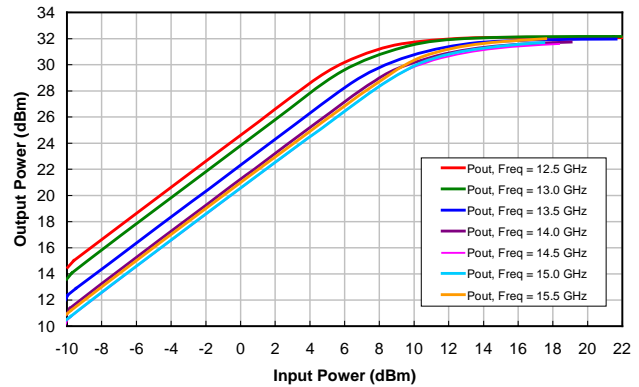
XP1043-QH  
RoHS

## Power Amplifier Measurements

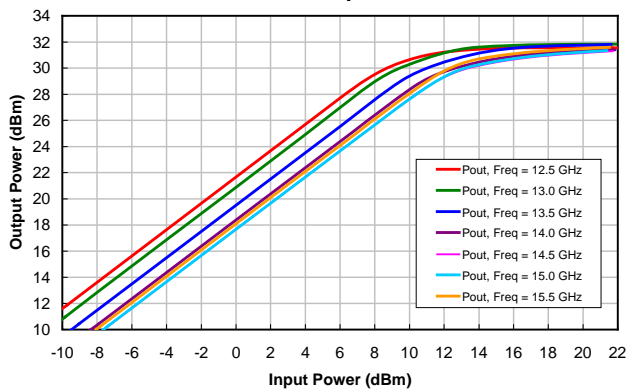
XP1043-QH: S-parameters (dB) vs. Freq (GHz),  
(VDD=7V, ID1=100mA, ID2=200mA, ID3=400mA)



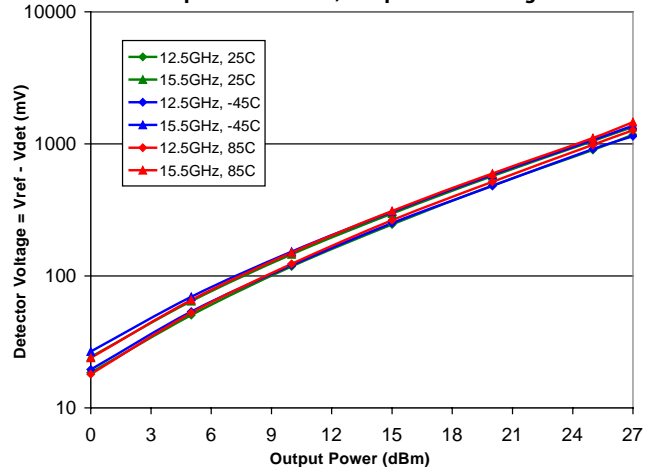
XP1043-QH: Pout (dBm) vs Pin (dBm) at Room Temp.  
Vd = 7 V, Iq = 700mA



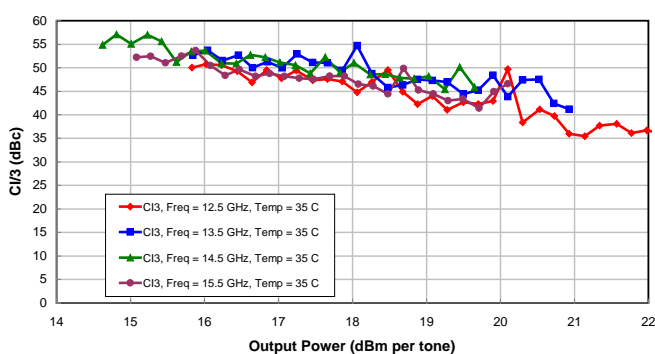
XP1043-QH: Pout (dBm) vs Pin (dBm) at +85 °C.  
Vd = 7 V, Iq = 700mA



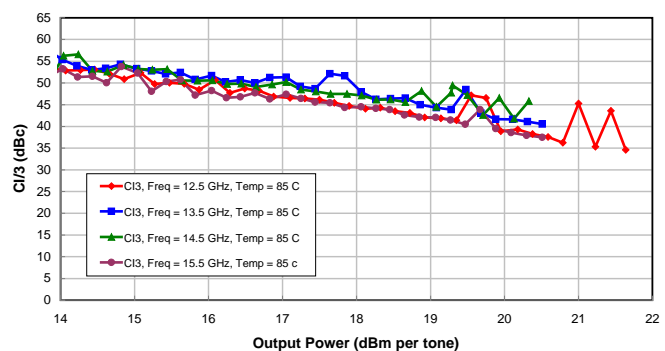
XP1043-QH: V\_Detect (mV) vs Output Power (dBm)  
Freq = 12.5-15.5 GHz, Temp = -45 to 85 Degree C



XP1043-QH: C/I3 (dBc) vs Pout per Tone (dBm) at Room Temp.  
Vd=7 V, Id=700 mA, 12.5 to 15.5 GHz



XP1043-QH: C/I3 (dBc) vs Pout per Tone (dBm) at +85 °C.  
Vd=7 V, Id=700 mA, 12.5 to 15.5 GHz

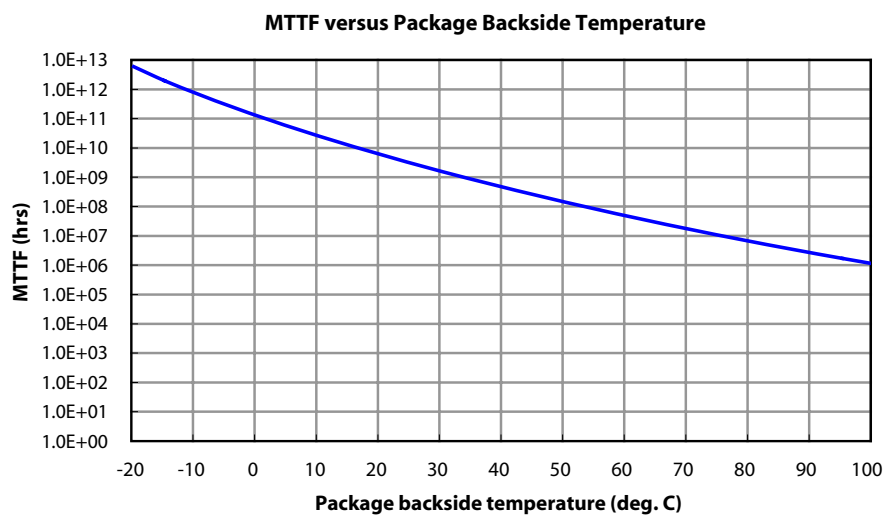


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## MTTF

These numbers were calculated based on accelerated life test information and thermal model analysis received from the fabricating foundry.

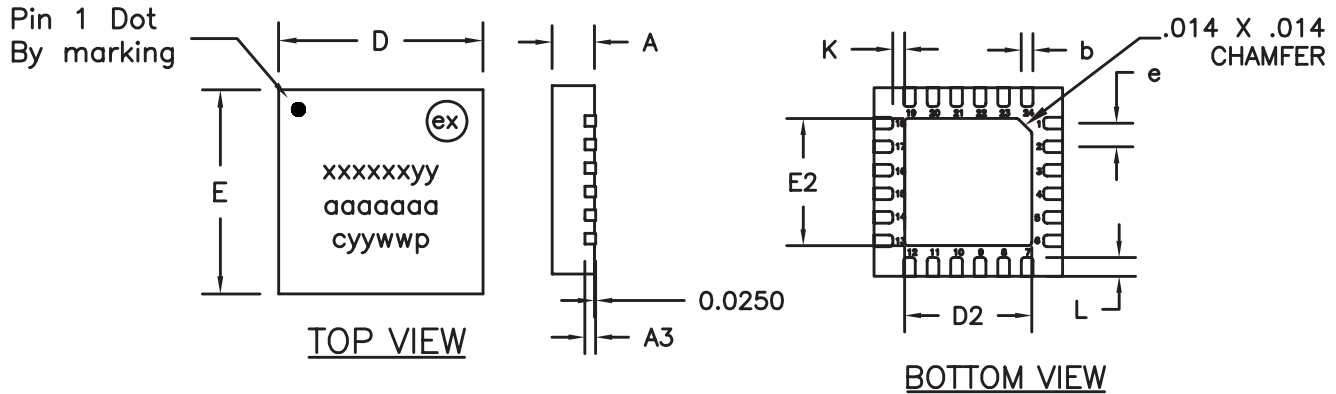


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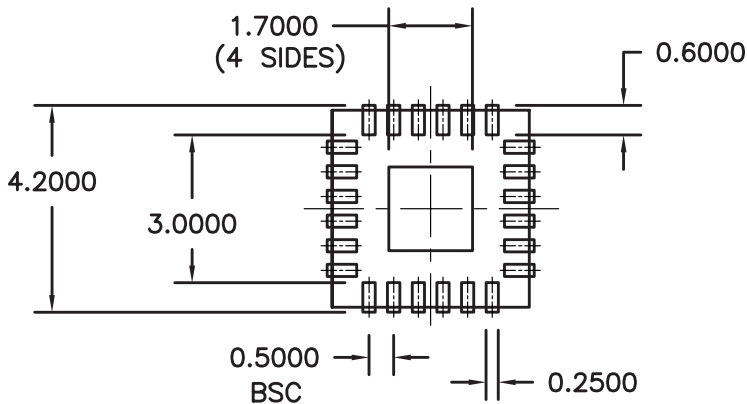
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## Package Dimensions / Layout



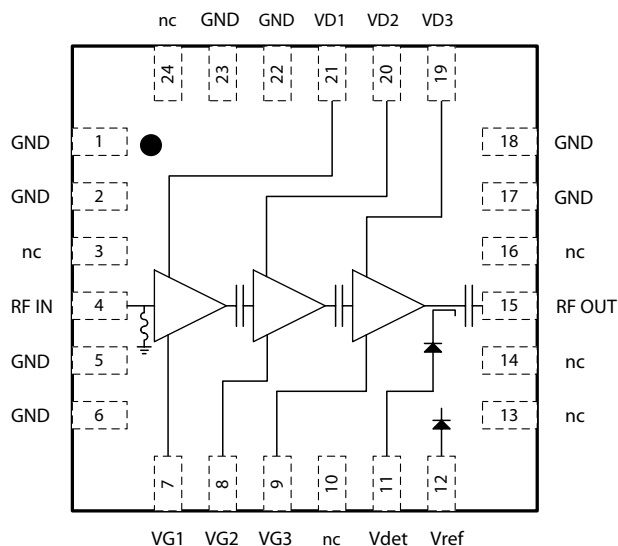
RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS Note:



1. ALL DIMENSIONS ARE IN mm.

	MIN	TYP	MAX
A	0.80	0.90	1.00
A3	0.20 REF		
b	0.20	0.25	0.30
K	0.20	-	-
D	4.00 BSC		
E	4.00 BSC		
e	0.50		
D2	2.45	2.60	2.75
E2	2.45	2.60	2.75
L	0.20	0.30	0.40

## Functional Schematic



## Pin Designations

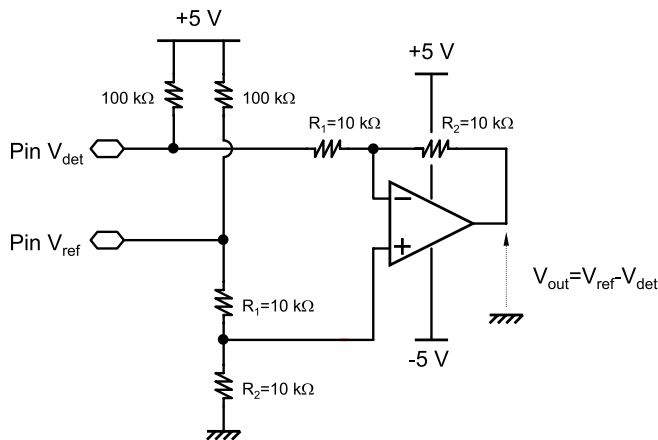
Pin Number	Pin Name	Pin Function	Nominal Value
1-2	GND	Ground	GND
3	nc	Not Connected	GND
4	RF In	RF Input	
5-6	GND	Ground	GND
7	VG1	Gate 1 Bias	~-1.0V
8	VG2	Gate 2 Bias	~-1.0V
9	VG3	Gate 3 Bias	~-1.0V
10	nc	Not Connected	GND
11	Vdet	Pwr Det	5.0V
12	Vref	Pwr Det Reference	5.0V
13-14	nc	Not Connected	GND
15	RF Out	RF Output	
16	nc	Not Connected	GND
17-18	GND	Ground	GND
19	VD3	Drain 3 Bias	7.0V, 400 mA
20	VD2	Drain 2 Bias	7.0V, 200 mA
21	VD1	Drain 1 Bias	7.0V, 100 mA
22-23	GND	Ground	GND
24	nc	Not Connected	GND

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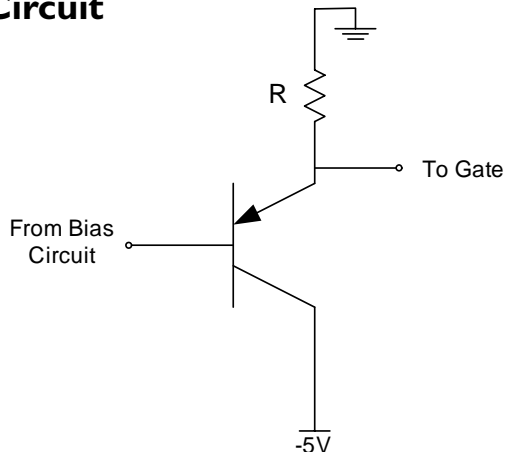
**App Note [1] Biasing** - As shown in the Pin Designations table, the device is operated under the nominal bias conditions of VD1,2,3 at 7.0V with 100, 200, 400mA respectively. The device can also be safely biased to a maximum of 9 V and 1.4 A to provide greater than 2 Watts of saturated RF power. It is recommended to use active bias to keep the currents constant in order to maintain the best performance over temperature. Under heavy RF saturation the device will tend to self bias and pull the desired drain current. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is -1.0V. Make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

**App Note [2] Board Layout** - As shown in the board layout, it is recommended to provide 100pF decoupling caps as close to the bias pins as possible, with additional 10µF decoupling caps.

**App Note [3] Power Detector** - As shown in the schematic below, the power detector is implemented by providing +5V bias and measuring the difference in output voltage with standard op-amp in a differential mode configuration.



## Bias Circuit



The output impedance of the bias circuit's gate output should be small. When in saturation, the gates of the XP1043-QH can draw several mA which may cause adverse affects in a gate circuit with high output impedance. It is recommended that an Emitter Follower circuit be used (shown above), which follows the bias circuit's gate output. This will result in a high-input impedance, low-output impedance buffer between the gate output of the bias circuit and the gate input of the XP1043-QH.

Emitter Follower placed between the  
(gate) output of the bias circuit MMIC gate

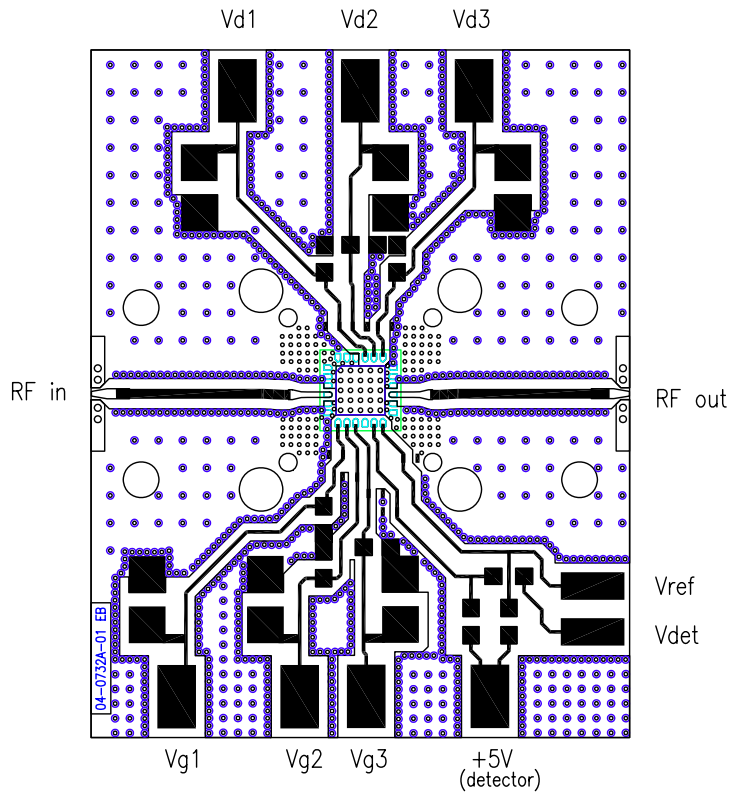
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## Recommended Layout



Recommended Decoupling Capacitors: 100pF 0402, 10 $\mu$ F 0805

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## Handling and Assembly Information

**CAUTION!** - Mimix Broadband MMIC Products contain gallium arsenide (GaAs) which can be hazardous to the human body and the environment. For safety, observe the following procedures:

- Do not ingest.
- Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.
- Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.

### Electrostatic Sensitive Device -

Observe all necessary precautions when handling.

**Life Support Policy** - Mimix Broadband's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of Mimix Broadband. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user. (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**Package Attachment** - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Vacuum tools or other suitable pick and place equipment may be used to pick and place this part. Care should be taken to ensure that there are no voids or gaps in the solder connection so that good RF, DC and ground connections are maintained. Voids or gaps can eventually lead not only to RF performance degradation, but reduced reliability and life of the product due to thermal stress.

### Typical Reflow Profiles

Reflow Profile	SnPb	Pb Free
Ramp Up Rate	3-4 °C/sec	3-4 °C/sec
Activation Time and Temperature	60-120 sec @ 140-160 °C	60-180 sec @ 170-200 °C
Time Above Melting Point	60-150 sec	60-150 sec
Max Peak Temperature	240 °C	265 °C
Time Within 5 °C of Peak	10-20 sec	10-20 sec
Ramp Down Rate	4-6 °C/sec	4-6 °C/sec

**Mimix Lead-Free RoHS Compliant Program** - Mimix has an active program in place to meet customer and governmental requirements for eliminating lead (Pb) and other environmentally hazardous materials from our products. All Mimix RoHS compliant components are form, fit and functional replacements for their non-RoHS equivalents. Lead plating of our RoHS compliant parts is 100% matte tin (Sn) over copper alloy and is backwards compatible with current standard SnPb low-temperature reflow processes as well as higher temperature (260°C reflow) "Pb Free" processes.

## Ordering Information

### Part Number for Ordering

XP1043-QH-0G00  
XP1043-QH-0G0T  
XP1043-QH-EV1

### Description

Matte Tin plated RoHS compliant 4x4 24L QFN surface mount package in bulk quantity  
Matte Tin plated RoHS compliant 4x4 24L QFN surface mount package in tape and reel  
XP1043-QH evaluation board



Proper ESD procedures should be followed when handling this device.

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