

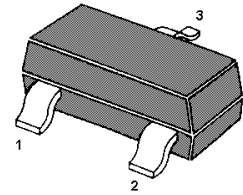
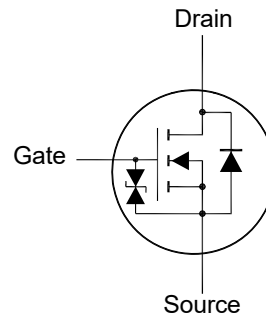
MKA02N020UK

N-Channel Enhancement Mode MOSFET

Features

- Surface-mounted package
- Extremely low threshold voltage
- Built-in G-S Protection Diode
- Typical ESD Protection HBM Class 1B

| Classification | Voltage Range(V) |
|----------------|------------------|
| 0A | < 125 |
| 0B | 125 to < 250 |
| 1A | 250 to < 500 |
| 1B | 500 to < 1000 |
| 1C | 1000 to < 2000 |
| 2 | 2000 to < 4000 |
| 3A | 4000 to < 8000 |
| 3B | ≥ 8000 |



1. Gate 2. Source 3. Drain
SOT-23 Plastic Package

Application

- Portable appliances
- Battery management

Absolute Maximum Ratings (at $T_a = 25^\circ\text{C}$ unless otherwise specified)

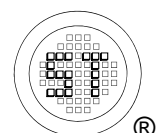
| Parameter | Symbol | Value | Unit |
|--|----------------|---------------|------------------|
| Drain Source Voltage | V_{DS} | 20 | V |
| Gate Source Voltage | V_{GS} | ± 12 | V |
| Drain Current | I_D | 6 | A |
| Peak Drain Current, Pulsed ¹⁾ | I_{DM} | 30 | A |
| Total Power Dissipation ²⁾ | P_{tot} | 1.25 | W |
| Operating Junction and Storage Temperature Range | T_j, T_{stg} | - 55 to + 150 | $^\circ\text{C}$ |

Thermal Resistance Ratings

| Parameter | Symbol | Max. | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance from Junction to Ambient ²⁾ | $R_{\theta JA}$ | 100 | $^\circ\text{C/W}$ |

¹⁾ Pulse Test: Pulse Width $\leq 100 \mu\text{s}$, Duty Cycle $\leq 2\%$, Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$.

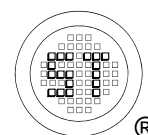
²⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air, $t \leq 10 \text{ s}$.



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Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--|--------------|------|-------------|----------------|---------------|
| STATIC PARAMETERS | | | | | |
| Drain-Source Breakdown Voltage at $I_D = 250 \mu\text{A}$ | BV_{DSS} | 20 | - | - | V |
| Drain-Source Leakage Current at $V_{DS} = 20 \text{ V}$ | I_{DSS} | - | - | 1 | μA |
| Gate Leakage Current at $V_{GS} = \pm 10 \text{ V}$ | I_{GSS} | - | - | ± 10 | μA |
| Gate-Source Threshold Voltage at $V_{DS} = V_{GS}, I_D = 250 \mu\text{A}$ | V_{GSth} | 0.4 | - | 1 | V |
| Drain-Source On-State Resistance at $V_{GS} = 4.5 \text{ V}, I_D = 6 \text{ A}$ at $V_{GS} = 2.5 \text{ V}, I_D = 5 \text{ A}$ at $V_{GS} = 1.8 \text{ V}, I_D = 4 \text{ A}$ | $R_{DS(on)}$ | - | - | 20 24 35 | m Ω |
| DYNAMIC PARAMETERS | | | | | |
| Forward Transconductance at $V_{DS} = 5 \text{ V}, I_D = 6 \text{ A}$ | g_{fs} | - | 14 | - | S |
| Gate resistance at $V_{DS} = 0 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ | R_g | - | 2.4 | - | Ω |
| Input Capacitance at $V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ | C_{iss} | - | 698 | - | pF |
| Output Capacitance at $V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ | C_{oss} | - | 107 | - | pF |
| Reverse Transfer Capacitance at $V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ | C_{rss} | - | 83 | - | pF |
| Gate charge total at $V_{DS} = 10 \text{ V}, I_D = 6 \text{ A}, V_{GS} = 4.5 \text{ V}$ at $V_{DS} = 10 \text{ V}, I_D = 6 \text{ A}, V_{GS} = 2.5 \text{ V}$ | Q_g | - | 12.4 7.2 | - | nC |
| Gate to Source Charge at $V_{DS} = 10 \text{ V}, I_D = 6 \text{ A}, V_{GS} = 4.5 \text{ V}$ | Q_{gs} | - | 1.4 | - | nC |
| Gate to Drain Charge at $V_{DS} = 10 \text{ V}, I_D = 6 \text{ A}, V_{GS} = 4.5 \text{ V}$ | Q_{gd} | - | 3.7 | - | nC |
| Turn-On Delay Time at $V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 6 \text{ A}, R_g = 3.3 \Omega$ | $t_{d(on)}$ | - | 14.5 | - | ns |
| Turn-On Rise Time at $V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 6 \text{ A}, R_g = 3.3 \Omega$ | t_r | - | 48 | - | ns |
| Turn-Off Delay Time at $V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 6 \text{ A}, R_g = 3.3 \Omega$ | $t_{d(off)}$ | - | 18.6 | - | ns |
| Turn-Off Fall Time at $V_{DS} = 10 \text{ V}, V_{GS} = 4.5 \text{ V}, I_D = 6 \text{ A}, R_g = 3.3 \Omega$ | t_f | - | 7.4 | - | ns |
| Body-Diode PARAMETERS | | | | | |
| Diode Forward Voltage at $I_s = 1 \text{ A}, V_{GS} = 0 \text{ V}$ | V_{SD} | - | - | 1.3 | V |
| Body-Diode Continuous Current | I_s | - | - | 6 | A |
| Body Diode Reverse Recovery Time at $I_s = 6 \text{ A}, di/dt = 100 \text{ A} / \mu\text{s}$ | t_{rr} | - | 6.5 | - | nS |
| Body Diode Reverse Recovery Charge at $I_s = 6 \text{ A}, di/dt = 100 \text{ A} / \mu\text{s}$ | Q_{rr} | - | 2 | - | nC |



Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

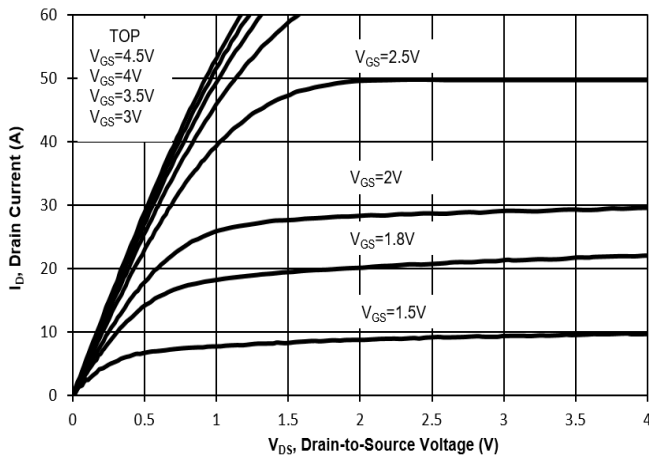


Fig. 2 Typical Transfer Characteristics

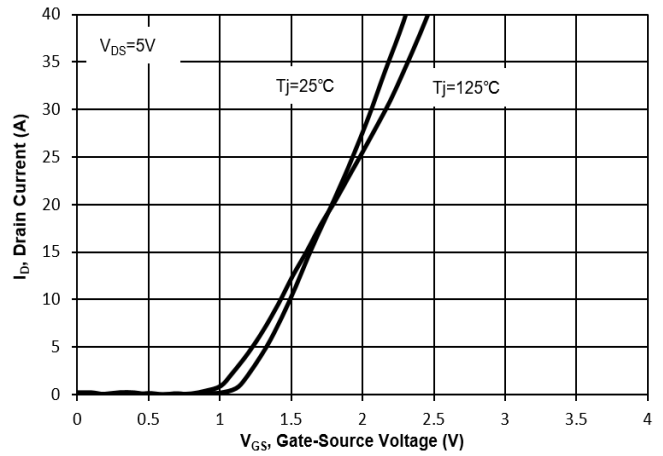


Fig. 3 On-Resistance vs. Drain Current

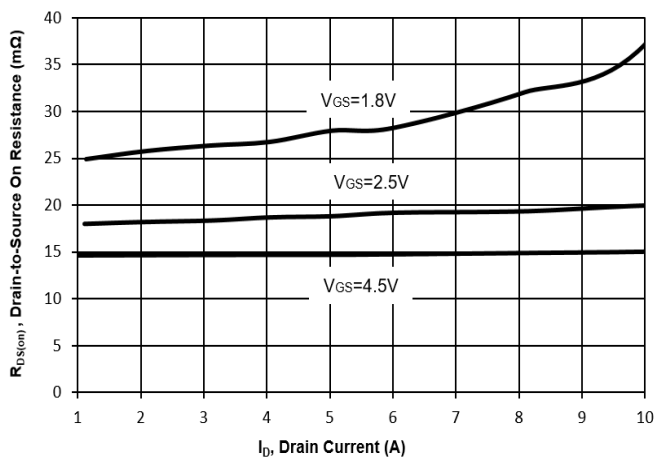


Fig. 4 On-Resistance vs. Gate-Source Voltage

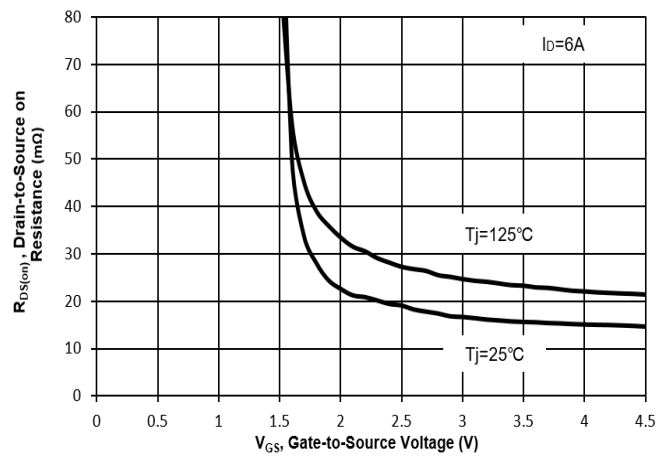


Fig. 5 On-Resistance vs. T_j

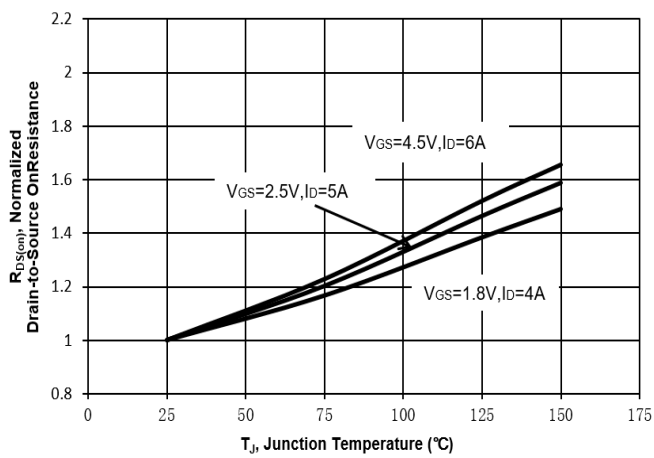
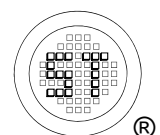
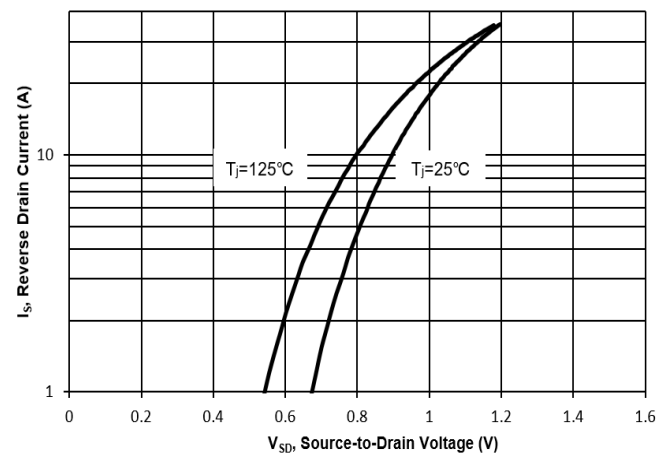


Fig. 6 Typical Body-Diode Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

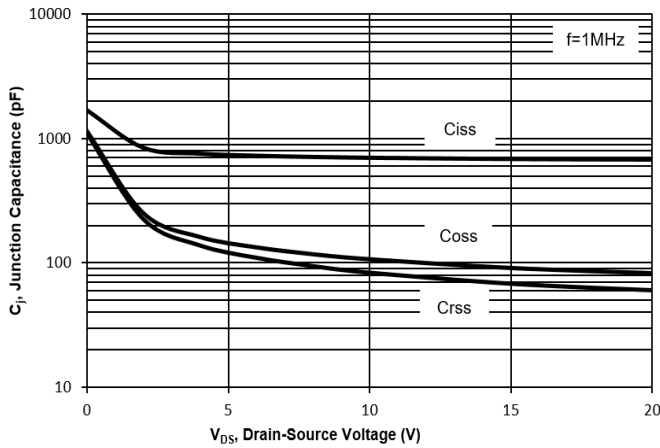


Fig. 8 Drain-Source Leakage Current vs. T_J

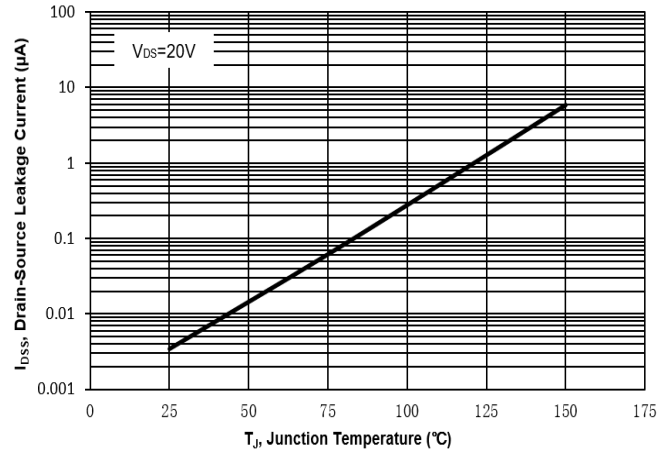


Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

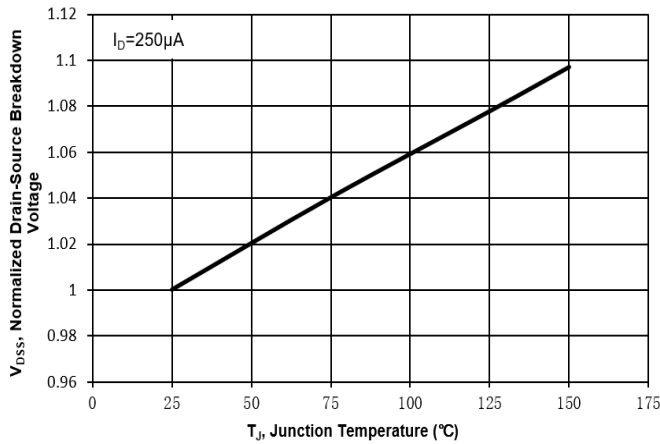


Fig. 10 Gate Threshold Variation vs. T_J

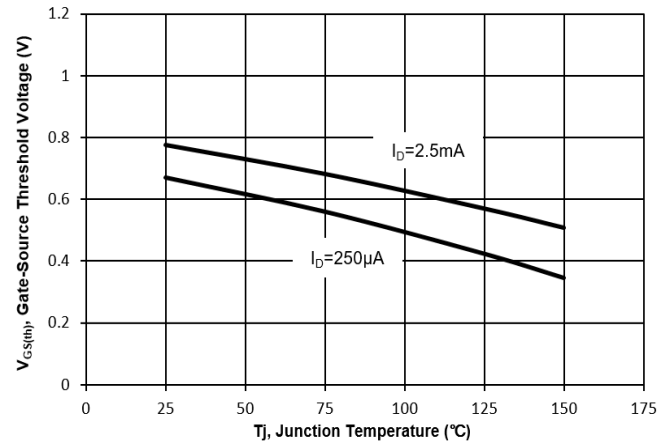
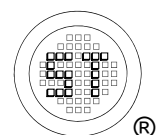
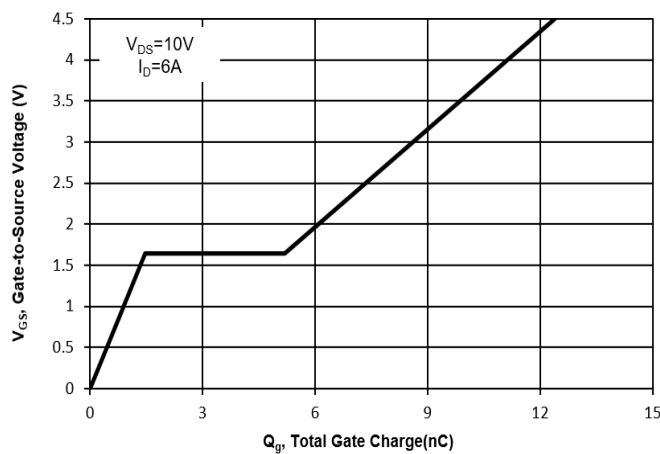


Fig. 11 Gate Charge



Test Circuits

Fig.1-1 Switching times test circuit

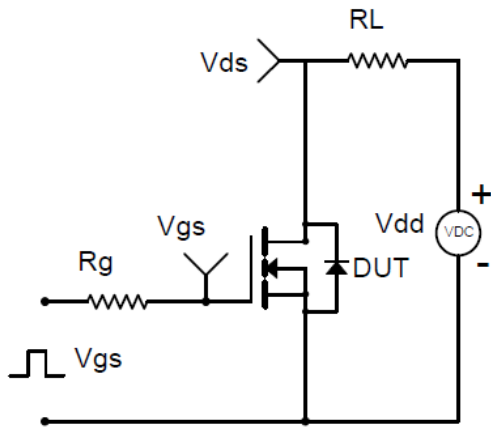


Fig.1-2 Switching Waveform

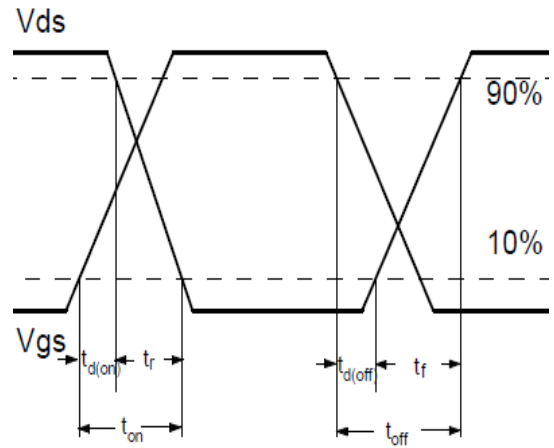


Fig.2-1 Gate charge test circuit

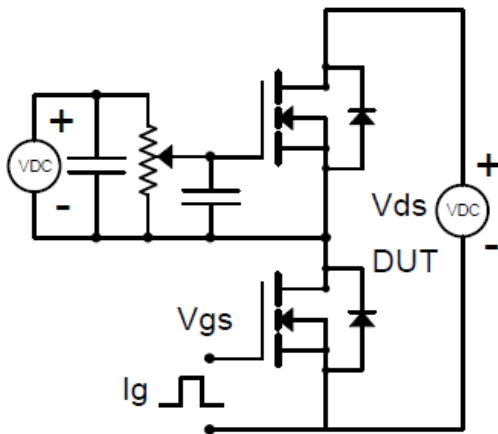
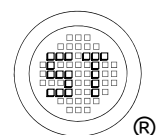
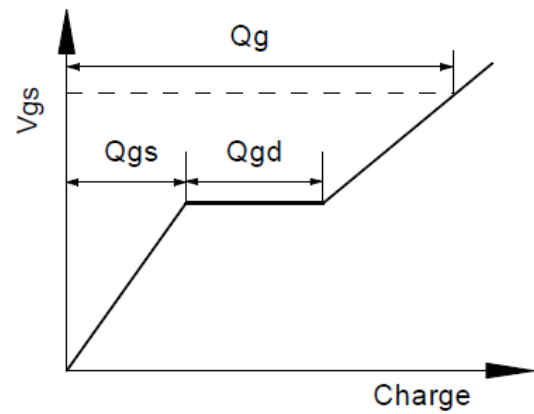


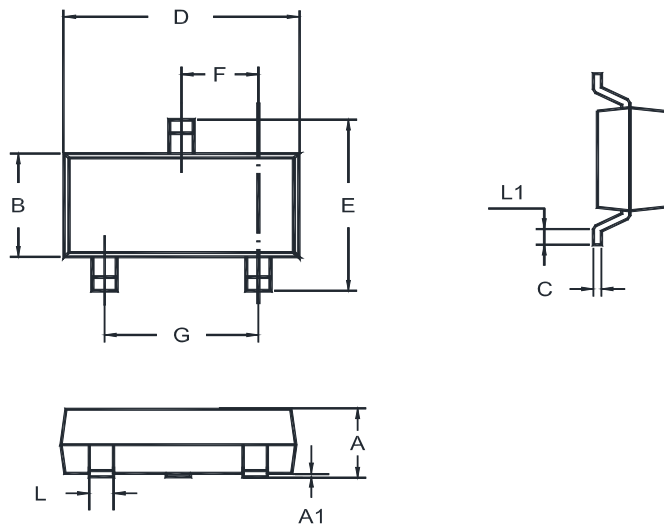
Fig.2-2 Gate charge waveform



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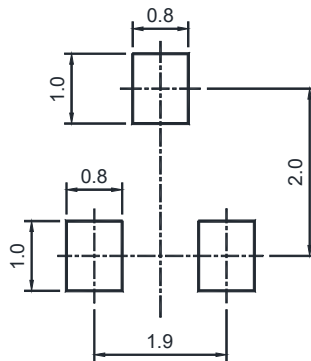
Package Outline (Dimensions in mm)

SOT-23



| Unit | A | A1 | B | C | D | E | F | G | L | L1 |
|------|------|-------|------|------|------|-----|------|------|------|-----|
| mm | 1.20 | 0.100 | 1.40 | 0.19 | 3.04 | 2.6 | 1.02 | 2.04 | 0.51 | 0.2 |
| | 0.89 | 0.013 | 1.20 | 0.08 | 2.80 | 2.2 | 0.89 | 1.78 | 0.37 | MIN |

Recommended Soldering Footprint



Packing information

| Package | Tape Width (mm) | Pitch | | Reel Size | | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
| | | mm | inch | mm | inch | |
| SOT-23 | 8 | 4 ± 0.1 | 0.157 ± 0.004 | 178 | 7 | 3,000 |

Marking information

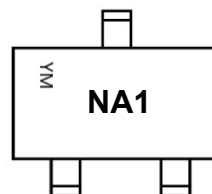
" NA1 " = Part No.

" YM " = Date Code Marking

" Y " = Year

" M " = Month

Font type: Arial



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