This user's guide describes the characteristics, operation, and use of the AXC-SMALLPKG1EVM Evaluation Module (EVM). A complete printed-circuit board layout, schematic diagrams, and bill of materials are included in this document.

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Trademarks
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1 Introduction

SN74AXCxxx devices are a new family of direction controlled level translators from Texas Instruments. AXC devices have dual-supply pins enabling configurable voltage translation from 0.65 V to 3.6 V and any intermediate voltage ranges. The AXC-SMALLPKG1EVM can be used to evaluate small package one, four and eight channel translator devices that are available in the AXC family. Refer to the competitive advantages of the AXC Family in the application report Power sequencing for the AXC family of devices (SCEA058). Watch Introduction to the AXC family of direction controlled translation device.

1.1 Features

The AXC family of direction controlled translation devices are dual-supply with configurable voltage translation and an operating range from 0.65 V to 3.6 V. The A port is designed to track $V_{CCA}$. $V_{CCA}$ accepts any supply voltage from 0.65 V to 3.6 V. The B port is designed to track $V_{CCB}$. $V_{CCB}$ accepts any supply voltage from 0.65 V to 3.60 V. This device is fully specified for partial-power-down applications using $I_{OFF}$. The $I_{OFF}$ circuitry disables the outputs, thus preventing damaging current backflow through the device when it is powered down. The $V_{CC}$ isolation feature ensures that if either $V_{CC}$ input is at ground, both A and B data I/O ports are in the high-impedance state.

The eight channel SN74AXC8T245 device has two direction control pins, each controlling 4 data I/Os enabling independent and simultaneous up and down translation. The DIR1 pin controls the direction of data I/O channels 1 through 4, and the DIR2 pin controls the direction of data I/O channels 5 through 8. The functional table of the SN74AXC8T245 is listed in Table 1 and the SN74AXC1T45 is listed in Table 3. Refer to SN74AXC8T245EVM for testing SN74AXC8T245PW package.

This EVM is designed to support SN74AXC1T45 in DEA and the DTO packages. There is an option of populating the SN74AXC8T245 in the RJW package and SN74AVC4T245 or the SN74AXC4T245 in the RSV package. It is also designed to support the bus-hold and -Q1 devices for the respective channel counts.

<table>
<thead>
<tr>
<th>OE</th>
<th>DIR1</th>
<th>DIR2</th>
<th>Signal Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>X</td>
<td>X</td>
<td>Hi-Z</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>B data to A bus</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
<td>B{1:4} to A{1:4} and A{5:8} to B{5:8}</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>L</td>
<td>A data to B bus</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>H</td>
<td>A{1:4} to B{1:4} and B{5:8} to A{5:8}</td>
</tr>
</tbody>
</table>

Table 2. Function: SN74AXC4T245

<table>
<thead>
<tr>
<th>OE</th>
<th>DIR1</th>
<th>DIR2</th>
<th>Signal Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>X</td>
<td>X</td>
<td>Hi-Z</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
<td>B data to A bus</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>H</td>
<td>B{1:2} to A{1:2} and A{3:4} to B{3:4}</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>L</td>
<td>A{1:2} to B{1:2} and B{3:4} to A{3:4}</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td>H</td>
<td>A data to B bus</td>
</tr>
</tbody>
</table>

Table 3. Function: SN74AXC1T45

<table>
<thead>
<tr>
<th>DIR</th>
<th>Signal Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>B data to A bus</td>
</tr>
<tr>
<td>H</td>
<td>A data to B bus</td>
</tr>
</tbody>
</table>
Figure 1. AXC-SMALLPKG1EVM: 8, 4, 2, 1 Channel versions

The supported packages are listed in Table 4.

<table>
<thead>
<tr>
<th>Version</th>
<th>Package</th>
<th>Device Populated</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Channel</td>
<td>DEA</td>
<td>Yes</td>
</tr>
<tr>
<td>One Channel</td>
<td>DTQ</td>
<td>Yes</td>
</tr>
<tr>
<td>Four Channel</td>
<td>RSV</td>
<td>No</td>
</tr>
<tr>
<td>Eight Channel</td>
<td>RJW</td>
<td>No</td>
</tr>
</tbody>
</table>
1.2 Hardware Description

1.2.1 Headers

The EVM has standard 100-mil headers with the side closer to the device connected to ground. The side farther away from the device is mapped to the device pinout for easier connection as seen in Figure 1. The silkscreen indicates the pin function.

1.2.2 Bypass Capacitors

C1, C3, C6, and C7 are the bypass capacitors for $V_{CCA}$ while C2, C4, C5, and C8 are the bypass capacitors for $V_{CCB}$ with a value of 0.1 µF.

1.2.3 Pullup and Pulldown Resistors

The direction control and output enable pins are the inputs for the devices and should never be left floating. The CMOS inputs must be held at a known state, either $V_{CC}$ or ground, to ensure proper device operation. Refer to Implications of Slow or Floating CMOS Inputs (SCBA004). The default state of the control input is referenced to $V_{CCA}$ using a 10-kΩ pullup resistor. There is also the option of connecting the inputs to ground using pulldown resistors, or directly to ground via jumper on the header pins.

Table 5 lists the pullup and pulldown resistors.

<table>
<thead>
<tr>
<th>Device</th>
<th>Pin</th>
<th>Pullup</th>
<th>Pulldown</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Channel DTQ</td>
<td>DIR</td>
<td>R4</td>
<td>R8</td>
</tr>
<tr>
<td>One Channel DEA</td>
<td>DIR</td>
<td>R2</td>
<td>R7</td>
</tr>
<tr>
<td>Four Channel RSV(1)</td>
<td>DIR1</td>
<td>R14</td>
<td>R25</td>
</tr>
<tr>
<td></td>
<td>DIR2</td>
<td>R13</td>
<td>R26</td>
</tr>
<tr>
<td></td>
<td>1OEN</td>
<td>R12</td>
<td>R23</td>
</tr>
<tr>
<td></td>
<td>2OEN</td>
<td>R18</td>
<td>R24</td>
</tr>
<tr>
<td>Eight Channel RJW (2)</td>
<td>DIR1</td>
<td>R11</td>
<td>R28</td>
</tr>
<tr>
<td></td>
<td>DIR2</td>
<td>R10</td>
<td>R27</td>
</tr>
<tr>
<td></td>
<td>OEN</td>
<td>R9</td>
<td>R22</td>
</tr>
</tbody>
</table>

(1) Four channel considering SN74AVC4T245
(2) Eight channel considering SN74AXC8T245

1.2.4 SMB Connectors

The edge-mounted SMB connector option is provided for each of the channel versions on data I/O pins of A1 and B1, respectively, for high-speed operation. One pair of SMB connector is installed on the A and B data I/O pair of the SN74AXC1T45DTQ package while the corresponding header pin has an uninstalled R1 and R3 zero-ohm resistor.
Figure 2 illustrates the AXC-SMALLPKG1EVM layout. Increase zoom level for clarity.

Figure 2. AXC-SMALLPKG1EVM Layout
3 Schematic and Bill of Materials

3.1 Schematic

Figure 3 illustrates the AXC-SMALLPKG1EVM One channel DTQ schematic. Increase the zoom level for clarity.

Figure 3. Schematic - One Channel DTQ

Figure 4 illustrates the AXC-SMALLPKG1EVM One channel DEA schematic

Figure 4. Schematic - One Channel DEA

Figure 5 illustrates the AXC-SMALLPKG1EVM Four channel RSV schematic

Figure 5. Schematic - Four Channel RSV
Figure 5. Schematic - Four Channel RSV

Figure 6 illustrates the AXC-SMALLPKG1EVM One channel DTQ schematic

Figure 6. Schematic - Eight Channel RJW
### Bill of Materials

Table 6 lists the AXC-SMALLPKG1EVM bill of materials.

<table>
<thead>
<tr>
<th>Designator</th>
<th>Quantity</th>
<th>Value</th>
<th>Description</th>
<th>Package Reference</th>
<th>Part Number</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB1</td>
<td>1</td>
<td></td>
<td>Printed Circuit Board</td>
<td>SLHR011</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>C1, C2, C3, C4, C5, C6, C7, C8</td>
<td>8</td>
<td>0.1uF</td>
<td>CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402</td>
<td>0402</td>
<td>0402YCF104KAT2A</td>
<td>AVX</td>
</tr>
<tr>
<td>J1, J2, J5, J6</td>
<td>4</td>
<td></td>
<td>Header, 100mil, 3x2, Gold, TH</td>
<td>3x2 Header</td>
<td>TSW-103-07-G-D</td>
<td>Samtec</td>
</tr>
<tr>
<td>J3, J4</td>
<td>2</td>
<td></td>
<td>Connector, SMB Jack, End launch, SMT</td>
<td>SMB End launch Jack, SMT</td>
<td>131-3701-801</td>
<td>Cinch Connectivity</td>
</tr>
<tr>
<td>J9, J12, J15, J17</td>
<td>4</td>
<td></td>
<td>Header, 100mil, 4x2, Gold, TH</td>
<td>4x2 Header</td>
<td>TSW-106-07-G-D</td>
<td>Samtec</td>
</tr>
<tr>
<td>J10, J11, J13, J14</td>
<td>4</td>
<td></td>
<td>Header, 100mil, 4x2, Gold, TH</td>
<td>4x2 Header</td>
<td>TSW-104-07-G-D</td>
<td>Samtec</td>
</tr>
<tr>
<td>R2, R4, R10, R11, R13, R14</td>
<td>6</td>
<td>10k</td>
<td>RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402</td>
<td>0402</td>
<td>CRCW040210KJNED</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R5, R6, R15, R16, R17, R19, R20, R21</td>
<td>8</td>
<td>0</td>
<td>RES, 0, 5%, 0.063 W, 0402</td>
<td>0402</td>
<td>ERJ-2GE0R00X</td>
<td>Panasonic</td>
</tr>
<tr>
<td>R22, R23, R24</td>
<td>3</td>
<td>10k</td>
<td>RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603</td>
<td>0603</td>
<td>CRCW060310KJNEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>U1</td>
<td>1</td>
<td></td>
<td>Single-Bit Dual-Supply Bus Transceiver with Configurable Voltage-Level Shifting and 3-State Outputs, DTQ0006A (X2SON-6)</td>
<td>DTQ0006A</td>
<td>SN74AXC1T4SDTOR</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td>U2</td>
<td>1</td>
<td></td>
<td>Single-Bit Dual-Supply Bus Transceiver With Configurable Voltage Translation and 3-State Outputs, DEA0006A (X2SON-6)</td>
<td>DEA0006A</td>
<td>SN74AXC1T4DDEAR</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td>FID1, FID2, FID3</td>
<td>0</td>
<td></td>
<td>Fiducial mark. There is nothing to buy or mount.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>J7, J8, J16, J18, J19, J20, J21, J22</td>
<td>0</td>
<td></td>
<td>Connector, SMB Jack, End launch, SMT</td>
<td>SMB End launch Jack, SMT</td>
<td>131-3701-801</td>
<td>Cinch Connectivity</td>
</tr>
<tr>
<td>R1, R3</td>
<td>0</td>
<td>0</td>
<td>RES, 0, 5%, 0.063 W, 0402</td>
<td>0402</td>
<td>ERJ-2GE0R00X</td>
<td>Panasonic</td>
</tr>
<tr>
<td>R7, R8, R25, R26, R27, R28</td>
<td>0</td>
<td>10k</td>
<td>RES, 10 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603</td>
<td>0603</td>
<td>CRCW060310KJNEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R9, R12, R18</td>
<td>0</td>
<td>10k</td>
<td>RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402</td>
<td>0402</td>
<td>CRCW040210KJNED</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>U3</td>
<td>0</td>
<td></td>
<td>Quad-Bit Bus Transceiver with Configurable Voltage Translation and 3-State Outputs, RSV0016A (UQFN-16)</td>
<td>RSV0016A</td>
<td>SN74AXC4T245RSVR</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td>U4</td>
<td>0</td>
<td></td>
<td>8-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation and 3-State Outputs, RJW0024A (UQFN-24)</td>
<td>RJW0024A</td>
<td>SN74AXC8T245JWV</td>
<td>Texas Instruments</td>
</tr>
</tbody>
</table>
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3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
FCC Interference Statement for Class B EVM devices
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada
3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247
Concerning EVMs Including Radio Transmitters:
This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:
(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:
Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables
Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/ldsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/ldsds/ti_ja/general/eStore/notice_01.page

3.3.2 Notice for Users of EVMs Considered “Radio Frequency Products” in Japan: EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.
If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):
1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry’s Rule for Enforcement of Radio Law of Japan.
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or EVMs.
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.
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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。


3.3.3 Notice for EVMs for Power Line Communication: Please see http://www.tij.co.jp/lstd/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lstd/ti_ja/general/eStore/notice_02.page

3.4 European Union

3.4.1 For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 EVM Use Restrictions and Warnings:

4.1 EVMs ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 Safety-Related Warnings and Restrictions:

4.3.1 User shall operate the EVM within TI’s recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User’s handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. Accuracy of Information: To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
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