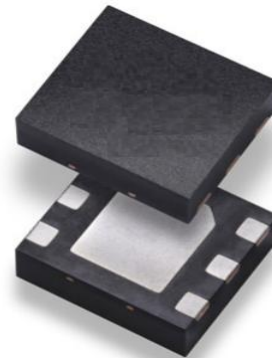
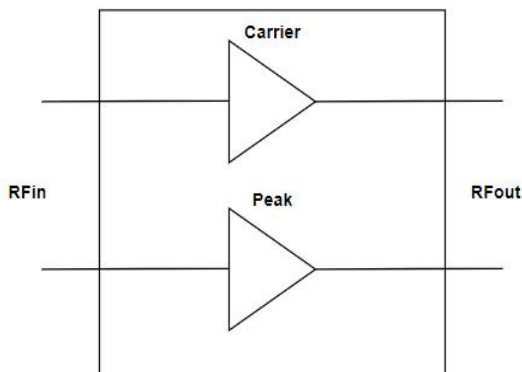


Description

This asymmetrical Doherty RF power GaN Transistor with saturation output power 56W is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 3400 to 3800 MHz.



Block Diagram



Features

- Operating Frequency Range: 3.4 to 3.8 GHz
- Operating Drain Voltage: +48 V
- Saturation Output Power: 56 W
- Advanced Linearity Performance
- High Efficiency
- High terminal impedance for optimal broadband performance
- High reliability
- Small footprint package, DFN 7x6.5

Applications

- 3GPP 5G NR FR1 and 4G/LTE band.
- Power Amplifier for micro base station.
- Driver Amplifier for macro base stations.
- Active antenna array for 5G mMIMO.
- Repeaters/DAS.
- Mobile Infrastructure.

Order Information

| Part Number | Description |
|--------------|--------------|
| HTH1D38P060P | Reel Package |

Typical Performances

| Freq(MHz) | P5dB(dBm) | Gain(dB) | Eff(%) | IRL(dB) |
|-----------|-----------|----------|--------|---------|
| 3400 | 47.6 | 15.3 | 51.4 | -11 |
| 3600 | 48.0 | 15.4 | 52.1 | -12 |
| 3800 | 47.6 | 14.2 | 53.5 | -10 |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, Pulsed CW, 100 us, Duty Cycle = 10%, Test on Holto EVB.

| Freq(MHz) | Gain(dB) | Eff(%) | ACPR 5MHz(dBc) | ACPR 10MHz(dBc) |
|-----------|----------|--------|----------------|-----------------|
| 3400 | 14.0 | 53.3 | -25.2 | -41.1 |
| 3600 | 14.5 | 52.0 | -28.6 | -44.1 |
| 3800 | 13.8 | 52.8 | -30.7 | -44.9 |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, single-carrier, 5MHz WCDMA signal with 9.9dB PAR @ 0.01% CCDF, Test on Holto EVB.

Absolute Maximum Ratings

| Parameter | Range/Value | Units |
|----------------------------|-------------|-------|
| Drain voltage (VDSS) | 0 to 150 | V |
| Gate voltage (VGS) | -10 to 2 | V |
| Storage Temperature (TSTG) | -65 to 150 | °C |
| Case Temperature (TC) | -40 to 150 | °C |
| Junction Temperature (TJ) | 275 | °C |

Electrical Specification

DC Characteristics

carrier

| Parameter | Conditions | Min | Typ | Max | Units |
|--|-----------------------|------|------|------|-------|
| Breakdown Voltage V(BR)DSS | VGS=-8V; IDS=3.3mA | 150 | - | - | V |
| Gate-Source threshold Voltage VGS(th) | VDS=10V; IDS=3.3mA | -3.6 | -2.8 | -2.0 | V |
| Drain leakage Current IDSS | VDS=50V; VGS=-8V | - | 0.15 | - | mA |
| Gate leakage Current IGSS | VDS=0V; VGS=-10V | - | 20 | - | uA |

Peak

| Parameter | Conditions | Min | Typ | Max | Units |
|--|-----------------------|------|------|------|-------|
| Breakdown Voltage V(BR)DSS | VGS=-8V; IDS=4.8mA | 150 | - | - | V |
| Gate-Source threshold Voltage VGS(th) | VDS=10V; IDS=4.8mA | -3.6 | -2.8 | -2.0 | V |
| Drain leakage Current IDSS | VDS=50V; VGS=-8V | - | 0.30 | - | mA |
| Gate leakage Current IGSS | VDS=0V; VGS=-10V | - | 40 | - | uA |

RF Characteristics (Pulsed CW)

| Parameter | Min | Typ | Max | Units |
|-----------------|------|------|------|-------|
| Frequency Range | 3.4 | - | 3.8 | GHz |
| P5dB | 47 | 47.5 | - | dBm |
| Gain | 13.0 | 13.5 | 14.5 | dB |
| Eff | 55 | 60 | - | % |
| IRL | -10 | -11 | - | dB |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, Pulsed CW, 100 us, Duty Cycle = 10%, Test on Holto Test Fixture with compensation.

RF Characteristics (WCDMA)

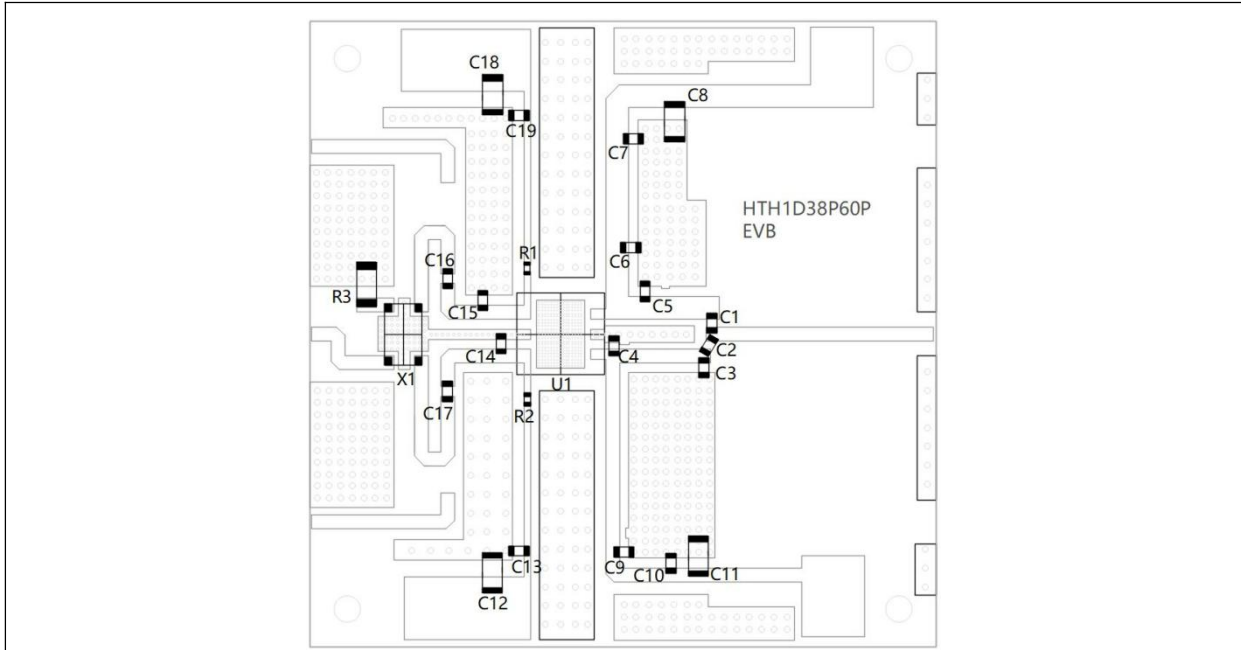
| Parameter | Min | Typ | Max | Units |
|-----------------|------|-------|-------|-------|
| Frequency Range | 3.4 | - | 3.8 | GHz |
| Gain | 13.0 | 13.5 | 14.5 | dB |
| Eff | 51 | 52 | - | % |
| IRL | -10 | -11 | - | dB |
| ACLR@5MHz | - | -31.0 | -29.0 | dBc |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, single-carrier, 5MHz WCDMA signal with 9.9dB PAR @ 0.01% CCDF, Test on Holto Test Fixture with compensation.

Thermal Information

| Parameter | Condition | Value (Typ) | Units |
|--------------------|---|-------------|-------|
| Thermal Resistance | Active die surface to Case (Rth) T-Case = 105°C, Pdis = 6.7W | 4.5 | K/W |

HTH1D38P060P 3.4-3.8 GHz Reference Design



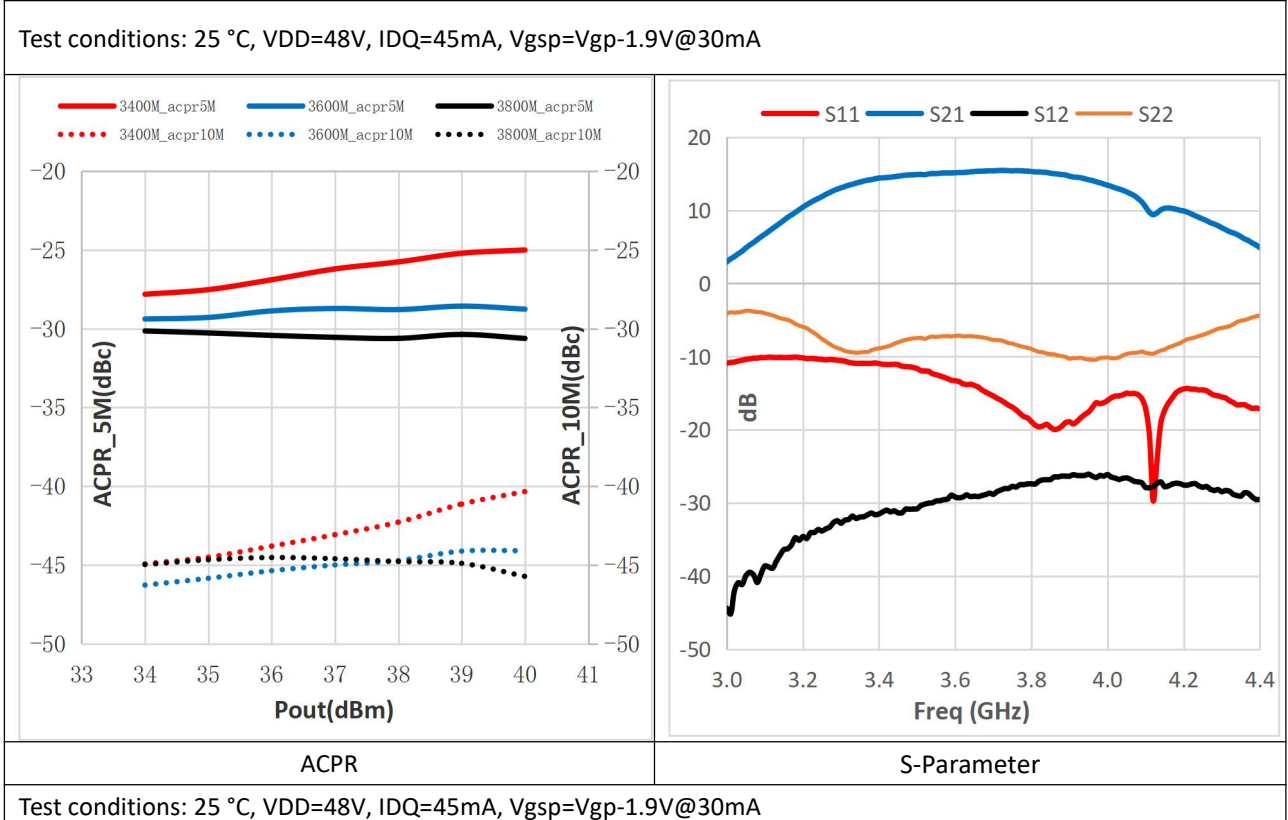
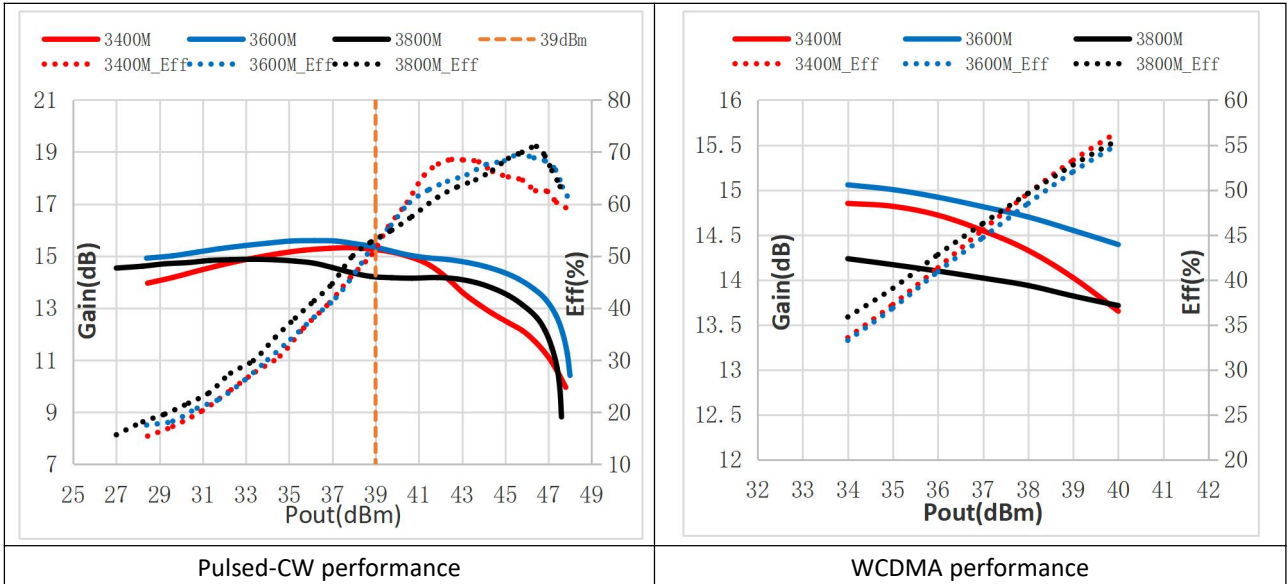
Rogers 4350B, thickness=20mil

PCB is soldered on a 47 mm by 47 mm copper base plate with 8 mm thickness

BOM-HTH1D38P060P 3.4 – 3.8 GHz Reference Design

| Component | Type | Value | Description | Manufacturer | P/N |
|-----------------------|------|-------|----------------|--------------|---------------------|
| C1 | 0603 | 0.9pF | MLCC | Murata | GQM1875G2ER90BB12D |
| C2 | 0603 | 2.7pF | MLCC | Murata | GQM1875G2E2R70BB12D |
| C3,C14 | 0603 | 0.4pF | MLCC | Murata | GQM1875G2ER40BB12D |
| C4 | 0603 | 1.6pF | MLCC | Murata | GQM1875G2E1R60BB12D |
| C5,C15 | 0603 | 0.7pF | MLCC | Murata | GQM1875G2ER70BB12D |
| C6,C9,C13,C16,C17,C19 | 0603 | 3.3pF | MLCC | Murata | GQM1875G2E3R30BB12D |
| C7,C10 | 0805 | 1uF | MLCC | Murata | |
| C8,C11,C12,C18 | 1210 | 10uF | MLCC | Murata | |
| R1,R2 | 0402 | 8.2 Ω | Resistor | / | |
| R3 | / | 50 Ω | Load | / | C16A50Z4 |
| X1 | / | 3dB | Hybrid Coupler | / | X3C35F103S |

Performance Plots



Typical Performances for 3.4-4.0GHz Broadband

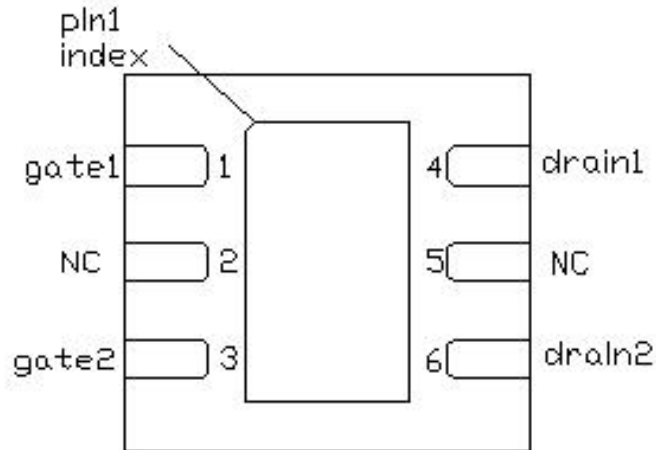
| Freq(MHz) | P5dB(dBm) | Gain(dB) | Eff(%) | IRL(dB) |
|-----------|-----------|----------|--------|---------|
| 3400 | 47.1 | 13.9 | 54.2 | -11 |
| 3600 | 48.1 | 14.2 | 61.8 | -12 |
| 3800 | 47.6 | 13.9 | 62.6 | -10 |
| 4000 | 47.2 | 12.4 | 57.7 | -9 |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, Pulsed CW, 100 us, Duty Cycle = 10%, Test on Holto EVB.

| Freq(MHz) | Gain(dB) | Eff(%) | ACPR 5MHz(dBc) | ACPR 10MHz(dBc) |
|-----------|----------|--------|----------------|-----------------|
| 3400 | 12.7 | 48.9 | -26.4 | -41.1 |
| 3600 | 12.9 | 48.0 | -30.1 | -43.6 |
| 3800 | 12.3 | 50.9 | -28.6 | -41.7 |
| 4000 | 10.7 | 48.5 | -30.6 | -40.4 |

Test conditions: 25 °C, VDD=48V, IDQ=45mA, Vgsp=Vgp-1.9V@30mA, Pout=39dBm, single-carrier, 5MHz WCDMA signal with 9.9dB PAR @ 0.01% CCDF, Test on Holto EVB.

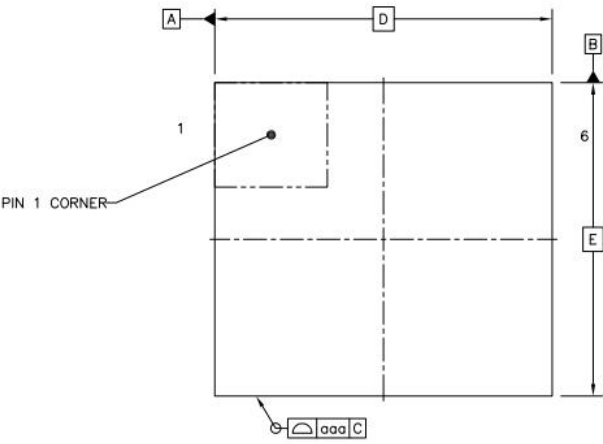
Pin Configuration and Description



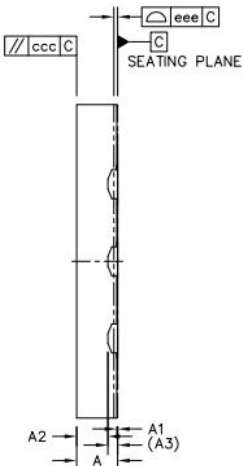
| Pin Configuration | | |
|-------------------|-----------------|---------------------------------|
| Pin Number | Label | Description |
| 1 | Gate1(carrier) | Gate-Source voltage of carrier |
| 2 | NC | NC |
| 3 | Gate2(peak) | Gate-Source voltage of peak |
| 4 | Drain1(carrier) | Drain-Source voltage of carrier |
| 5 | NC | NC |
| 6 | Drain2(peak) | Drain-Source voltage of peak |

Package Marking and Dimensions

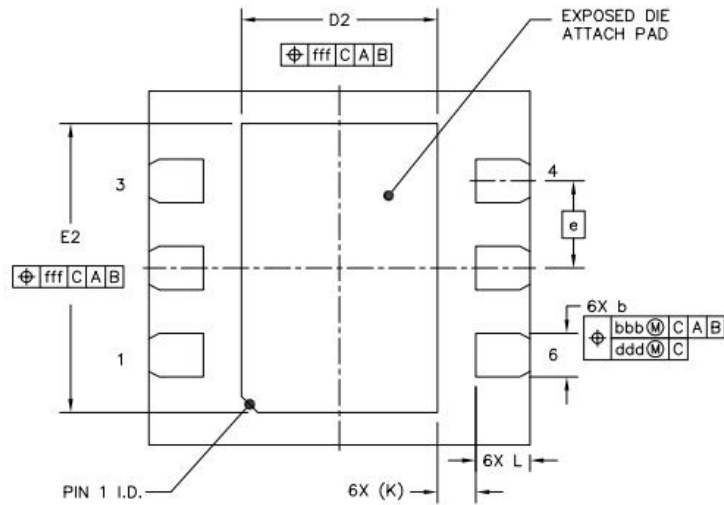
Marking



TOP VIEW



SIDE VIEW




BOTTOM VIEW

| | | SYMBOL | MIN | NOM | MAX |
|------------------------------|---|--------|-----------|------|------|
| TOTAL THICKNESS | | A | 0.8 | 0.85 | 0.9 |
| STAND OFF | | A1 | 0 | 0.02 | 0.05 |
| MOLD THICKNESS | | A2 | --- | 0.65 | --- |
| L/F THICKNESS | | A3 | 0.203 REF | | |
| LEAD WIDTH | | b | 0.75 | 0.8 | 0.85 |
| BODY SIZE | X | D | 7 BSC | | |
| | Y | E | 6.5 BSC | | |
| LEAD PITCH | | e | 1.6 BSC | | |
| EP SIZE | X | D2 | 3.5 | 3.6 | 3.7 |
| | Y | E2 | 5.21 | 5.31 | 5.41 |
| LEAD LENGTH | | L | 0.9 | 1 | 1.1 |
| LEAD TIP TO EXPOSED PAD EDGE | | K | 0.7 REF | | |
| PACKAGE EDGE TOLERANCE | | aaa | 0.1 | | |
| MOLD FLATNESS | | ccc | 0.1 | | |
| COPLANARITY | | eee | 0.08 | | |
| LEAD OFFSET | | bbb | 0.1 | | |
| | | ddd | 0.05 | | |
| EXPOSED PAD OFFSET | | fff | 0.1 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Package Dimensions

Handling Precautions

| Parameter | Rating | Standard | |
|----------------------------------|--------|---------------------------------|---|
| ESD – Human Body Model (HBM) | 1A | ANSI/ESDA/JEDEC Standard JS-001 |  |
| ESD – Charged Device Model (CDM) | C2A | ANSI/ESDA/JEDEC Standard JS-002 | |
| MSL – 260°C Convection Reflow | MSL3 | IPC/JEDEC Standard J-STD-020 | |

RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.

Datasheet Status

| Document status | Product status | Definition |
|-----------------------|-------------------|--|
| Objective datasheet | Design simulation | Product objective specification |
| Preliminary datasheet | Customer sample | Engineering samples and first test results |
| Product datasheet | Mass production | Final product specification |

Revision history

| Document ID | Datasheet status | Release date | Version revision record |
|--------------|---------------------|--------------|---|
| HTH1D38P060P | Preliminary Rev.0.1 | 2022-12-01 | Initial Version |
| HTH1D38P060P | Preliminary Rev.0.3 | 2022-12-26 | Update Reference Design and Performance Plots |
| HTH1D38P060P | Product Rev.1.0 | 2023-04-13 | Update RF data and add package information |
| HTH1D38P060P | Product Rev.2.0 | 2024-03-08 | Change part number |

Abbreviations

| Acronym | Definition |
|---------|--|
| LDMOS | Laterally-diffused metal-oxide semiconductor |
| GaN | Gallium Nitride |
| CW | Continuous Waveform |
| VSWR | Voltage Standing Wave Ratio |

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations and information about HOTLO:

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