

LP395 Ultra Reliable Power Transistor

Check for Samples: [LP395](#)

FEATURES

- Internal Thermal Limiting
- Internal Current and Power Limiting
- Specified 100 mA Output Current
- 0.5 μ A Typical Base Current
- Directly Interfaces with TTL or CMOS
- +36 Volts On Base Causes No Damage
- 2 μ s Switching Time

DESCRIPTION

The LP395 is a fast monolithic transistor with complete overload protection. This very high gain transistor has included on the chip, current limiting, power limiting, and thermal overload protection, making it difficult to destroy from almost any type of overload. Available in an epoxy TO-92 transistor package this device is specified to deliver 100 mA.

Thermal limiting at the chip level, a feature not available in discrete designs, provides comprehensive protection against overload. Excessive power dissipation or inadequate heat sinking causes the thermal limiting circuitry to turn off the device preventing excessive die temperature.

The LP395 offers a significant increase in reliability while simplifying protection circuitry. It is especially attractive as a small incandescent lamp or solenoid driver because of its low drive requirements and blowout-proof design.

Connection Diagram

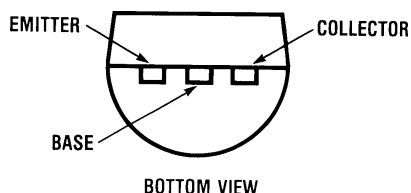


Figure 1. TO-92 Package
See NS Package LP0003A

The LP395 is easy to use and only a few precautions need be observed. Excessive collector to emitter voltage can destroy the LP395 as with any transistor. When the device is used as an emitter follower with a low source impedance, it is necessary to insert a 4.7 k Ω resistor in series with the base lead to prevent possible emitter follower oscillations. Also since it has good high frequency response, supply by-passing is recommended.

Areas where the LP395 differs from a standard NPN transistor are in saturation voltage, leakage (quiescent) current and in base current. Since the internal protection circuitry requires voltage and current to function, the minimum voltage across the device in the on condition (saturated) is typically 1.6 Volts, while in the off condition the quiescent (leakage) current is typically 200 μ A. Base current in this device flows out of the base lead, rather than into the base as is the case with conventional NPN transistors. Also the base can be driven positive up to 36 Volts without damage, but will draw current if driven negative more than 0.6 Volts. Additionally, if the base lead is left open, the LP395 will turn on.

The LP395 is a low-power version of the 1-Amp LM195/LM295/LM395 Ultra Reliable Power Transistor.

The LP395 is rated for operation over a -40°C to $+125^{\circ}\text{C}$ range.

Typical Applications

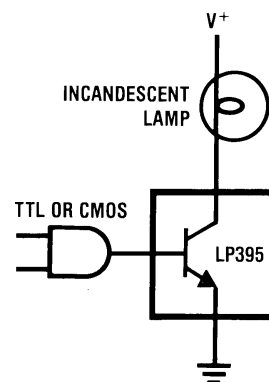


Figure 2. Fully Protected Lamp Driver



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Collector to Emitter Voltage	36V
Collector to Base Voltage	36V
Base to Emitter Voltage (Forward)	36V
Base to Emitter Voltage (Reverse)	10V
Base to Emitter Current (Reverse)	20 mA
Collector Current Limit	Internally Limited
Power Dissipation	Internally Limited
Operating Temperature Range	–40°C to +125°C
Storage Temperature Range	–65°C to +150°C
Lead Temp. (Soldering, 10 seconds)	260°C

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits.

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	Typical	Tested Limit ⁽¹⁾	Design Limit ⁽²⁾	Units (Limit)
V_{CE}	Collector to Emitter Operating Voltage	$0.5 \text{ mA} \leq I_C \leq 100 \text{ mA}$		36	36 ⁽³⁾	V(Max)
I_{CL}	Collector Current Limit ⁽⁴⁾	$V_{BE} = 2\text{V}, V_{CE} = 36\text{V}$	45	25	20	mA(Min)
		$V_{BE} = 2\text{V}, V_{CE} = 15\text{V}$	90	60	50	mA(Min)
		$V_{BE} = 2\text{V}, 2\text{V} \leq V_{CE} \leq 6\text{V}$	130	100	100	mA(Min)
I_B	Base Current	$0 \leq I_C \leq 100 \text{ mA}$	–0.3	–2.0	–2.5	$\mu\text{A}(\text{Max})$
I_Q	Quiescent Current	$V_{BE} = 0\text{V}, 0 \leq V_{CE} \leq 36\text{V}$	0.24	0.50	0.60	mA(Max)
$V_{CE(\text{SAT})}$	Saturation Voltage	$V_{BE} = 2\text{V}, I_C = 100 \text{ mA}$	1.82	2.00	2.10	V(Max)
BV_{BE}	Base to Emitter Break-down Voltage ⁽⁴⁾	$0 \leq V_{CE} \leq 36\text{V}, I_B = 2 \mu\text{A}$		36	36	V(Min)
V_{BE}	Base to Emitter Voltage ⁽⁵⁾	$I_C = 5 \text{ mA}$	0.69	0.79	0.90	V(Max)
		$I_C = 100 \text{ mA}$ ⁽⁴⁾	1.02		1.40	V (Max)
t_S	Switching Time	$V_{CE} = 20\text{V}, R_L = 200\Omega$ $V_{BE} = 0\text{V}, +2\text{V}, 0\text{V}$	2			μs
θ_{JA}	Thermal Resistance Junction to Ambient	0.4" leads soldered to printed circuit board	150		180	°C/W (Max)
		0.125" leads soldered to printed circuit board	130		160	°C/W (Max)

(1) Specified and 100% production tested.

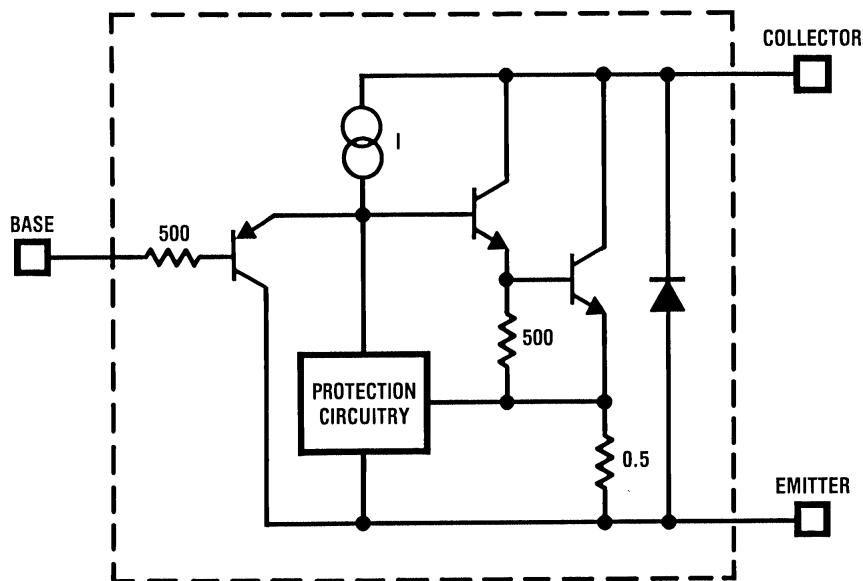
(2) Specified (but not 100% production tested) over the operating temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.

(3) Parameters identified with **boldface type** apply at temp. extremes. All other numbers, unless noted apply at +25°C.

(4) These numbers apply for pulse testing with a low duty cycle.

(5) Base positive with respect to emitter.

SIMPLIFIED CIRCUIT



APPLICATIONS INFORMATION

One failure mode incandescent lamps may experience is one in which the filament resistance drops to a very low value before it actually blows out. This is especially rough on most solid-state lamp drivers and in most cases a lamp failure of this type will also cause the lamp driver to fail. Because of its high gain and blowout-proof design, the LP395 is an ideal candidate for reliably driving small incandescent lamps. Additionally, the current limiting characteristics of the LP395 are advantageous as it serves to limit the cold filament inrush current, thus increasing lamp life.

TYPICAL PERFORMANCE CHARACTERISTICS

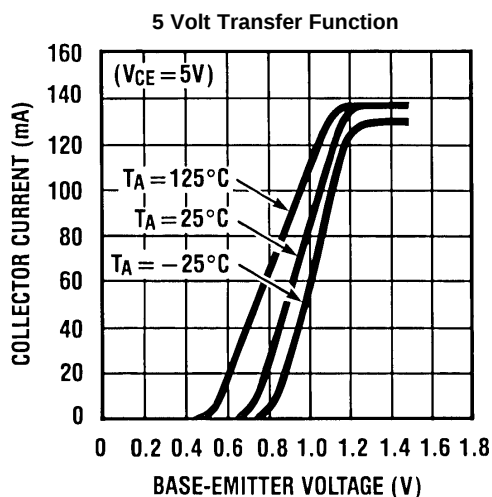


Figure 3.

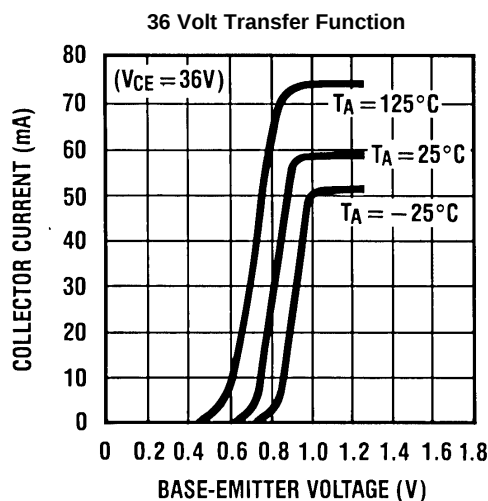


Figure 4.

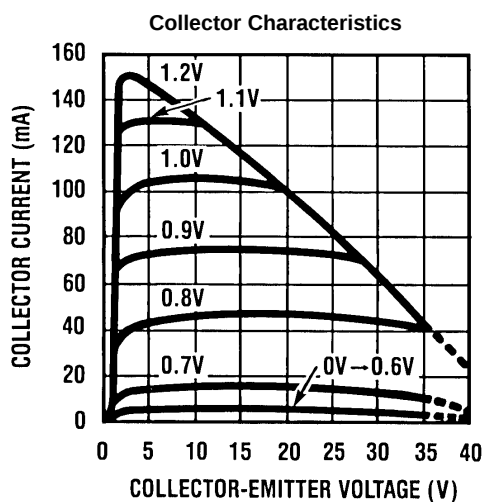


Figure 5.

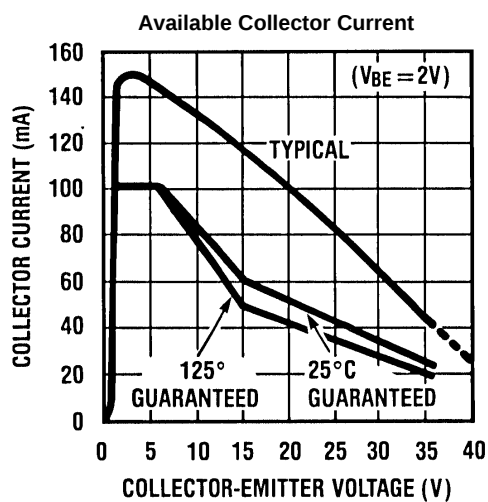


Figure 6.

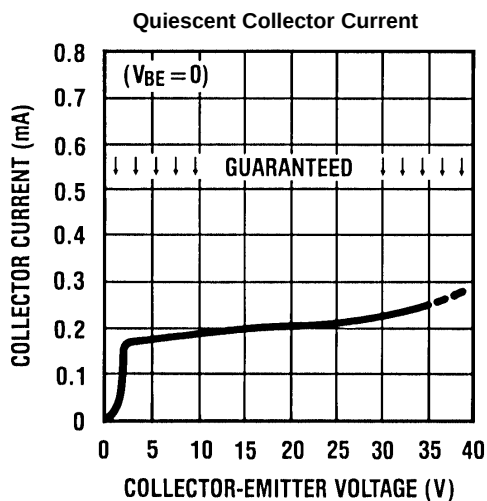


Figure 7.

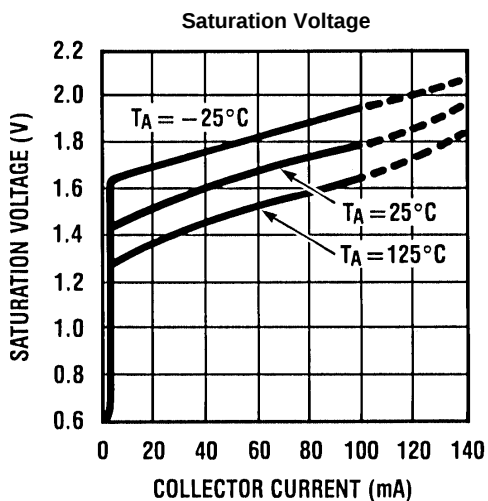
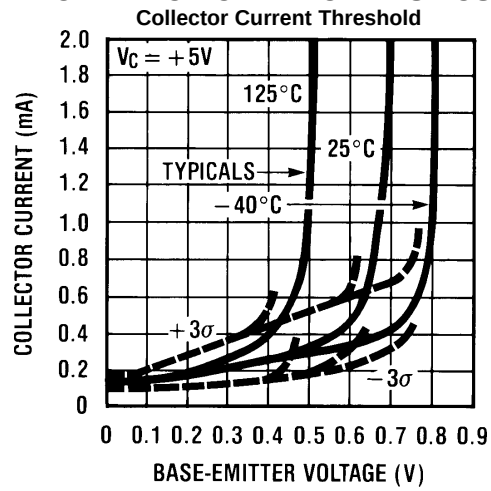
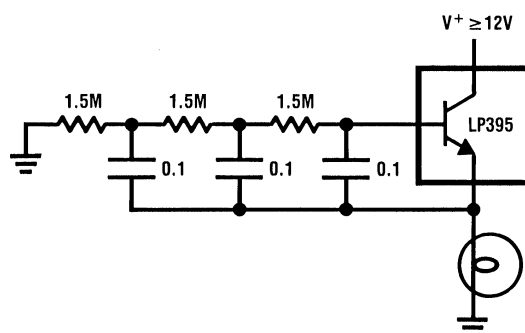


Figure 8.

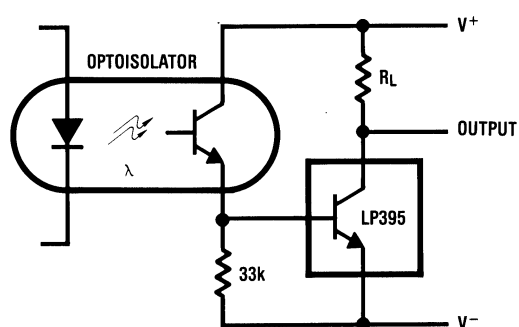
TYPICAL PERFORMANCE CHARACTERISTICS (continued)



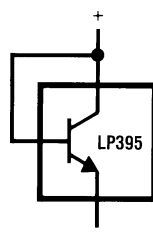
TYPICAL APPLICATIONS



**Figure 10. Lamp Flasher
(Short Circuit Proof)**



**Figure 11. Optically Isolated
Switch**



**Figure 12. Two Terminal
Current Limiter**

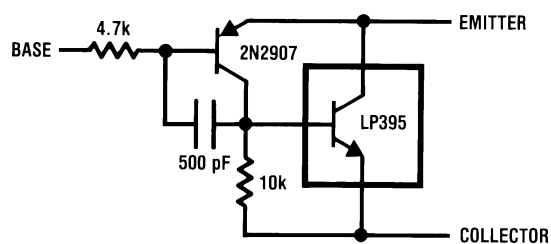


Figure 13. Composite PNP

REVISION HISTORY

Changes from Revision B (March 2013) to Revision C

Page

- Changed layout of National Data Sheet to TI format [6](#)

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LP395Z/LFT1	Active	Production	TO-92 (LP) 3	2000 LARGE T&R	Yes	SN	N/A for Pkg Type	-	LP 395Z
LP395Z/LFT1.B	Active	Production	TO-92 (LP) 3	2000 LARGE T&R	Yes	SN	N/A for Pkg Type	-40 to 125	LP 395Z
LP395Z/NOPB	Active	Production	TO-92 (LP) 3	1800 BULK	Yes	SN	N/A for Pkg Type	-40 to 125	LP 395Z
LP395Z/NOPB.B	Active	Production	TO-92 (LP) 3	1800 BULK	Yes	SN	N/A for Pkg Type	-40 to 125	LP 395Z

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TO-92 - 5.34 mm max height

Technical drawing of a connector assembly showing three views: a side view on the left, a top view in the center, and a partial side view on the right.

Side View (Left):

- Body width: $2 \times 4 \text{ MAX}$
- Pin width: $2 \times \frac{2.9}{2.4}$
- Seating Plane: Indicated by a horizontal line and arrow.

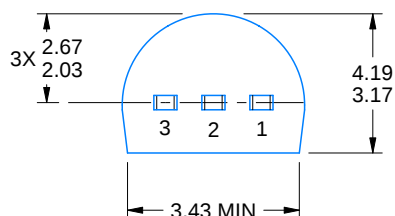
Top View (Center):

- Body width: $5.21 / 4.44$
- Body height: $5.34 / 4.32$
- Pin pitch: $(2.54) \text{ NOTE 3}$
- Pin width: $(1.5) \text{ TYP}$
- Pin thickness: $(0.51) \text{ TYP}$
- Pin length: $6 \times 0.076 \text{ MAX}$
- Pin length (overall): $3 \times 12.7 \text{ MIN}$
- Pin width (overall): $3 \times \frac{0.55}{0.38}$
- Pin spacing: $2 \times 1.27 \pm 0.13$
- Seating Plane: Indicated by a horizontal line and arrow.
- Ejector Pin: Indicated by a circular feature and arrow, labeled "EJECTOR PIN OPTIONAL".

Partial Side View (Right):

- Pin width: $3 \times \frac{0.43}{0.35}$

STRAIGHT LEAD OPTION



NOTES:

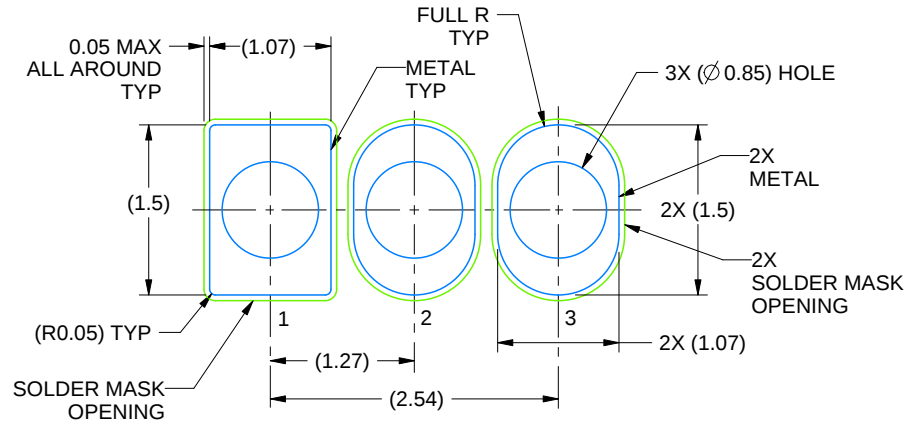
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
 - a. Straight lead option available in bulk pack only.
 - b. Formed lead option available in tape and reel or ammo pack.
 - c. Specific products can be offered in limited combinations of shipping medium and lead options.
 - d. Consult product folder for more information on available options.

EXAMPLE BOARD LAYOUT

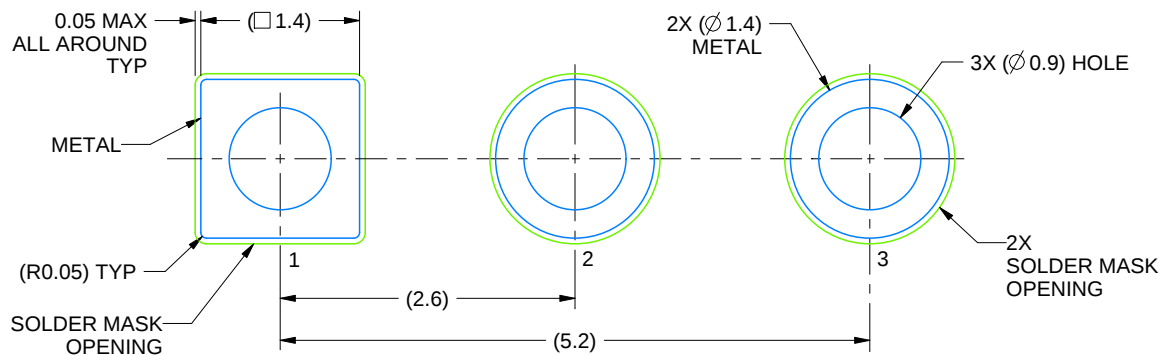
LP0003A

TO-92 - 5.34 mm max height

TO-92



LAND PATTERN EXAMPLE
STRAIGHT LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X



LAND PATTERN EXAMPLE
FORMED LEAD OPTION
NON-SOLDER MASK DEFINED
SCALE:15X

4215214/C 04/2025

TO-92

Technical drawing of a PCB layout for a 2x2 array of components. The drawing shows a top-down view of the board with dimensions in millimeters.

Overall dimensions: 32 (width) x 23 (height).

Component dimensions and spacing:

- Component width: 13.7 (top) / 11.7 (bottom)
- Component height: 16.5 (top) / 15.5 (bottom)
- Component pitch: 11.0 (top) / 8.5 (bottom)
- Component offset: 2.9 (left) / 2.4 (bottom) / 6.75 (right) / 5.95 (bottom)
- Component diameter: Ø 3.7-4.3 TYP

Board dimensions and spacing:

- Board width: 19.0 (top) / 17.5 (bottom)
- Board offset: 0.5 MIN (top) / 9.75 (right) / 8.50 (bottom)
- Board pitch: 13.0 (top) / 12.4 (bottom)

Note: (2.5) TYP indicates typical spacing between components.

FOR FORMED LEAD OPTION PACKAGE

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