FAIRCHILD
SEMICONDUCTOR®

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RMPA2271
WCDMA/UMTS Power Edge™ Power Amplifier Module with Integrated Power Detector

Features

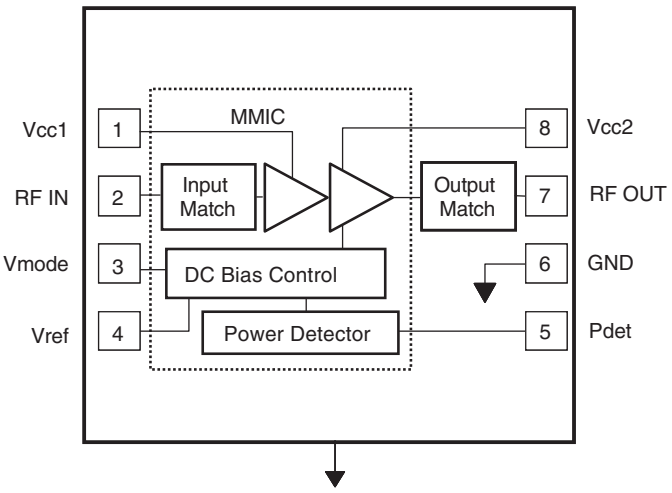
- Temperature compensated, integrated power detector with >20dB dynamic range
- 41% WCDMA efficiency at +28dBm average output power 1920–1980MHz
- Meets UMTS/WCDMA and HSDPA performance requirements
- Compact Lead-free compliant LCC package– (3.0 x 3.0 x 1.0 mm nominal)
- Single positive-supply operation and low power and shutdown modes
- Low Vref (2.85V) compatible with advanced handset chipsets
- Internally matched to 50Ω and DC blocked RF input/output

General Description

The RMPA2271 Power Amplifier Module (PAM) is Fairchild's latest innovation in 50Ω matched, surface mount modules targeting WCDMA/UMTS applications. Answering the call for integrated Power Detection, the RMPA2271 offers the ability to measure power output over a 20dB range. This feature eliminates the need of an external power detector and lossy directional coupler, improving system perfomance and reducing overall cost. Simple two-state Vmode control is all that is needed to change the PA optimization from high power to low power mode to minimize current usage. The 3 x 3 x 1.0mm LCC package fits into the tightest spaces available on handset boards and is footprint compatible with existing 3 x 3mm LCC power amplifiers. The multi-stage GaAs Microwave Monolithic Integrated Circuit (MMIC) is manufactured using Fairchild's InGaP Heterojunction Bipolar Transistor (HBT) process.

Device

Functional Block Diagram



Absolute Ratings [1]

Symbol	Parameter	Ratings	Units
V_{CC1}, V_{CC2}	Supply Voltages	5.0	V
V_{ref}	Reference Voltage	2.6 to 3.5	V
V_{mode}	Power Control Voltage	3.5	V
P_{IN}	RF Input Power	+10	dBm
T_{STG}	Storage Temperature	-55 to +150	°C

Note:

1. No permanent damage with only one parameter set at extreme limit. Other parameters set to typical values.

Electrical Characteristics (1920 to 1980 MHz)[1]

Symbol	Parameter	Min	Typ	Max	Units	Comments
f	Operating Frequency	1920		1980	MHz	
WCDMA Operation						
Gp	Power Gain		27		dB	Po = +28dBm, Vmode = 0V
			26		dB	Po = +16dBm, Vmode ≥ 2.0V
Po	Linear Output Power	28			dBm	Vmode = 0V
		16			dBm	Vmode ≥ 2.0V
PAEd	PAEd (digital) @ +28dBm		41		%	Vmode = 0V
	PAEd (digital) @ +16dBm		9		%	Vmode ≥ 2.0V
	PAEd (digital) @ +16dBm		25		%	Vmode ≥ 2.0V, Vcc = 1.4V
Itot	High Power Total Current		450		mA	Po = +28dBm, Vmode = 0V
	Low Power Total Current		130		mA	Po = +16dBm, Vmode ≥ 2.0V
P_{det}	Detector Output		1.4		V	Po = +28dBm, Vmode = 0V
			0.3		V	Po = +16dBm, Vmode ≥ 2.0V
	Adjacent Channel Leakage Ratio					WCDMA Modulation 3GPP 3.2 03-00 DPCCH+1 DCDCH
ACLR1	±5.00MHz Offset 1920–1980MHz		-40		dBc	Po = +28dBm, Vmode = 0V
			-42		dBc	Po = +16dBm, Vmode ≥ 2.0V
ACLR2	±10.00MHz Offset 1920–1980MHz		-54		dBc	Po = +28dBm, Vmode = 0V
			-66		dBc	Po = +16dBm, Vmode ≥ 2.0V
General Characteristics						
VSWR	Input Impedance		2.0:1			
NF	Noise Figure		4		dB	
Rx No	Receive Band Noise Power		-142		dBm/Hz	Po ≤ +28dBm, 2110 to 2170MHz
2fo – 5fo	Harmonic Suppression[3]			-50	dBc	Po ≤ +28dBm
S	Spurious Outputs[2, 3]			-60	dBc	Load VSWR ≤ 5.0:1
	Ruggedness with Load Mismatch[3]			10:1		No permanent damage
Tc	Case Operating Temperature	-30		85	°C	
DC Characteristics						
Iccq	Quiescent Current		50		mA	Vmode ≥ 2.0V
Iref	Reference Current		7		mA	Po ≤ +28dBm
Icc(off)	Shutdown Leakage Current		1	5	µA	No applied RF signal

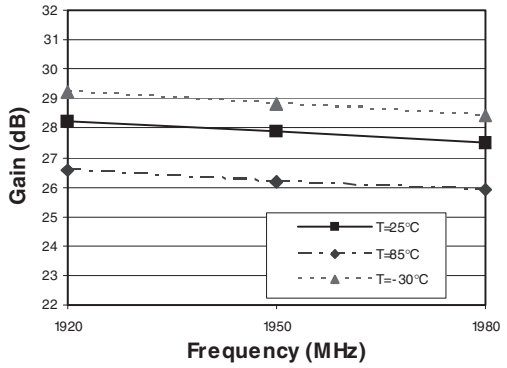
Notes:

1. All parameters met at T_C = +25°C, V_{CC} = +3.4V, V_{ref} = 2.85V and load VSWR ≤ 1.2:1, unless otherwise noted.

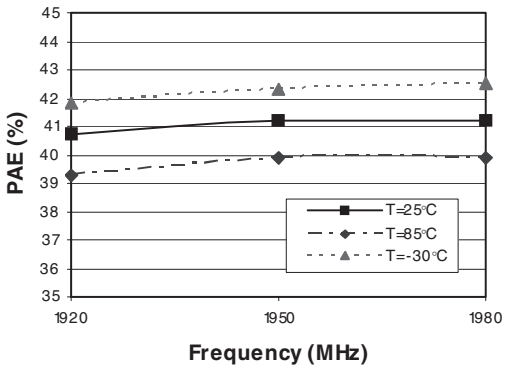
Typical Characteristics

Frequency and Temperature dependency

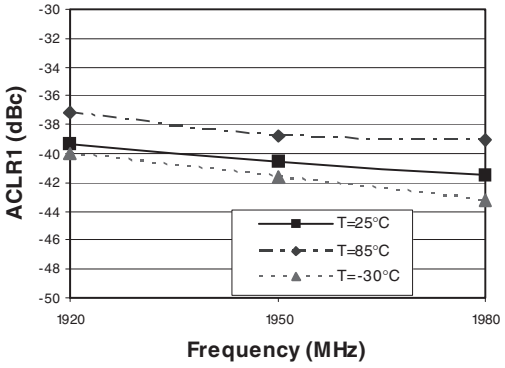
RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vref=2.85V, Vmode=0V, Pout=28dBm



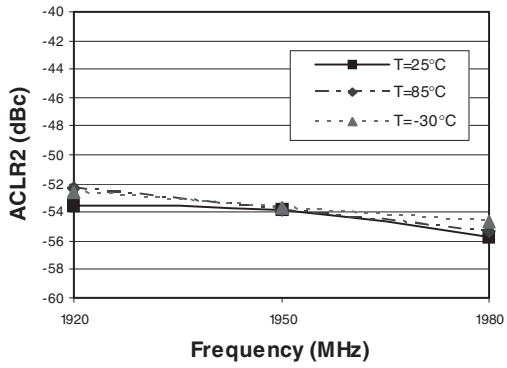
RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vref=2.85V, Vmode=0V, Pout=28dBm



RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vref=2.85V, Vmode=0V, Pout=28dBm

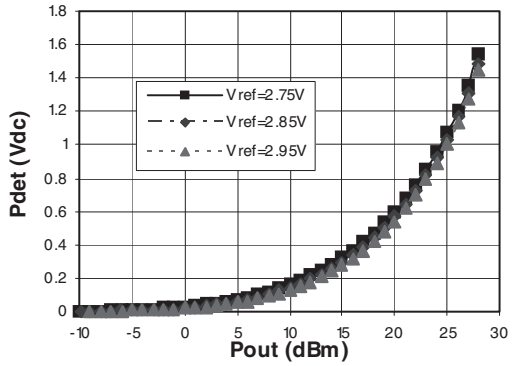


RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vref=2.85V, Vmode=0V, Pout=28dBm

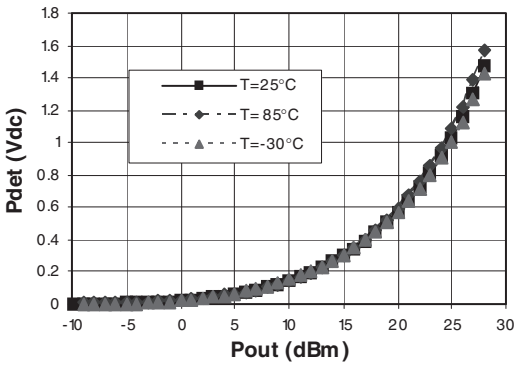


Power Detector dependency

RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vmode=0V, Freq=1950MHz, Temp=25°C

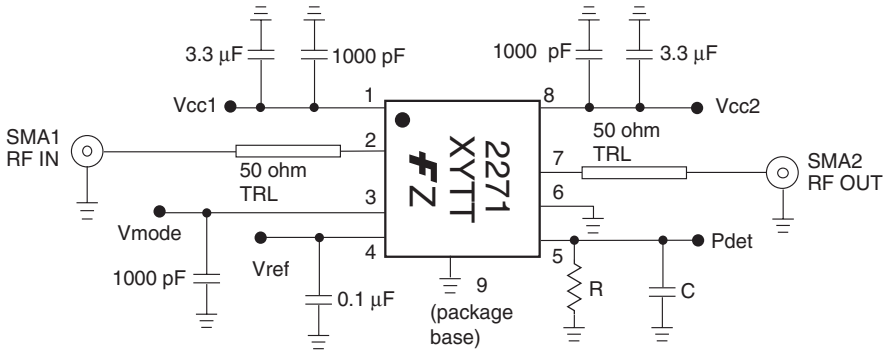


RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vmode=0V, Freq=1950MHz, Vref=2.85V



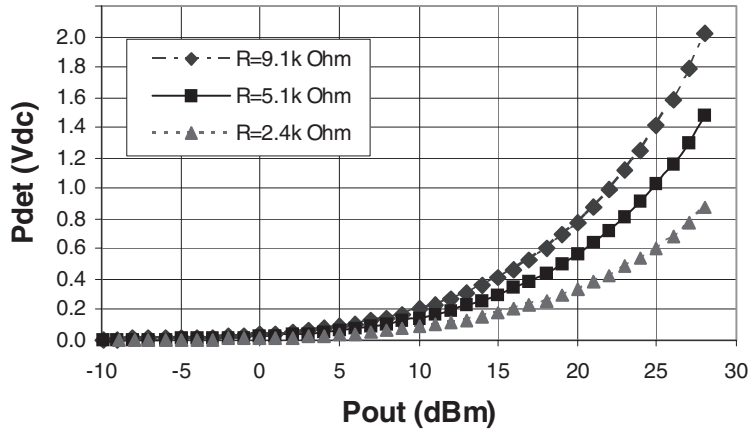
Application Note

Due to the varying amplitude envelope of WCDMA signal, a filter is required at the Pdet pin in order to minimize the ripple noise of the detector output voltage (Pdet). RMPA2271 has no integrated filter for the Pdet pin. Therefore, an external low-pass filter, comprising a shunt resistor (R) and a shunt capacitor (C), is required to detect the WCDMA signal properly. The filter bandwidth is determined by the RC time constant of the filter, and can be reduced by increasing the values of the resistor and/or capacitor. A narrower filter bandwidth has the advantage of lower voltage ripple noise, but it comes at the expense of increased response time. A tradeoff needs to be made between the ripple noise and response time for the optimal system performance.



The detector output voltage (Pdet) range can be adjusted by the value of the external shunt resistor (R). The following figure shows the dependence of Pdet voltage as a function of R. The maximum Pdet voltage can be increased by raising the value of R. This provides the added flexibility to handset designers to change the detector range to meet the system requirements.

RMPA2271 3x3 WCDMA PAM with Power Detector
Vcc=3.4V, Vref=2.85V, Vmode=0V, Freq=1950MHz, Temp=25°C



It is recommended that the value of the resistor R is first determined depending on the desired detector output voltage range. Then the value of the shunt capacitor C is selected for the required detector output voltage ripple level, and response time.

Efficiency Improvement Applications

In addition to high-power/low-power bias modes, the efficiency of the PA module can be significantly increased at backed-off RF power levels by dynamically varying the supply voltage (Vcc) applied to the amplifier. Since mobile handsets and power amplifiers frequently operate at 10-20 dB back-off, or more, from maximum rated linear power, battery life is highly dependent on the DC power consumed at antenna power levels in the range of 0 to +16dBm. The reduced demand on transmitted RF power allows the PA supply voltage to be reduced for improved efficiency, while still meeting linearity requirements for WCDMA modulation with excellent margin. High-efficiency DC-DC converters are now available to implement switched-voltage operation.

With the PA module in low-power mode (Vmode = +2.0V) at+16dBm output power and supply voltages reduced from 3.4V nominal down to 1.2V, power-added efficiency is more than doubled from 9.5 percent to nearly 25 percent (Vcc = 1.2V) while maintaining a typical ACLR1 of –40dBc and ACLR2 of less than –54dBc. Operation at even lower levels of Vcc supply voltage are possible with a further restriction on the maximum RF output power.

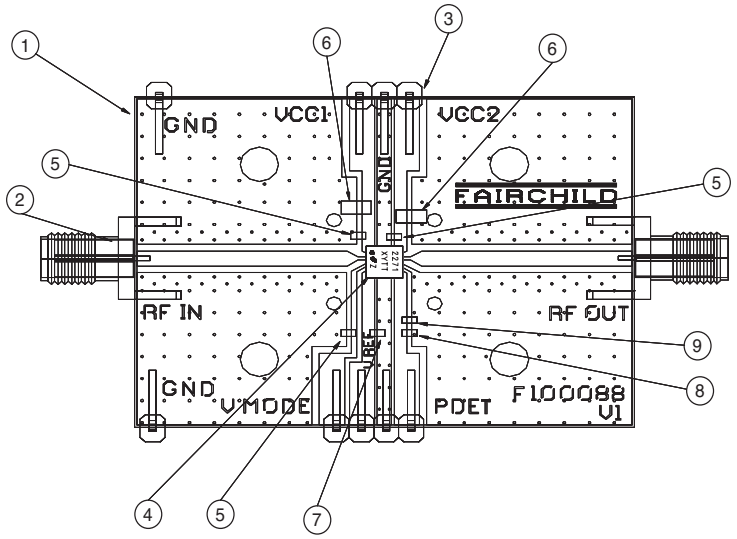
Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units
f	Operating Frequency	1920		1980	MHz
Vcc1, Vcc2	Supply Voltage	3.0	3.4	4.2	V
Vref	Reference Voltage (Operating) (Shutdown)	 2.7 0	 2.85	 3.1 0.5	 V V
Vmode	Bias Control Voltage (Low-Power) (High-Power)	 1.8 0	 2.0	 3.0 0.5	 V V
Pout	Linear Output Power (High-Power) (Low-Power)			 +28 +16	 dBm dBm
Tc	Case Operating Temperature	-30		+85	°C

DC Turn On Sequence:

1. Vcc1 = Vcc2 = 3.4V (typical)
2. Vref = 2.85V (typical)
3. High-Power: Vmode = 0V (Pout > 16dBm)
   Low-Power: Vmode = 2.0V (Pout < 16dBm)

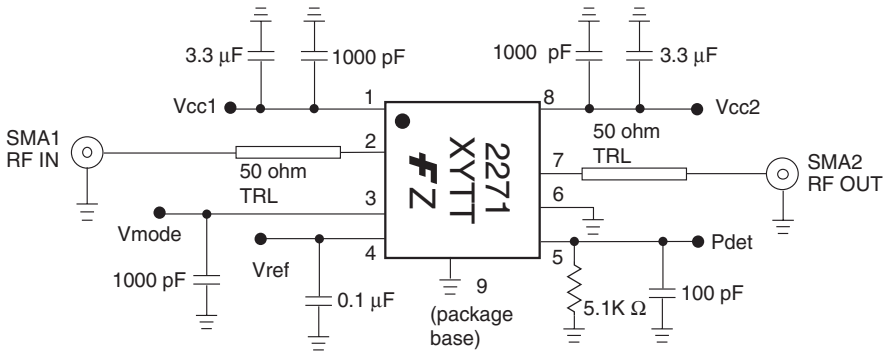
Evaluation Board Layout



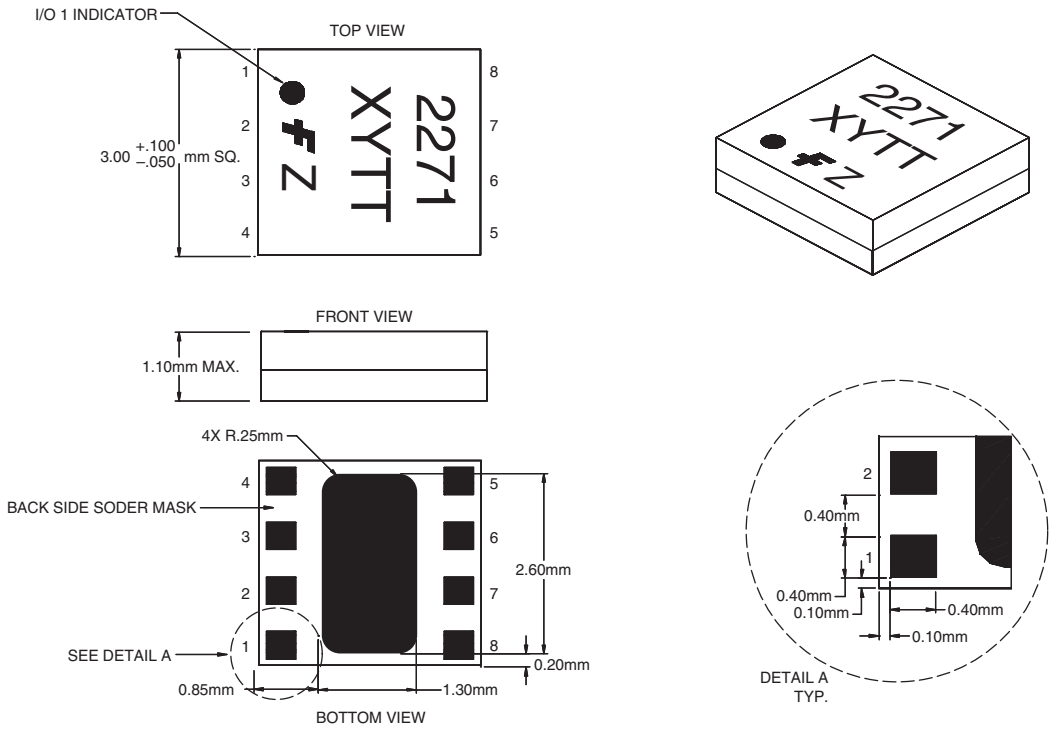
Material List

Qty	Item No.	Part Number	Description	Vendor
1	1	F100088	PC, Board	Fairchild
2	2	#142-0701-841	SMA Connector	Johnson
6	3	#S1322-XX-ND	RT Angle SGL M Header	Digikey
REF	4		Assembly, RMPA2271	Fairchild
3	5	GRM39X7R102K50V	1000 pF Capacitor (0603)	Murata
3	5 (ALT)	ECJ-1VB1H102K	1000 pF Capacitor (0603)	Panasonic
2	6	C3215X5R1A335M	3.3 µF Capacitor (1206)	TDK
1	7	GRM39Y5V104Z16V	0.1 µF Capacitor (0603)	Murata
1	7 (ALT)	ECJ-1VB1C104K	0.1 µF Capacitor (0603)	Panasonic
1	8	GRM1885C1H101JA01D	100 pF Capacitor (0603)	Murata
1	9	RCI-0603-5101J	5.1 KΩ Resistor (0603)	IMS
A/R	10	SN63	Solder Paste	Indium Corp.
A/R	11	SN96	Solder Paste	Indium Corp.

Evaluation Board Schematic



Package Outline



Signal Description

Pin #	Signal Name	Description
1	Vcc1	Supply Voltage to Input Stage
2	RF In	RF Input Signal
3	Vmode	High Power/Low Power Switch
4	Vref	Reference Voltage
5	P_{DET}	Power detector output voltage
6	GND	Ground
7	RF Out	RF Output Signal
8	Vcc2	Supply Voltage to Output Stage
9	GND	Ground

Applications Information

CAUTION: THIS IS AN ESD SENSITIVE DEVICE.

Precautions to Avoid Permanent Device Damage:

- Cleanliness: Observe proper handling procedures to ensure clean devices and PCBs. Devices should remain in their original packaging until component placement to ensure no contamination or damage to RF, DC and ground contact areas.
- Device Cleaning: Standard board cleaning techniques should not present device problems provided that the boards are properly dried to remove solvents or water residues.
- Static Sensitivity: Follow ESD precautions to protect against ESD damage:
  - A properly grounded static-dissipative surface on which to place devices.
  - Static-dissipative floor or mat.
  - A properly grounded conductive wrist strap for each person to wear while handling devices.
- General Handling: Handle the package on the top with a vacuum collet or along the edges with a sharp pair of bent tweezers. Avoiding damaging the RF, DC, and ground contacts on the package bottom. Do not apply excessive pressure to the top of the lid.
- Device Storage: Devices are supplied in heat-sealed, moisture-barrier bags. In this condition, devices are protected and require no special storage conditions. Once the sealed bag has been opened, devices should be stored in a dry nitrogen environment.

Device Usage:
Fairchild recommends the following procedures prior to assembly.

- Dry-bake devices at 125°C for 24 hours minimum. Note: The shipping trays cannot withstand 125°C baking temperature.
- Assemble the dry-baked devices within 7 days of removal from the oven.
- During the 7-day period, the devices must be stored in an environment of less than 60% relative humidity and a maximum temperature of 30°C
- If the 7-day period or the environmental conditions have been exceeded, then the dry-bake procedure must be repeated.

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FACT™	ImpliedDisconnect™	OCX™	RapidConfigure™	TruTranslation™
FACT Quiet Series™		OCXPro™	RapidConnect™	UHC™
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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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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