

# IP4359CX4

## Dual channel low capacitance high performance ESD protection

Rev. 1 — 6 August 2010

Product data sheet

## 1. Product profile

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### 1.1 General description

The IP4359CX4 is a dual channel low capacitance ElectroStatic Discharge (ESD) protection device, providing protection to downstream components from ESD voltages as high as  $\pm 15$  kV contact discharge and  $> \pm 15$  kV air discharge according the IEC 61000-4-2 model, far exceeding standard level 4.

The device is optimized for protection of high speed interfaces such as Universal Serial Bus (USB) 2.0, High Definition Multimedia Interface (HDMI), Digital Visual Interface (DVI) and other interfaces requiring very low capacitance ESD protection.

The device is available in two different heights. 0.61 mm and reduced maximum height of 0.5 mm. Both versions contain identical circuits and show an identical electrical performance. Both ESD protection channels share common ground connections, but are electrically separated, thereby preventing current back drive into the adjacent channel. IP4359CX4 is fabricated using monolithic silicon technology in a single Wafer-Level Chip-Scale Package (WLCSP). These features make the IP4359CX4 ideal for use in applications requiring component miniaturization such as mobile phone handsets and other portable electronic devices.

### 1.2 Features and benefits

- Pb-free, RoHS compliant and free of halogen and antimony (Dark Green compliant)
- 2 ultra low input capacity rail-to-rail ESD protection diodes with  $C_{(I/O-GND)} = 1.3$  pF
- $R_{dyn} = 0.45 \Omega$
- Integrated ESD protection withstanding  $\pm 15$  kV contact discharge and  $> \pm 15$  kV air discharge, far exceeding IEC 61000-4-2 level 4
- Standard height version (0.61 mm) available as IP4359CX4/LF
- Reduced height version (maximum height of 0.5 mm) available as IP4359CX4/LF-H500
- $2 \times 2$  solder ball WLCSP with 0.4 mm pitch

### 1.3 Applications

- High-speed interface ESD protection such as USB 2.0, HDMI, DVI etc.
- Interfaces with special requirements on low capacitive ESD protection
- Interfaces requiring separation of the positive clamping voltage/current path



## 2. Pinning information

Table 1. Pinning

| Pin       | Description    | Simplified outline | Graphic symbol   |
|-----------|----------------|--------------------|------------------|
| A1 and A2 | ESD protection | <p>008aaa236</p>   | <p>008aaa239</p> |
| B1 and B2 | ground         |                    |                  |

transparent top view,  
solder balls facing down

## 3. Ordering information

Table 2. Ordering information

| Type number       | Package height          | Package |  |           |
|-------------------|-------------------------|---------|--|-----------|
|                   |                         | Name    | Description                                    | Version   |
| IP4359CX4/LF      | standard <sup>[1]</sup> | WLCSP4  | wafer level chip-size package; 4 bumps (2 × 2) | IP4359CX4 |
| IP4359CX4/LF-H500 | reduced <sup>[2]</sup>  | WLCSP4  | wafer level chip-size package; 4 bumps (2 × 2) | IP4359CX4 |

[1] For details see [Table 5](#).

[2] For details see [Table 6](#).

## 4. Limiting values

**Table 3. Limiting values**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol             | Parameter                       | Conditions  | Min  | Max     | Unit |
|--------------------|---------------------------------|---|------|---------|------|
| $V_I$              | input voltage                   | pins A1 and A2 to ground (B1, B2)                           | -0.5 | +5.5    | V    |
| $V_{ESD}$          | electrostatic discharge voltage | pins A1 and A2 to ground (B1, B2)                           |      |         |      |
|                    |                                 | contact discharge   | [1]  | -15 +15 | kV   |
|                    |                                 | air discharge   | [1]  | -20 +20 | kV   |
|                    |                                 | IEC 61000-4-2 level 4;<br>pins A1 and A2 to ground (B1, B2) |      |         |      |
|                    |                                 | contact discharge   | -8   | +8      | kV   |
|                    |                                 | air discharge   | -15  | +15     | kV   |
| $T_{stg}$          | storage temperature             |   | -55  | +150    | °C   |
| $T_{reflow(peak)}$ | peak reflow temperature         | 10 s maximum  | -    | 260     | °C   |
| $T_{amb}$          | ambient temperature             |   | -35  | +85     | °C   |

[1] Device is qualified with 1000 pulses of  $\pm 15$  kV contact discharges each, according to the IEC61000-4-2 model and far exceeds the specified level 4 (8 kV contact discharge).

## 5. Characteristics

**Table 4. Electrical characteristics**

$T_{amb} = 25$  °C; unless otherwise specified.

| Symbol          | Parameter                          | Conditions  | Min | Typ  | Max     | Unit     |
|-----------------|------------------------------------|---|-----|------|---------|----------|
| $C_{(I/O-GND)}$ | input/output to ground capacitance | pins A1 and A2 to ground (B1, B2); $V_I = 3.3$ V; $f = 1$ MHz | [1] | -    | 1.3 1.5 | pF       |
| $I_{LR}$        | reverse leakage current            | pins A1 and A2 to ground (B1, B2); $V_I = 3.3$ V              | -   | -    | 100     | nA       |
| $V_{BRzd}$      | Zener diode breakdown voltage      | $I_{test} = 1$ mA   | 6   | -    | 9       | V        |
| $V_F$           | forward voltage                    |   | -   | 0.7  | -       | V        |
| $R_{dyn}$       | dynamic resistance                 | $I_{test} = 1$ A; IEC 61000-4-5                               |     |      |         |          |
|                 |                                    | positive discharge  | -   | 0.45 | -       | $\Omega$ |
|                 |                                    | negative discharge  | -   | 0.45 | -       | $\Omega$ |

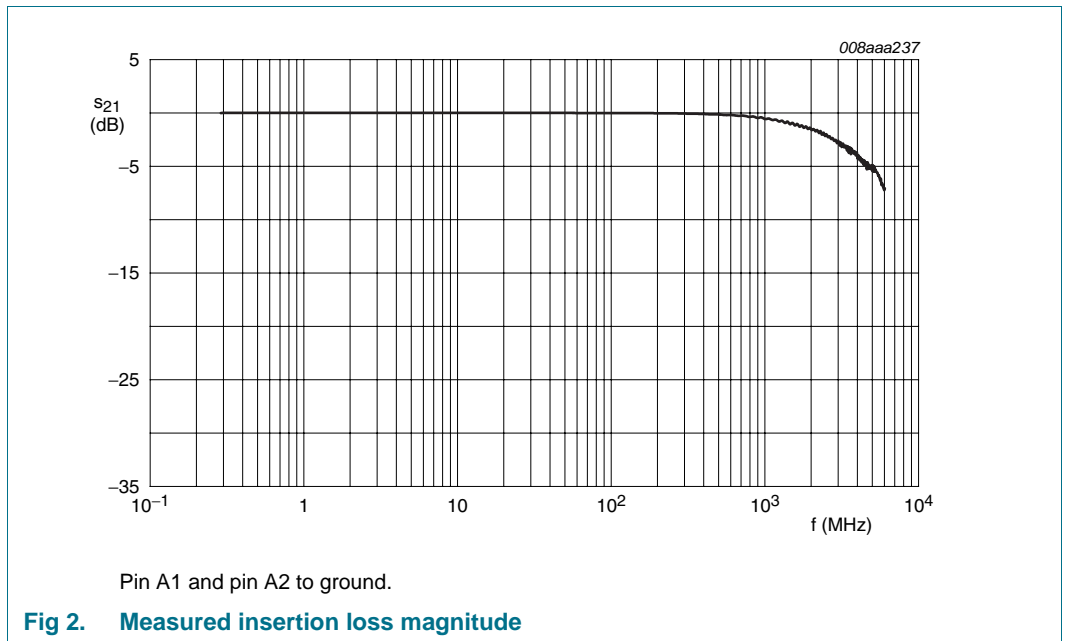
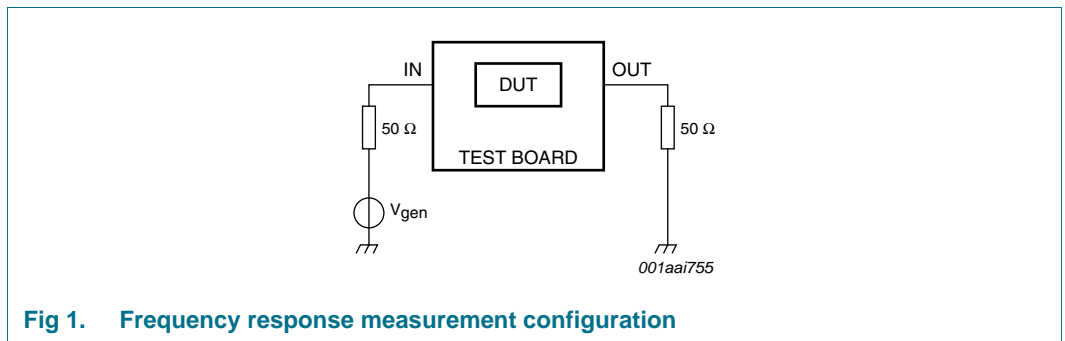
[1] Guaranteed by design.

## 6. Application information

### 6.1 Insertion loss

The IP4359CX4 is mainly designed as an ESD protection device for high speed interfaces such as USB 2.0, DVI and HDMI high speed data lines etc. The insertion loss measurement configuration of a typical 50 Ω NetWork Analyzer (NWA) system for evaluation of the IP4359CX4 is shown in [Figure 1](#).

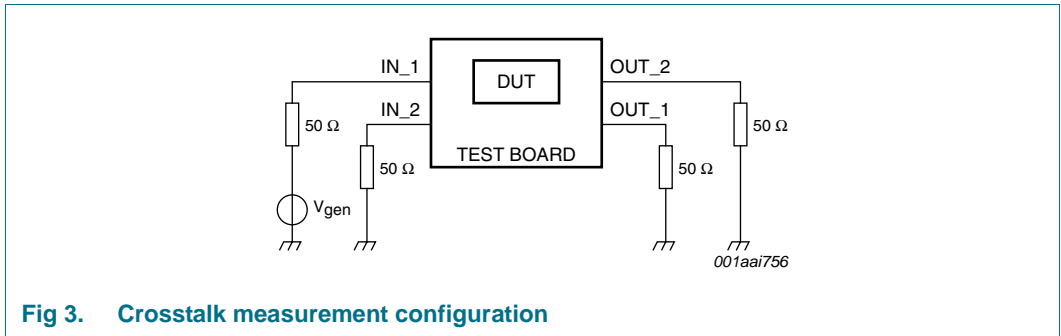
The insertion loss of IP4359CX4 is depicted in [Figure 2](#).



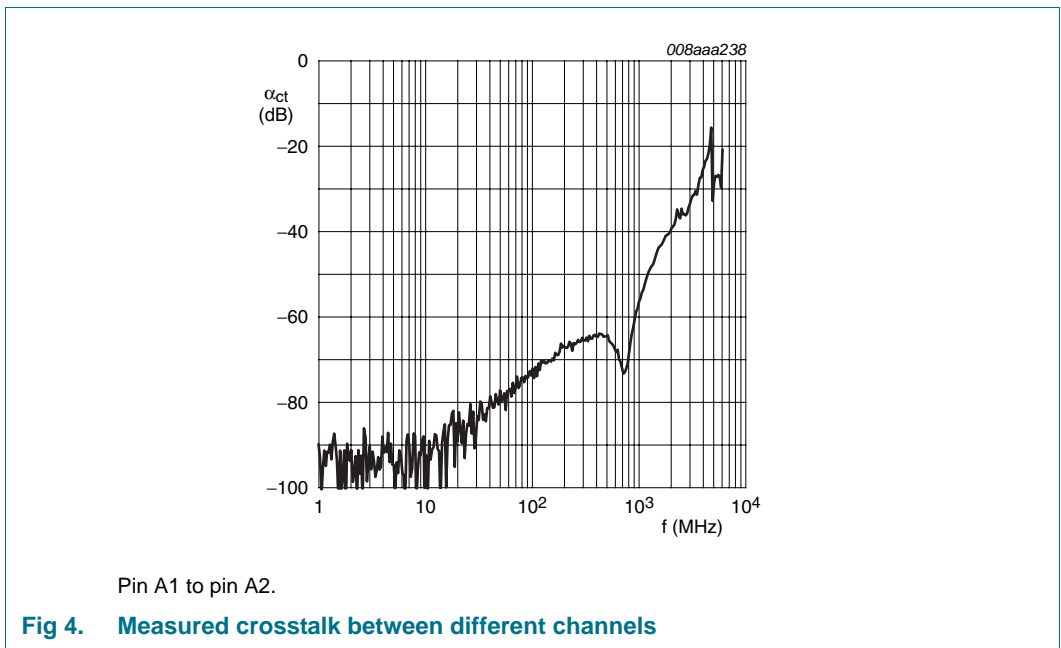
### 6.2 Crosstalk

The crosstalk measurement configuration of a typical 50 Ω NWA system for evaluation of the IP4359CX4 is shown in [Figure 3](#).

The crosstalk measurement results of IP4359CX4 are depicted in [Figure 4](#).



**Fig 3. Crosstalk measurement configuration**



**Fig 4. Measured crosstalk between different channels**

## 7. Package outline

WLCSP4: wafer level chip-size package; 4 bumps (2 x 2)

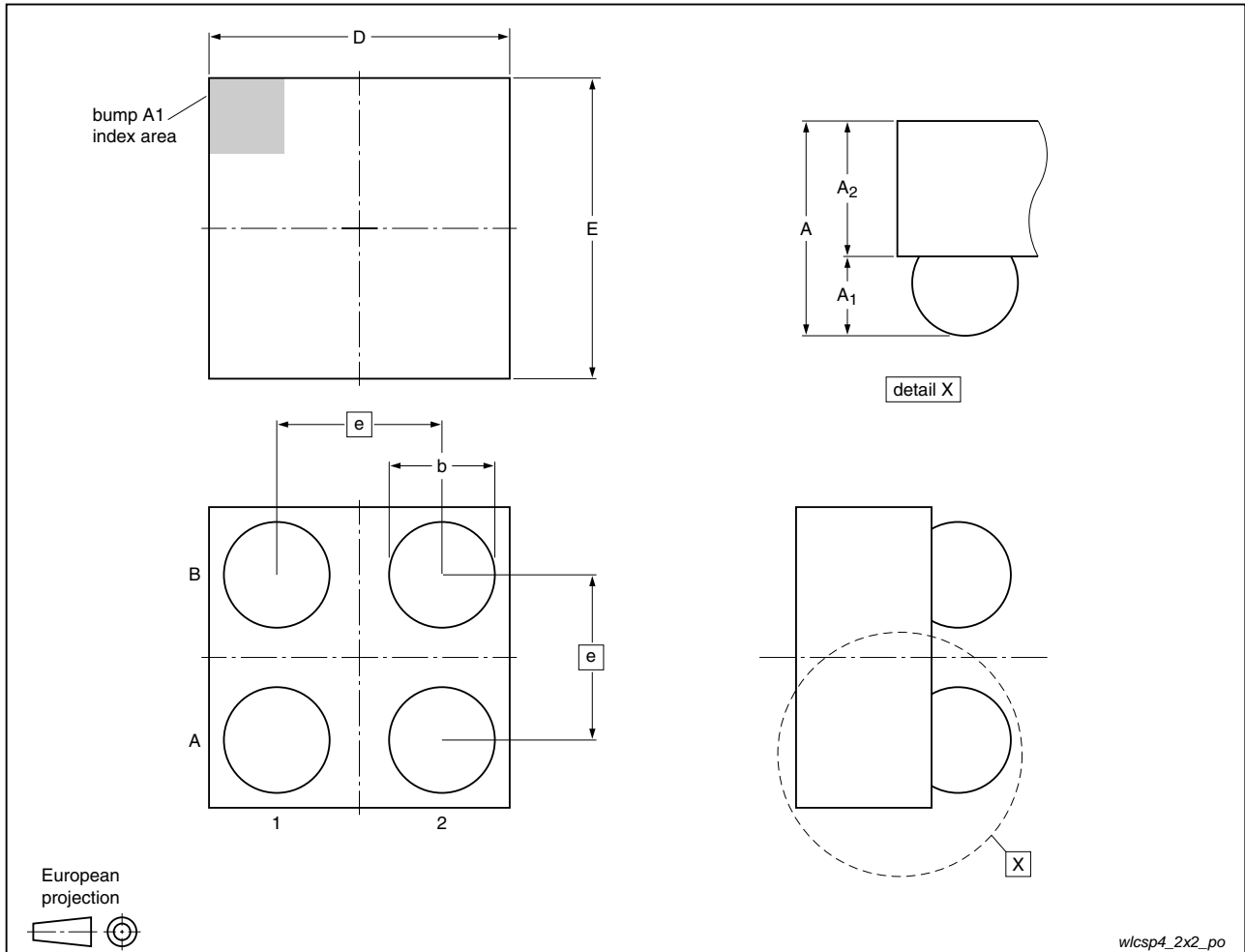


Fig 5. Package outline IP4359CX4 (WLCSP4)

Table 5. Dimensions of IP4359CX4/LF for [Figure 5](#)

| Symbol         | Min  | Typ  | Max  | Unit |
|----------------|------|------|------|------|
| A              | 0.57 | 0.61 | 0.65 | mm   |
| A <sub>1</sub> | 0.18 | 0.20 | 0.22 | mm   |
| A <sub>2</sub> | 0.39 | 0.41 | 0.43 | mm   |
| b              | 0.21 | 0.26 | 0.31 | mm   |
| D              | 0.71 | 0.76 | 0.81 | mm   |
| E              | 0.71 | 0.76 | 0.81 | mm   |
| e              | -    | 0.4  | -    | mm   |

Table 6. Dimensions of IP4359CX4/LF-H500 for [Figure 5](#)

| Symbol         | Min  | Typ  | Max  | Unit |
|----------------|------|------|------|------|
| A              | 0.41 | 0.45 | 0.49 | mm   |
| A <sub>1</sub> | 0.18 | 0.20 | 0.22 | mm   |
| A <sub>2</sub> | 0.23 | 0.25 | 0.27 | mm   |
| b              | 0.21 | 0.26 | 0.31 | mm   |
| D              | 0.71 | 0.76 | 0.81 | mm   |
| E              | 0.71 | 0.76 | 0.81 | mm   |
| e              | -    | 0.4  | -    | mm   |

## 8. Design and assembly recommendations

### 8.1 PCB design guidelines

For optimum performance it is recommended to use a Non-Solder Mask Defined (NSMD), also known as a copper-defined design, incorporating laser-drilled micro-vias connecting the ground pads to a buried ground-plane layer. This results in the lowest possible ground inductance and provides the best high frequency and ESD performance. For this case, refer to [Table 7](#) for the recommended PCB design parameters.

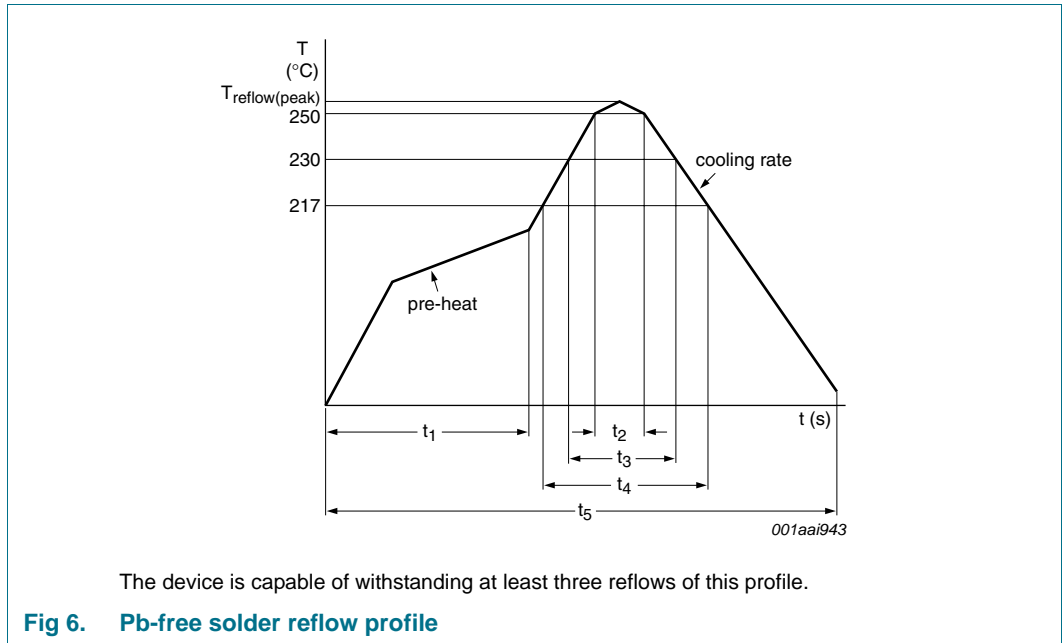
Table 7. Recommended PCB design parameters

| Parameter                     | Value or specification |
|-------------------------------|------------------------|
| PCB pad diameter              | 250 μm                 |
| Micro-via diameter            | 100 μm (0.004 inch)    |
| Solder mask aperture diameter | 325 μm                 |
| Copper thickness              | 20 μm to 40 μm         |
| Copper finish                 | AuNi or OSP            |
| PCB material                  | FR4                    |

### 8.2 PCB assembly guidelines for Pb-free soldering

Table 8. Assembly recommendations

| Parameter                       | Value or specification                |
|---------------------------------|---------------------------------------|
| Solder screen aperture diameter | 290 μm                                |
| Solder screen thickness         | 100 μm (0.004 inch)                   |
| Solder paste: Pb-free           | SnAg (3 % to 4 %) Cu (0.5 % to 0.9 %) |
| Solder / flux ratio             | 50 / 50                               |
| Solder reflow profile           | see <a href="#">Figure 6</a>          |



**Table 9. Characteristics**

| Symbol                    | Parameter                     | Conditions                         | Min | Typ | Max | Unit |
|---------------------------|-------------------------------|------------------------------------|-----|-----|-----|------|
| $T_{\text{reflow(peak)}}$ | peak reflow temperature       |                                    | 230 | -   | 260 | °C   |
| $t_1$                     | time 1                        | soak time                          | 60  | -   | 180 | s    |
| $t_2$                     | time 2                        | time during $T \geq 250\text{ °C}$ | -   | -   | 30  | s    |
| $t_3$                     | time 3                        | time during $T \geq 230\text{ °C}$ | 10  | -   | 50  | s    |
| $t_4$                     | time 4                        | time during $T > 217\text{ °C}$    | 30  | -   | 150 | s    |
| $t_5$                     | time 5                        |                                    | -   | -   | 540 | s    |
| $dT/dt$                   | rate of change of temperature | cooling rate                       | -   | -   | -6  | °C/s |
|                           |                               | pre-heat                           | 2.5 | -   | 4.0 | °C/s |



## 9. Abbreviations

**Table 10. Abbreviations**

| Acronym | Description                               |
|---------|---|
| DUT     | Device Under Test                         |
| DVI     | Digital Visual Interface                  |
| ESD     | ElectroStatic Discharge                   |
| FR4     | Flame Retard 4                            |
| HDMI    | High Definition Multimedia Interface      |
| IEC     | International Electrotechnical Commission |
| NSMD    | Non-Solder Mask Defined                   |
| NWA     | NetWork Analyzer                          |
| OSP     | Organic Solderability Preservative        |
| PCB     | Printed-Circuit Board                     |
| RoHS    | Restriction of Hazardous Substances       |
| USB     | Universal Serial Bus                      |
| WLCSP   | Wafer-Level Chip-Scale Package            |

## 10. Revision history

**Table 11. Revision history**

| Document ID   | Release date | Data sheet status  | Change notice | Supersedes |
|---------------|--------------|--------------------|---------------|------------|
| IP4359CX4 v.1 | 20100806     | Product data sheet | -             | -          |

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### 11.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
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| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

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