

## GENERAL DESCRIPTION

The LM393 consists of two independent voltage comparators. They were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent from the magnitude of the power supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

Available Package : SOP-8P

## FEATURES

- ◆ Wide Supply Voltage Range : 2 V to 36 V or  $\pm 1V$  to  $\pm 18V$
- ◆ Low Supply Current Drain independent from the Supply Voltage
- ◆ Low Input Biasing Current
- ◆ Low Input Offset Current
- ◆ Low Input Offset Voltage
- ◆ Input Common-mode Voltage Range includes GND
- ◆ Differential Input Voltage Range Equal to the Power Supply Voltage
- ◆ Low Output Saturation Voltage
- ◆ Output Voltage Compatible with TTL, MOS and CMOS Logic.
- ◆ Temperature Range: -40°C to 125°C

## APPLICATIONS

- ◆ A/D converters
- ◆ Wide range VCO
- ◆ Clock generator
- ◆ High voltage logic gate
- ◆ Multi vibrators

## ORDERING INFORMATION

| ORDER NUMBER | Marking ID        | Package | Description  |
|--------------|-------------------|---------|--|
| PJ76393P_R2  | PJ76393<br>PYMDNN | SOP-8P  | Halogen free RoHS compliant in T/R, 3,000 pcs/Reel |

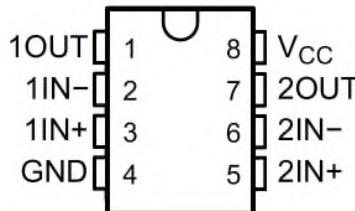
### Note 1

1. Panjit can meet RoHS 2.0/REACH requirement. So most package types Panjit offers only states halogen free, instead of lead free.

## MARKING INFORMATION

| Marking ID        | Package | Definition   |
|-------------------|---------|--|
| PJ76393<br>PYMDNN | SOP-8P  | PJ76393: Product code<br>P: Package code Y: Year code M: Month code D: Day code NN: Serial No. |

## PIN CONFIGURATION



SOP-8P (TOP VIEW)

## FUNCTIONAL PIN DESCRIPTION

| TERMINAL |      | DESCRIPTION                             |
|----------|------|---|
| NUMBER   | NAME |   |
| 1        | 1OUT | Output pin of comparator 1              |
| 2        | 1IN- | Inverting Input Pin of comparator 1     |
| 3        | 1IN+ | Non-Inverting Input Pin of comparator 1 |
| 4        | GND  | Ground Pin                              |
| 5        | 2IN+ | Non-Inverting Input Pin of comparator 2 |
| 6        | 2IN- | Inverting Input Pin of comparator 2     |
| 7        | 2OUT | Output Pin of comparator 2              |
| 8        | VCC  | IC Power Supply                         |

## ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

| PARAMETER                                |                     | MIN  | MAX | Unit |
|--|---------------------|------|-----|------|
| Supply Voltage                           | V <sub>CC</sub>     | -0.3 | 36  | V    |
|  |                     | -18  | 18  | V    |
| Differential Input Voltage               | V <sub>IND</sub>    | -36  | 36  | V    |
| Input Voltage                            | V <sub>IN</sub>     | -0.3 | 36  | V    |
|  |                     | -18  | 18  | V    |
| Input Current (V <sub>IN</sub> < -0.3 V) | I <sub>IO</sub>     |      | 50  | mA   |
| Operating junction temperature range     | T <sub>J</sub>      | -40  | 125 | °C   |
| Maximum Junction Temperature             | T <sub>J(MAX)</sub> |      | 150 | °C   |
| Storage temperature range                | T <sub>STG</sub>    | -65  | 150 | °C   |

(1) Stresses beyond those listed under **absolute maximum ratings** may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under **recommended operating conditions** is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER       |                               | MIN | TYP | MAX | UNIT |
|-----------------|-------------------------------|-----|-----|-----|------|
| V <sub>CC</sub> | Supply Voltage                | 2   |     | 32  | V    |
| T <sub>A</sub>  | Operating Ambient temperature | -40 |     | 85  | °C   |

## ELECTRICAL CHARACTERISTICS

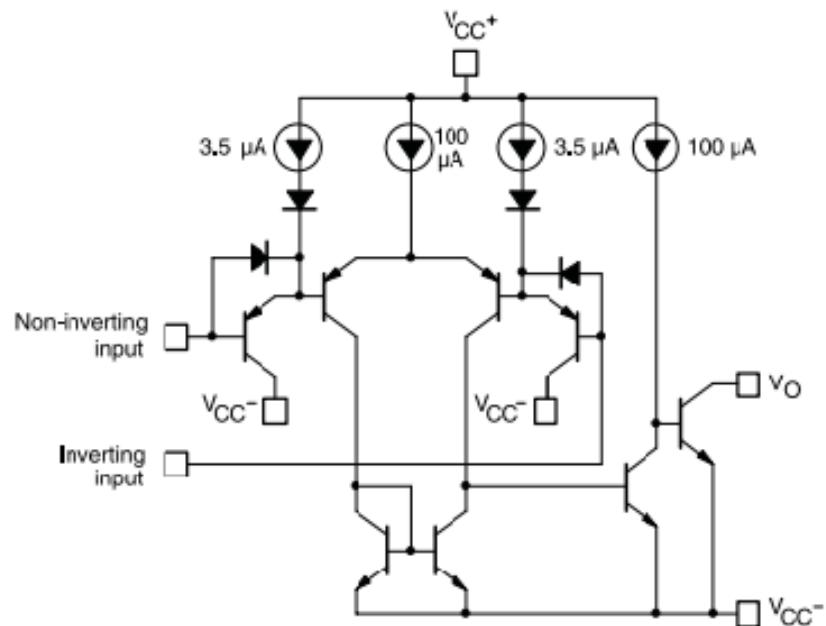
Test Condition :  $V_{CC} = 5.0V$ , unless otherwise specified, all limits are 100% test at  $T_A=25^\circ C$ . <sup>(1)</sup>

| PARAMETER |   | TEST CONDITIONS   | MIN | TYP | MAX          | UNIT |
|-----------|---|---|-----|-----|--------------|------|
| $V_{IO}$  | Input Offset Voltage                            | $V_{CC} = 5 V$ to $30 V$ , $V_{IC} = V_{ICRMIN}$ ,<br>$V_O = 1.4 V$ , $T_A = 25^\circ C$                                |     | 2   | 5            | mV   |
|           |   | $V_{CC} = 5 V$ to $30 V$ , $V_{IC} = V_{ICRMIN}$ ,<br>$V_O = 1.4 V$ , $T_A = -40$ to $125^\circ C$                      |     |     | 9            | mV   |
| $I_{IO}$  | Input Offset Current                            | $V_O = 1.4 V$ , $T_A = 25^\circ C$  |     | 5   | 50           | nA   |
|           |   | $V_O = 1.4 V$ , $T_A = -40$ to $125^\circ C$  |     |     | 150          | nA   |
| $I_{IB}$  | Input Bias Current                              | $V_O = 1.4 V$ , $T_A = 25^\circ C$  |     | -25 | -250         | nA   |
|           |   | $V_O = 1.4 V$ , $T_A = -40$ to $125^\circ C$  |     |     | -400         | nA   |
| $V_{ICR}$ | Common-mode Input Voltage Range <sup>(1)</sup>  | $T_A = 25^\circ C$  | 0   |     | $V_{CC}-1.5$ | V    |
|           |   | $T_A = -40$ to $125^\circ C$  | 0   |     | $V_{CC}-2.0$ | V    |
| $A_{VD}$  | Large-signal Differential Voltage Amplification | $V_{CC} = 15 V$ , $V_O = 1.4 V$ to $11.4 V$ ,<br>$R_L = 15 k\Omega$ to $V_{CC}$   | 50  | 200 |              | V/mV |
| $V_{OL}$  | Low-Level Output Voltage                        | $I_{OL} = 4 mA$ , $V_{ID} = -1 V$ , $T_A = 25^\circ C$  |     | 150 | 400          | mV   |
|           |   | $I_{OL} = 4 mA$ , $V_{ID} = -1 V$ ,<br>$T_A = -40$ to $125^\circ C$   |     |     | 700          | mV   |
| $I_{OH}$  | High-Level Output Current                       | $V_{OH} = 5 V$ , $V_{ID} = 1 V$ , $T_A = 25^\circ C$  |     | 0.1 | 50           | nA   |
|           |   | $V_{OH} = 30 V$ , $V_{ID} = 1 V$ ,<br>$T_A = -40$ to $125^\circ C$  |     |     | 1            | uA   |
| $I_{OL}$  | Low-Level Output Current                        | $V_{OL} = 1.5 V$ , $V_{ID} = -1 V$  | 6   |     |              | mA   |
| $I_{CC}$  | Supply Current                                  | $R_L = \infty$ , $V_{CC} = 5 V$ , $T_A = 25^\circ C$  |     | 0.8 | 1            | mA   |
|           |   | $R_L = \infty$ , $V_{CC} = 30 V$ ,<br>$T_A = -40$ to $125^\circ C$  |     |     | 2.5          | mA   |
| $t_{RES}$ | Response Time                                   | $R_L$ connected to $5 V$ through<br>$5.1 k\Omega$ , $C_L = 15 pF^{(2)}$ , $100 mV$ input<br>step with $5 mV$ over-drive |     |     | 1.3          | uS   |
|           |   | $R_L$ connected to $5 V$ through<br>$5.1 k\Omega$ , $C_L = 15 pF^{(2)}$ , TTL-level<br>input step                       |     |     | 0.3          | uS   |

(1) The voltage at either input or common-mode should not be allowed to go negative by more than  $0.3V$ . The upper end of the common-mode voltage range is  $V_{CC}-1.5V$ , but either or both inputs can go to  $30V$  without damage.

(2) The response time specified is the interval between the input step function and the instant, when the output crosses  $1.4 V$ .  $C_L$  includes probe and jig capacitance.

## SCHEMATIC DIAGRAM



## TYPICAL PERFORMANCE CHARACTERISTICS

Figure 3: Supply current vs. supply voltage

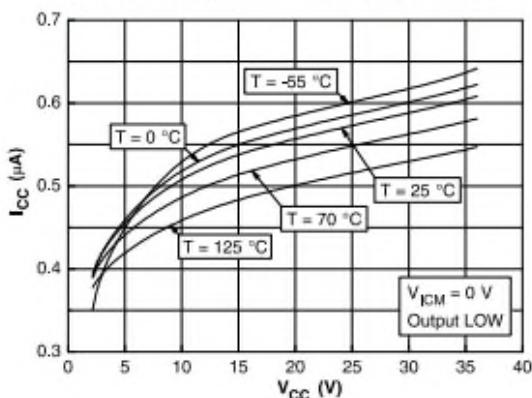


Figure 4: Input current vs. supply voltage

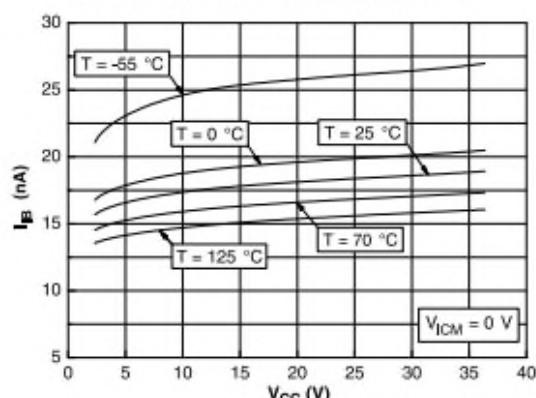


Figure 5: Output saturation voltage vs. output current

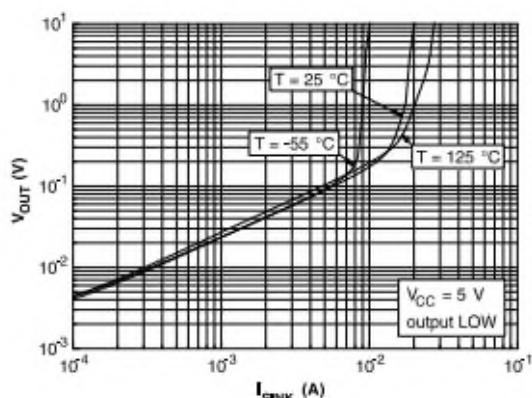


Figure 6: Response time for various input overdrives - negative transition

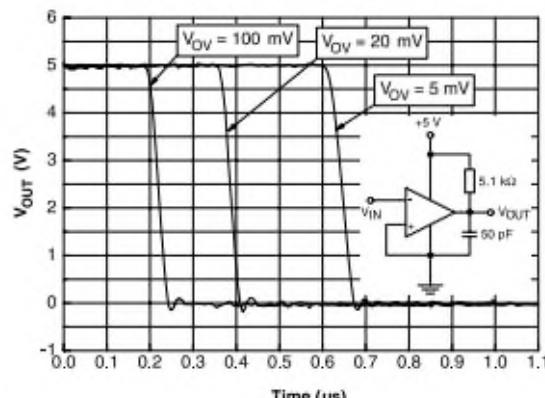
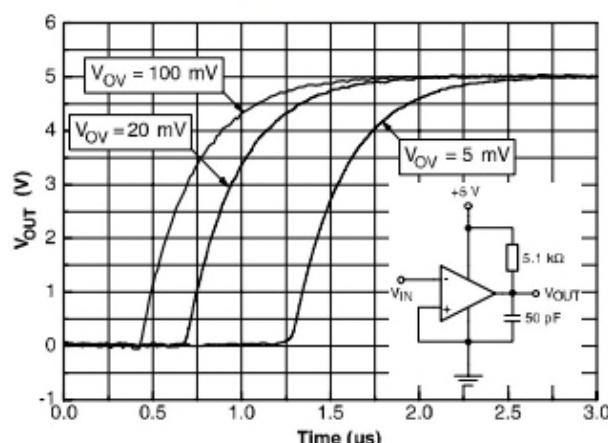


Figure 7: Response time for various input overdrives - positive transition



## TYPICAL PERFORMANCE CHARACTERISTICS

Figure 8: Basic comparator

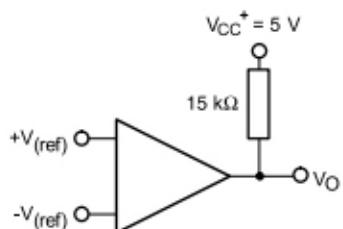


Figure 9: Driving TTL

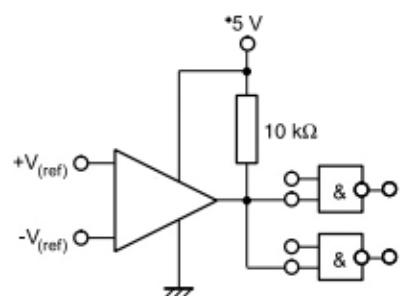


Figure 10: Low-frequency op amp (1)

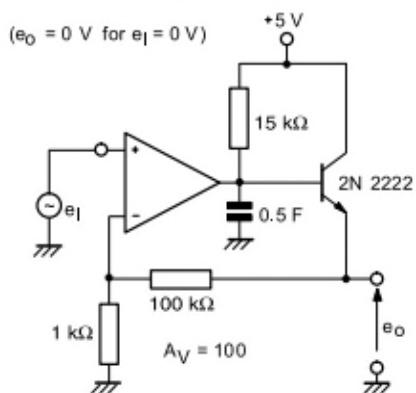


Figure 11: Driving CMOS

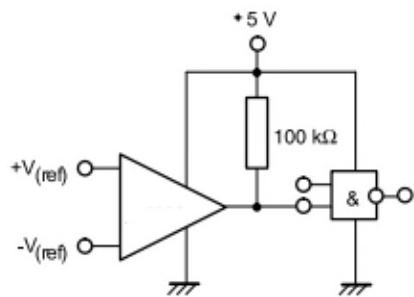


Figure 12: Low-frequency op amp (2)

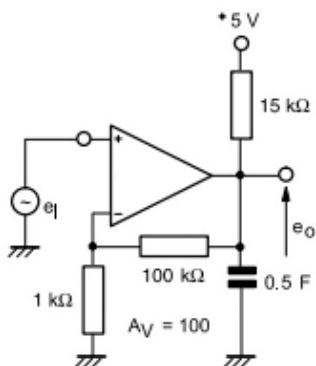


Figure 13: Transducer amplifier

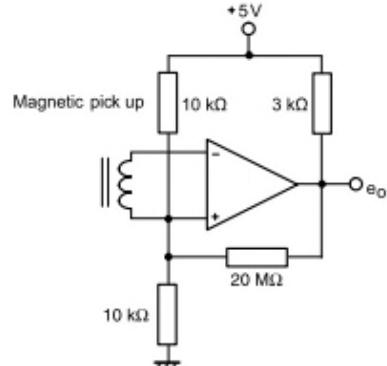


Figure 14: Low-frequency op amp with offset adjust

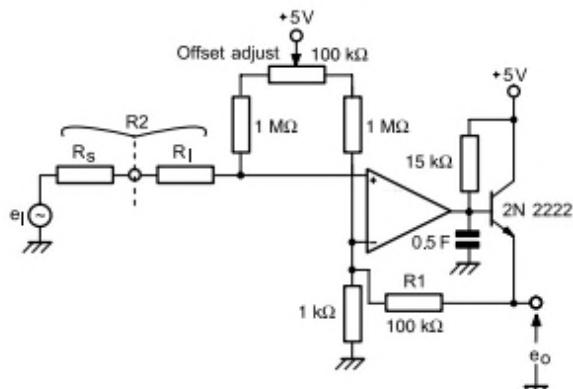


Figure 15: Zero crossing detector (single power supply)

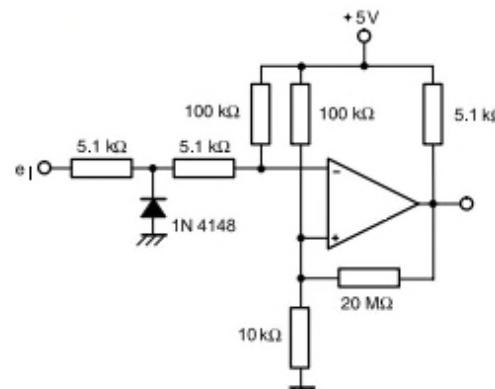


Figure 16: Limit comparator

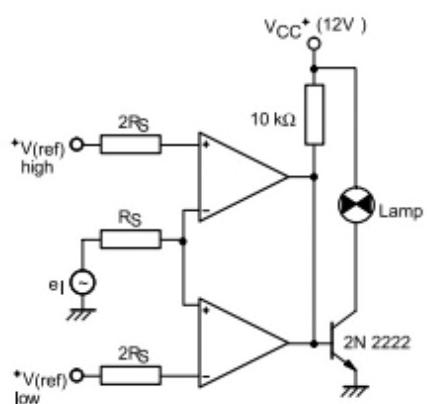


Figure 17: Crystal controlled comparator

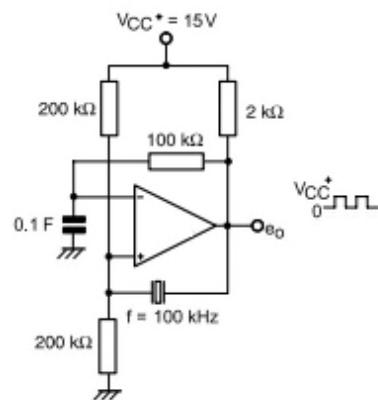


Figure 18: Split supply applications  
(zero crossing detector)

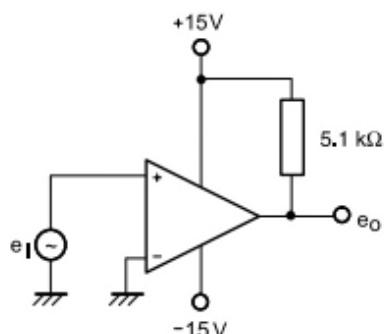
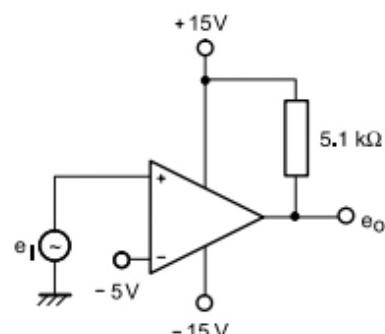
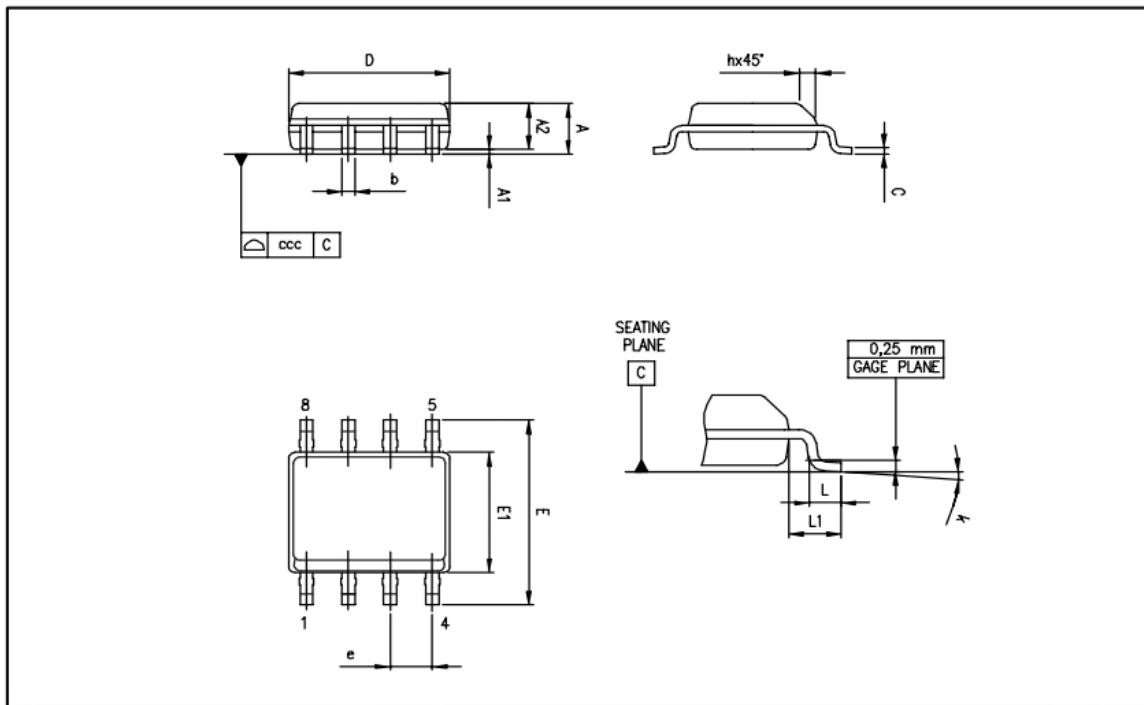


Figure 19: Comparator with a negative reference



**PACKAGE OUTLINE DIMENSION (SOP-8P)**

**SOP-8P Unit (mm)**



| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max   |
| A    |             |      | 1.75 |        |       | 0.069 |
| A1   | 0.10        |      | 0.25 | 0.004  |       | 0.010 |
| A2   | 1.25        |      |      | 0.049  |       |       |
| b    | 0.28        |      | 0.48 | 0.011  |       | 0.019 |
| c    | 0.17        |      | 0.23 | 0.007  |       | 0.010 |
| D    | 4.80        | 4.90 | 5.00 | 0.189  | 0.193 | 0.197 |
| E    | 5.80        | 6.00 | 6.20 | 0.228  | 0.236 | 0.244 |
| E1   | 3.80        | 3.90 | 4.00 | 0.150  | 0.154 | 0.157 |
| e    |             | 1.27 |      |        | 0.050 |       |
| h    | 0.25        |      | 0.50 | 0.010  |       | 0.020 |
| L    | 0.40        |      | 1.27 | 0.016  |       | 0.050 |
| L1   |             | 1.04 |      |        | 0.040 |       |
| k    | 0°          |      | 8°   | 0°     |       | 8°    |
| ccc  |             |      | 0.10 |        |       | 0.004 |

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