

FEATURES

- Efficiency up to 82%
- 3kVDC Isolation 'Hi Pot Test'
- Wide temperature performance at full 1 Watt load, -40°C to 85°C
- Industry standard pinout
- Power sharing on output
- 3.3V, 5V & 12V Input
- 3.3V, 5V, 9V, 12V and 15V output
- Internal SMD construction
- No external components required
- MTTF up to 1.6 Million hours
- No electrolytic or tantalum capacitors
- Pin compatible with NMA & MEA1 series

DESCRIPTION

The NKA sub-miniature series of industrial temperature range DC-DC converters are the standard building blocks for on-board distributed power systems. The series offers smaller package size, improved efficiency, lower output ripple and 3kVDC isolation capability through the use of state of the art packaging and technology. Ideally suited for providing dual rail supplies on primarily digital boards with the added benefit of galvanic isolation to reduce switching noise. All of the rated power may be drawn from a single pin provided the total load does not exceed 1 watt.



For full details go to www.murata-ps.com/rohs

SELECTION GUIDE

| Order Code | Nominal Input Voltage | Output Voltage | Output Current | Input Current at Rated Load | Efficiency | Isolation Capacitance | MTTF ¹ | Package Style | |
|---|-----------------------|----------------|----------------|-----------------------------|------------|-----------------------|-------------------|---------------|-------------------------|
| | V | V | mA | | % | pF | kHrs | | |
| Recommended In Production | | | | | | | | | |
| NKA0303SC | 3.3 | ±3.3 | ±152 | 407 | 74 | 20 | 195 | SIP | |
| NKA0305SC | 3.3 | ±5 | ±100 | 383 | 79 | 22 | 1121 | SIP | |
| NKA0312SC | 3.3 | ±12 | ±42 | 390 | 78 | 31 | 375 | SIP | |
| NKA0312DC | 3.3 | ±12 | ±42 | 390 | 78 | 31 | 375 | DIP | |
| NKA0315SC | 3.3 | ±15 | ±33 | 384 | 79 | 32 | 206 | SIP | |
| NKA0503SC | 5 | ±3.3 | ±152 | 259 | 77 | 22 | 205 | SIP | |
| NKA0505SC | 5 | ±5 | ±100 | 285 | 70 | 21 | 1697 | SIP | |
| NKA0509SC | 5 | ±9 | ±56 | 263 | 76 | 25 | 682 | SIP | |
| NKA0512SC | 5 | ±12 | ±42 | 255 | 78 | 28 | 343 | SIP | |
| NKA0515SC | 5 | ±15 | ±33 | 253 | 79 | 29 | 188 | SIP | |
| NKA1205SC | 12 | ±5 | ±100 | 112 | 74 | 33 | 559 | SIP | |
| NKA1209SC | 12 | ±9 | ±56 | 106 | 79 | 48 | 375 | SIP | |
| NKA1212SC | 12 | ±12 | ±42 | 104 | 81 | 55 | 243 | SIP | |
| NKA1215SC | 12 | ±15 | ±33 | 102 | 82 | 60 | 154 | SIP | |
| NKA1215DC | 12 | ±15 | ±33 | 102 | 82 | 60 | 154 | DIP | |
| Discontinued | | | | | | | | | |
| NKA0303DC | 3.3 | ±3.3 | ±152 | 407 | 74 | 20 | 195 | DIP | Recommended Alternative |
| NKA0305DC | 3.3 | ±5 | ±100 | 383 | 79 | 22 | 1121 | DIP | NKA0305SC |
| NKA0309DC | 3.3 | ±9 | ±56 | 402 | 75 | 30 | 1035 | DIP | Contact Murata |
| NKA0309SC | 3.3 | ±9 | ±56 | 402 | 75 | 30 | 1035 | SIP | Contact Murata |
| NKA0315DC | 3.3 | ±15 | ±33 | 384 | 79 | 32 | 206 | DIP | NKA0315SC |
| NKA0503DC | 5 | ±3.3 | ±152 | 259 | 77 | 22 | 205 | DIP | NKA0503SC |
| NKA0505DC | 5 | ±5 | ±100 | 285 | 70 | 21 | 1697 | DIP | NMA0505DC |
| NKA0505DEC | 5 | ±5 | ±100 | 249 | 80 | 26 | 1557 | DIP | NMA0505DC |
| NKA0505SEC | 5 | ±5 | ±100 | 249 | 80 | 26 | 1557 | SIP | NMA0505SC |
| NKA0509DC | 5 | ±9 | ±56 | 263 | 76 | 25 | 682 | DIP | NMA0509DC |
| NKA0512DC | 5 | ±12 | ±42 | 255 | 78 | 28 | 343 | DIP | NMA0512DC |
| NKA0515DC | 5 | ±15 | ±33 | 253 | 79 | 29 | 188 | DIP | NMA0515DC |
| NKA1205DC | 12 | ±5 | ±100 | 112 | 74 | 33 | 559 | DIP | NMA1205DC |
| NKA1209DC | 12 | ±9 | ±56 | 106 | 79 | 48 | 375 | DIP | NMA1209DC |
| NKA1212DC | 12 | ±12 | ±42 | 104 | 81 | 55 | 243 | DIP | NMA1212DC |

NKA0505DEC/NKA0505SEC offer higher efficiency than NKA0505SC/NKA0505DC but over a narrower operating temperature range. See temperature characteristics graph.

INPUT CHARACTERISTICS

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|--------------------------|--|------|------|------|--------|
| Voltage range | Continuous operation, 3.3V input types | 2.97 | 3.3 | 3.63 | V |
| | Continuous operation, 5V input types | 4.5 | 5 | 5.5 | |
| | Continuous operation, 12V input types | 10.8 | 12 | 13.2 | |
| Reflected ripple current | 3.3V input types | | 30 | 60 | mA p-p |
| | All other types | | 20 | 35 | |

ABSOLUTE MAXIMUM RATINGS

| | |
|---|-------|
| Lead temperature 1.5mm from case for 10 seconds | 260°C |
| Input voltage V_{IN} , NKA03 types | 5.5V |
| Input voltage V_{IN} , NKA05 types | 7V |
| Input voltage V_{IN} , NKA12 types | 15V |

1. Calculated using MIL-HDBK-217F with nominal input voltage at full load.

All specifications typical at $T_A=25^\circ\text{C}$, nominal input voltage and rated output current unless otherwise specified.

| OUTPUT CHARACTERISTICS | | | | | |
|------------------------------|---|------|------|------|--------|
| Parameter | Conditions | Min. | Typ. | Max. | Units |
| Rated Power | T _A =-40°C to 120°C, see derating graphs | | | 1 | W |
| Voltage Set Point Accuracy | See tolerance envelope | | | | |
| Line regulation | High V _{IN} to low V _{IN} | | 1.0 | 1.2 | %/% |
| Load Regulation ² | 10% load to rated load, 0312 & 0315 | | 8 | 14 | % |
| | 10% load to rated load, 3.3V output types | | 10 | 15 | |
| | 10% load to rated load, 5V output types | | 10 | 12 | |
| | 10% load to rated load, 9V output types | | 6.5 | 8 | |
| | 10% load to rated load, 12V output types | | 6 | 8.5 | |
| | 10% load to rated load, 15V output types | | 6 | 7 | |
| Ripple and Noise | BW=DC to 20MHz, 0312 & 0315 | | 25 | 60 | mV p-p |
| | BW=DC to 20MHz, 3.3V output types | | 40 | 80 | |
| | BW=DC to 20MHz, 5V output types | | 50 | 75 | |
| | BW=DC to 20MHz, 9V output types | | 40 | 65 | |
| | BW=DC to 20MHz, 12V output types | | 40 | 60 | |
| | BW=DC to 20MHz, 15V output types | | 40 | 60 | |

| ISOLATION CHARACTERISTICS | | | | | |
|---------------------------|---------------------------|------|------|------|-------|
| Parameter | Conditions | Min. | Typ. | Max. | Units |
| Isolation test voltage | Flash tested for 1 second | 3000 | | | VDC |
| Resistance | Viso= 1000VDC | | 10 | | GΩ |

| GENERAL CHARACTERISTICS | | | | | |
|-------------------------|---|------|------|------|-------|
| Parameter | Conditions | Min. | Typ. | Max. | Units |
| Switching frequency | 0303, 0305, 0312, 0315, 0503 and 0505XE | | 95 | | kHz |
| | All other types | | 120 | | |

| TEMPERATURE CHARACTERISTICS | | | | | |
|-------------------------------------|------------------------|------|------|------|-------|
| Parameter | Conditions | Min. | Typ. | Max. | Units |
| Specification | All output types | -40 | | 85 | °C |
| Storage | | -50 | | 130 | |
| Case temperature rise above ambient | 5V output types | | 30 | | |
| | All other output types | | 21 | | |
| Cooling | Free air convection | | | | |

TECHNICAL NOTES

ISOLATION VOLTAGE

'Hi Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' & 'Isolation Test Voltage' are all terms that relate to the same thing, a test voltage, applied for a specified time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NKA series of DC-DC converters are all 100% production tested at their stated isolation voltage. This is 1kVDC for 1 second.

A question commonly asked is, "What is the continuous voltage that can be applied across the part in normal operation?"

For a part holding no specific agency approvals, such as the NKA series, both input and output should normally be maintained within SELV limits i.e. less than 42.4V peak, or 60VDC. The isolation test voltage represents a measure of immunity to transient voltages and the part should never be used as an element of a safety isolation system. The part could be expected to function correctly with several hundred volts offset applied continuously across the isolation barrier; but then the circuitry on both sides of the barrier must be regarded as operating at an unsafe voltage and further isolation/insulation systems must form a barrier between these circuits and any user-accessible circuitry according to safety standard requirements.

REPEATED HIGH-VOLTAGE ISOLATION TESTING

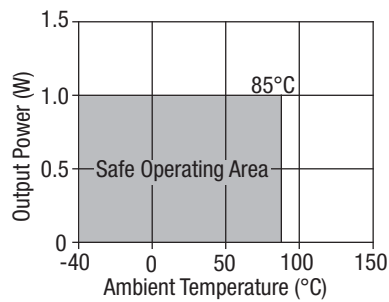
It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The NKA series has toroidal isolation transformers, with no additional insulation between primary and secondary windings of enameled wire. While parts can be expected to withstand several times the stated test voltage, the isolation capability does depend on the wire insulation. Any material, including this enamel (typically polyurethane) is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage.

This consideration equally applies to agency recognized parts rated for better than functional isolation where the wire enamel insulation is always supplemented by a further insulation system of physical spacing or barriers.

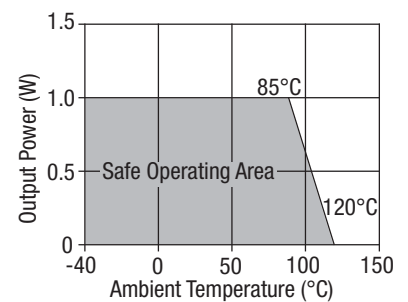
1. 12V input types have typically 3% less load regulation.

TEMPERATURE DERATING GRAPHS

NKA0303DC/SC, 0305DC/SC
0309DC/SC, 0505DEC/SEC
types only.

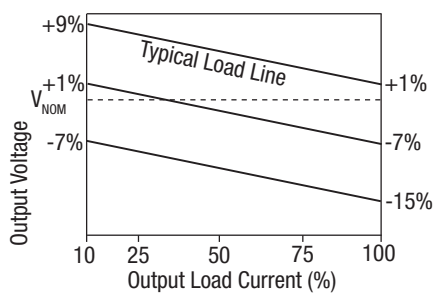


All other types.

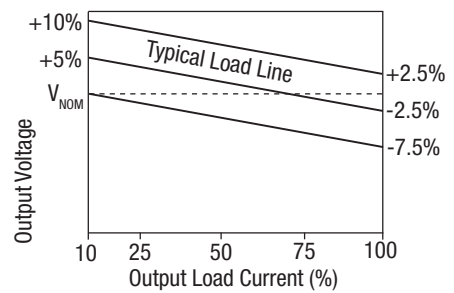


TOLERANCE ENVELOPES

3.3V output types.



All other types.



The voltage tolerance envelope shows typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading.

APPLICATION NOTES

Minimum load

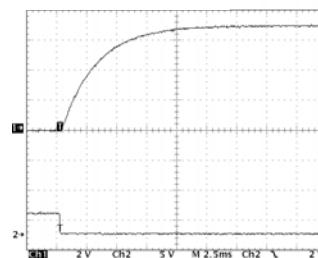
The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

Capacitive loading and start up

Typical start up times for this series, with a typical input voltage rise time of 2.2µs and output capacitance of 10µF, are shown in the table below. The product series will start into a capacitance of 47µF with an increased start time, however, the maximum recommended output capacitance is 10µF.

| | Start-up time ms | | Start-up time ms |
|------------|---------------------|-----------|---------------------|
| NKA0303SC | 1.35 | NKA0509SC | 8.01 |
| NKA0305SC | 3.35 | NKA0512SC | 14.63 |
| NKA0309SC | 9.30 | NKA0515SC | 28.38 |
| NKA0312SC | 22.13 | NKA1205SC | 2.11 |
| NKA0315SC | 25.04 | NKA1209SC | 7.62 |
| NKA0503SC | 0.80 | NKA1212SC | 9.08 |
| NKA0505SC | 2.32 | NKA1215SC | 14.39 |
| NKA0505SEC | 2.03 | | |

Typical Start-Up Wave Form



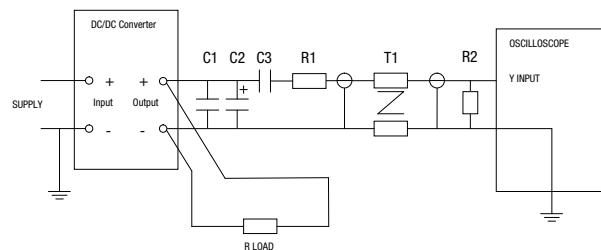
Ripple & Noise Characterisation Method

Ripple and noise measurements are performed with the following test configuration.

| | |
|-------|--|
| C1 | 1µF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC-DC converter |
| C2 | 10µF tantalum capacitor, voltage rating to be a minimum of 1.5 times the output voltage of the DC-DC converter with an ESR of less than 100mΩ at 100 kHz |
| C3 | 100nF multilayer ceramic capacitor, general purpose |
| R1 | 450Ω resistor, carbon film, ±1% tolerance |
| R2 | 50Ω BNC termination |
| T1 | 3T of the coax cable through a ferrite toroid |
| RLOAD | Resistive load to the maximum power rating of the DC-DC converter. Connections should be made via twisted wires |

Measured values are multiplied by 10 to obtain the specified values.

Differential Mode Noise Test Schematic



APPLICATION NOTES (continued)

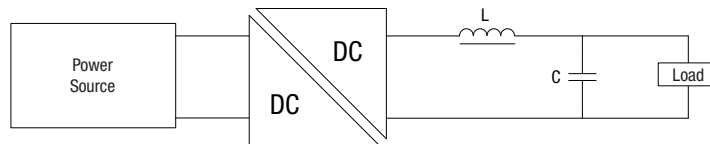
Output Ripple Reduction

By using the values of inductance and capacitance stated, the output ripple at the rated load is lowered to 5mV p-p max.

Component selection

Capacitor: It is required that the ESR (Equivalent Series Resistance) should be as low as possible, ceramic types are recommended. The voltage rating should be at least twice (except for 15V output), the rated output voltage of the DC-DC converter.

Inductor: The rated current of the inductor should not be less than that of the output of the DC-DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC-DC converter. The SRF (Self Resonant Frequency) should be >20MHz.

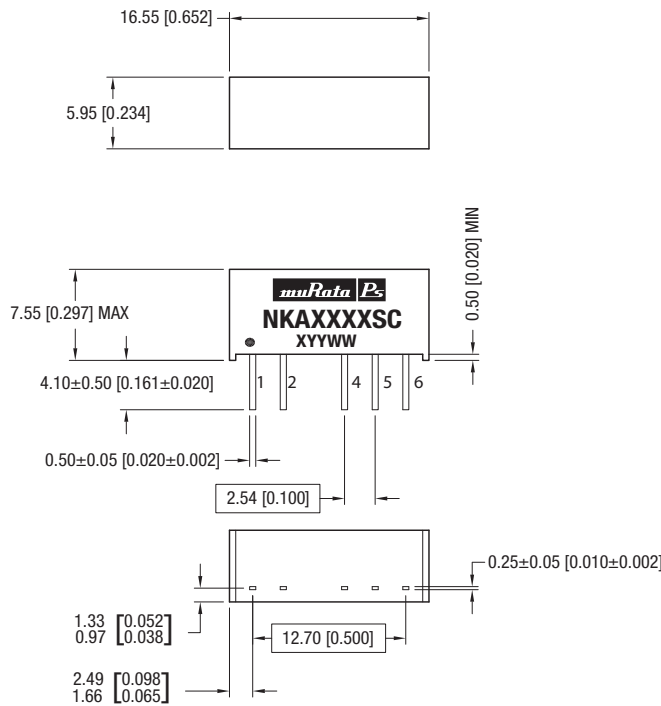


| | Inductor | | | Capacitor |
|------------|------------|--------|--------------|--------------|
| | L, μ H | SMD | Through Hole | C, μ F |
| NKA0303xC | 10 | 82103C | 11R103C | 1 μ F |
| NKA0305xC | 22 | 82223C | 11R223C | 2.2 μ F |
| NKA0309xC | 47 | 82473C | 11R473C | 2.2 μ F |
| NKA0312xC | 68 | 82683C | 11R683C | 3.3 μ F |
| NKA0315xC | 470 | 82474C | 11R474C | 2.2 μ F |
| NKA0503xC | 10 | 82103C | 11R103C | 1 μ F |
| NKA0505xC | 22 | 82223C | 11R223C | 2.2 μ F |
| NKA0505xEC | 22 | 82223C | 11R223C | 2.2 μ F |
| NKA0509xC | 47 | 82473C | 11R473C | 2.2 μ F |
| NKA0512xC | 150 | 82154C | 11R154C | 0.33 μ F |
| NKA0515xC | 470 | 82474C | 11R474C | 2.2 μ F |
| NKA1205xC | 22 | 82223C | 11R223C | 2.2 μ F |
| NKA1209xC | 47 | 82473C | 11R473C | 2.2 μ F |
| NKA1212xC | 150 | 82154C | 11R154C | 0.33 μ F |
| NKA1215xC | 470 | 82474C | 11R474C | 2.2 μ F |

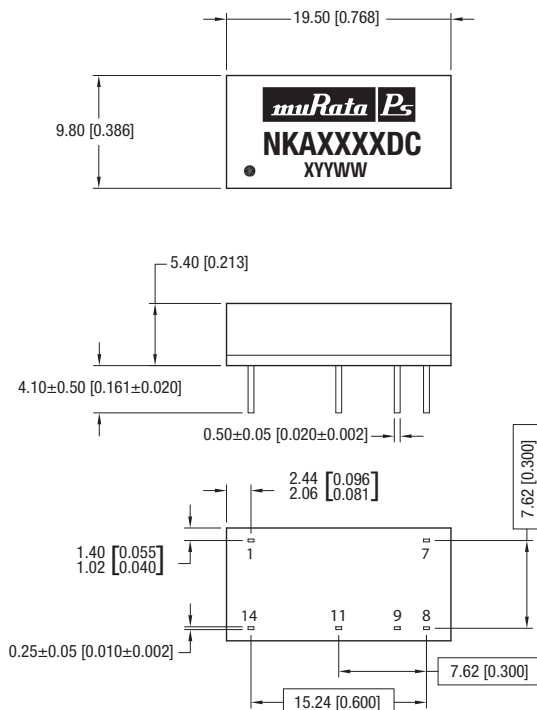
PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS

SIP package



DIP package



Controlling dimension is mm.

Unless otherwise stated all dimensions in mm (inches) ±0.25mm (0.010).

All pins on a 2.54mm (0.100") pitch and within 0.25mm (0.010") of true position.

Weight: 1.4g (SIP) 1.9g (DIP)

PIN CONNECTIONS - 14 PIN DIP

| Pin | Function |
|-----|----------|
| 1 | -VIN |
| 7 | NC |
| 8 | OV |
| 9 | +VOUT |
| 11 | -VOUT |
| 14 | +VIN |

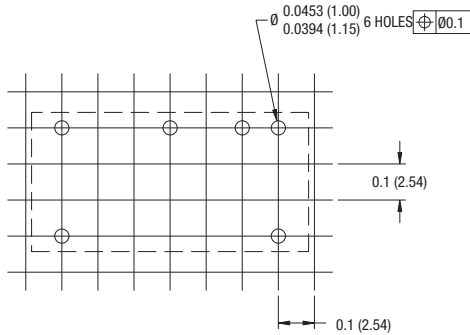
PIN CONNECTIONS - 6 PIN SIP

| Pin | Function |
|-----|----------|
| 1 | +VIN |
| 2 | -VIN |
| 4 | -VOUT |
| 5 | OV |
| 6 | +VOUT |

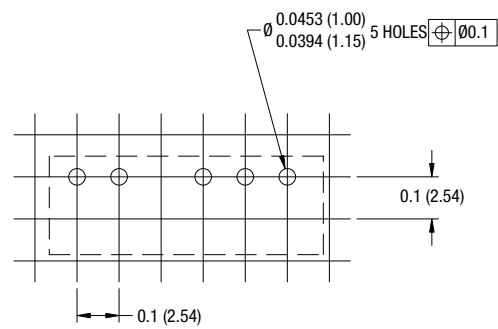
PACKAGE SPECIFICATIONS (continued)

RECOMMENDED FOOTPRINT DETAILS

14 Pin DIP Package

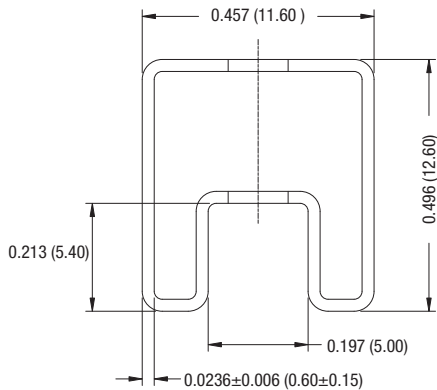


6 Pin SIP Package

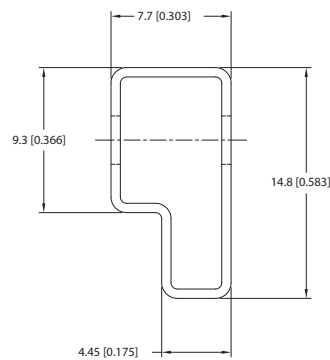


TUBE OUTLINE DIMENSIONS

14 Pin DIP Tube



6 Pin SIP Tube



Unless otherwise specified all dimensions in mm [inches] $\pm 0.55\text{mm}$ [0.022].
 Tube length (14 Pin DIP) : 520mm $\pm 2\text{mm}$ (20.47).
 Tube length (6 Pin SIP) : 525mm [20.669] ± 2.0 [0.079].

DIP Tube Quantity : 25
 SIP Tube Quantity : 30

RoHS COMPLIANCE INFORMATION



This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260°C for 10 seconds. The pin termination finish on the SIP package type is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The DIP types are Matte Tin over Nickel Preplate. Both types in this series are backward compatible with Sn/Pb soldering systems.

For further information, please visit www.murata-ps.com/rohs



This product is subject to the following **operating requirements** and the **Life and Safety Critical Application Sales Policy**:

Refer to: <http://www.murata-ps.com/requirements/>

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