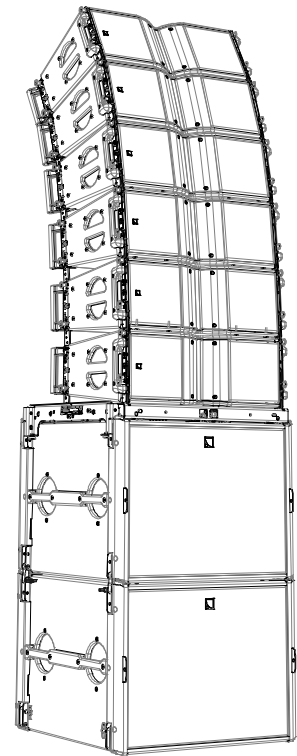
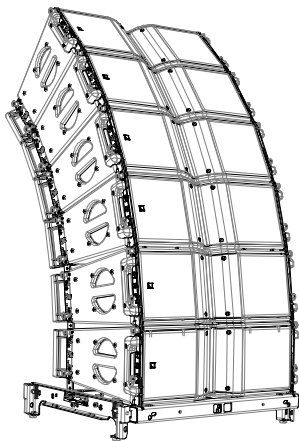
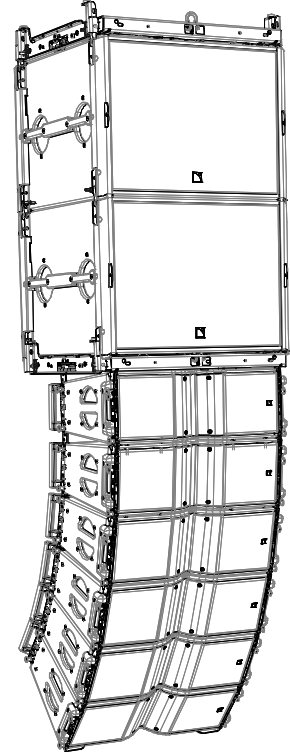
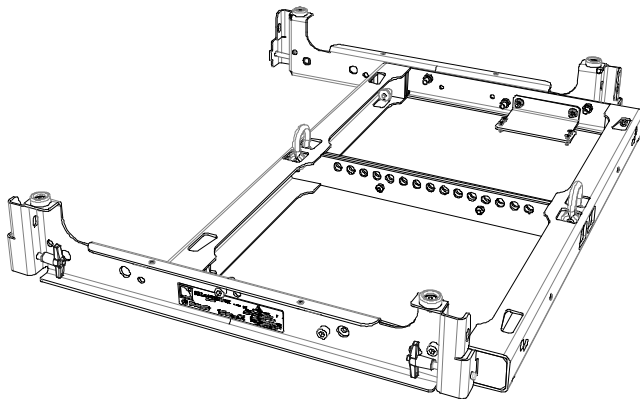
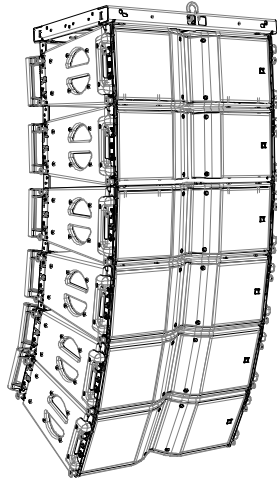


# KARA<sup>®</sup> MODULAR WST<sup>®</sup> SYSTEM

RIGGING PROCEDURES USING KARA-MINIBU

VERSION 1.0








# 1 SAFETY WARNINGS

All information hereafter detailed applies for the L-ACOUSTICS® **KARA-MINIBU** rigging structure, **KARA-MINIBUEX** extension bars, **KARA-ANGARMEX** angle arm extensions, or **KARA-PULLBACK** rigging accessory designated in this section as **the product**.



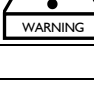

## 1.1 Symbol description

Throughout this manual the potential risks are indicated by the following symbols:

	<p>The <b>WARNING</b> symbol indicates a potential risk of physical harm to the user or people within close proximity to the product. In addition, the product may also be damaged.</p>
	<p>The <b>CAUTION</b> symbol notifies the user about information to prevent possible product damage.</p>
	<p>The <b>IMPORTANT</b> symbol is a notification of an important recommendation of use.</p>

## 1.2 Important safety instructions

1. **Read this manual**
2. **Heed all safety warnings**
3. **Follow all instructions**
4. **The user should never incorporate equipment or accessories not approved by L-ACOUSTICS®**

	<p><b>5. Personnel qualification</b> Installation and set-up should only be carried out by qualified personnel that are familiar with the rigging techniques and safety recommendations outlined in this manual. It is recommended to attend the training courses offered by L-ACOUSTICS® before proceeding with the loudspeaker assembling procedure.</p>
	<p><b>6. Personnel health and safety</b> During installation and set-up personnel should wear protective headgear and footwear at all times. Under no circumstances personnel should climb on the loudspeaker assembly.</p>
	<p><b>7. System parts and rigging inspection</b> All system components must be inspected before use in order to detect any possible defects. Please refer to the <b>Care and Maintenance</b> section of this manual as well as any other manuals pertaining to the system for a detailed description of the inspection procedure. Any part showing any sign of defect must immediately be put aside and withdrawn from use to be inspected by qualified service personnel.</p>
	<p><b>8. Additional rigging equipment</b> L-ACOUSTICS® is not responsible for any rigging equipment and accessories provided by third party manufacturers. It is the user's responsibility to verify that the Working Load Limit (WLL) of all additional hardware rigging accessories is greater than the total weight of the loudspeaker assembly in use.</p>



#### **9. Suspension points**

It is the user's responsibility to verify that the Working Load Limit (WLL) of the suspension points and/or chain hoists is greater than the total weight of the loudspeaker assembly in use.



#### **10. Loudspeaker assembly load capacity and setup safety limits**

Load capacity and setup safety limits when flying or stacking a loudspeaker assembly should be strictly followed according to the instructions outlined in this manual.

Always refer to the mechanical data and warning indications provided in SOUNDVISION Software (**Mechanical Data** section) [3.4] to ensure the mechanical conformity of the assembly before installation.



#### **11. Local regulations**

Some countries require higher Ultimate Strength Safety Factors and specific rigging approvals. It is the user's responsibility to verify that any overhead suspension of L-ACOUSTICS® loudspeaker assemblies has been made in accordance with all applicable local regulations.



#### **12. Flying a loudspeaker assembly**

Always verify that nobody is standing underneath the loudspeaker assembly when it is being raised. As the assembly is being raised check each individual component to make sure that it is securely fastened to the component above. Never leave the assembly unattended during the installation process.

As a general rule, L-ACOUSTICS® recommends the use of safety slings at all times.



#### **13. Stacking a loudspeaker assembly**

Do not ground stack the assembly on unstable ground or platform.

If the assembly is ground stacked on a structure, platform, or stage always check that the latter can support the total weight of the assembly.

As a general rule, L-ACOUSTICS® recommends the use of safety straps at all times.



#### **14. Dynamic load**

When a loudspeaker assembly is deployed in an open air environment, wind effects should be taken into account. Wind can produce dynamic stress to the rigging components and suspension points. If the wind force exceeds 6 bft (Beaufort scale) it is highly recommended to lower down and/or secure the loudspeaker assembly.



#### **15. Manual**

Keep this manual in a safe place during the product lifetime. This manual forms an integral part of the product. Reselling of the product is only possible if the user manual is available. Any changes made to the product have to be documented in writing and passed on to the buyer in the event of resale.



### 1.3 EC declaration of conformity

---

L-ACOUSTICS®

13 rue Levacher Cintrat  
Parc de la Fontaine de Jouvence  
91462 Marcoussis Cedex  
France



States that the following products:

Rigging structure, KARA-MINIBU  
Extension bars, KARA-MINIBUEX  
Angle arm extensions, KARA-ANGARMEX  
Rigging accessory, KARA-PULLBACK

Are in conformity with the provisions of:

Machinery Directive 2006/42/EC

Applied rules and standards<sup>1</sup>:

EN ISO 12100-1: 2004 (Mechanical Safety)  
DIN 18800 (Mechanical Structure)  
BGV-C1 (Mechanical Standard applied in Germany)

Established at Marcoussis, France

December 6<sup>th</sup>, 2010



Jacques Spillmann  
Head of Engineering & Design dept.

<sup>1</sup> Maximum **flown** vertical array configurations: **6 KARA** or **2 SB18/6 KARA** or **4 SB18**.  
Maximum **stacked** vertical array configuration: **6 KARA**.

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## 3 INTRODUCTION

### 3.1 Welcome to L-ACOUSTICS®

Thank you for purchasing the **L-ACOUSTICS® KARA® Modular WST® System**.

This manual contains essential information on rigging the product correctly and safely. Read this manual carefully in order to become familiar with these procedures.

**As part of a continuous evolution of techniques and standards, L-ACOUSTICS® reserves the right to change the specifications of the product and the content of this manual without prior notice.**

Should the product requires repair or if information about the warranty is needed, please contact an approved L-ACOUSTICS® distributor. The address of the nearest distributor is available on the L-ACOUSTICS® web site.

### 3.2 Symbol description

All along the manual, a bracketed number refers to a section. For example, [3.2] stands for the present **Symbol description** section.

### 3.3 Unpacking


Carefully open the shipping carton and check the product for any noticeable damage. Each L-ACOUSTICS® product is tested and inspected before leaving the factory and should arrive in perfect condition.

If found to be damaged, notify the shipping company or the distributor immediately. Only the consignee may initiate a claim with the carrier for damage incurred during shipping. Be sure to save the carton and packing materials for the carrier's inspection.

Refer to [5] for full description of the shipping carton contents.

### 3.4 Web links

Please check the L-ACOUSTICS® web site on a regular basis for latest document and software application updates. Table I provides links for all downloadable items mentioned in this manual.



ALWAYS refer to the latest document version.  
ALWAYS use the latest software application version.

**Table I: Links to documents and software applications**

<b>KARA User manual</b>	<a href="http://www.l-acoustics.com/kara">www.l-acoustics.com/kara</a>
<b>KARA Rigging procedures pack</b>	
<b>SB18 User manual</b>	<a href="http://www.l-acoustics.com/sb18">www.l-acoustics.com/sb18</a>
<b>TECH TOOLCASE Product spec sheet</b>	<a href="http://www.l-acoustics.com/tech-toolcase">www.l-acoustics.com/tech-toolcase</a>
<b>SOUNDVISION Software</b>	<a href="http://www.l-acoustics.com/soundvision">www.l-acoustics.com/soundvision</a>

## 4 KARA® SYSTEM

The **L-ACOUSTICS® KARA-MINIBU**, **KARA-MINIBUEX**, **KARA-ANGARMEX**, and **KARA-PULLBACK** elements have been designed to assemble the **KARA® Modular WST® Line Source System** as a flown or stacked vertical array.

The system approach developed by L-ACOUSTICS® for KARA consists of the elements needed to fully take advantage of the possible configurations and optimize the system. The main components of the system are (see also Figure 1 and Figure 2):

<b>KARA®</b>	⇒ Full range active 2-way modular WST® enclosure
<b>KARA-MINIBU</b>	⇒ Structure for flying or stacking a small format KARA and/or SB18 array
<b>KARA-MINIBUEX</b>	⇒ KARA-MINIBU extension accessories for SB18 rigging
<b>KARA-ANGARMEX</b>	⇒ Angle arm extensions (x2) for stacked KARA arrays
<b>KARA-PULLBACK</b>	⇒ Rigging accessory for KARA array pullback configuration
<b>SB18</b>	⇒ Compact high power subwoofer
<b>SB28</b>	⇒ High power subwoofer
<b>LA8</b>	⇒ Amplified controller
<b>LA NETWORK MANAGER</b>	⇒ Remote control software for amplified controllers
<b>SOUNDVISION</b>	⇒ Acoustical and mechanical modeling software

Each loudspeaker assembly configuration should first be modeled using **L-ACOUSTICS® SOUNDVISION Software [3.4]** to verify its mechanical conformity. Please refer to the **SOUNDVISION Help menu** to obtain a detailed description on software use.



**Figure 1: KARA system components (part 1)**



Figure 2: KARA system components (part 2)

## 5 KARA® RIGGING COMPONENTS

### 5.1 KARA-MINIBU

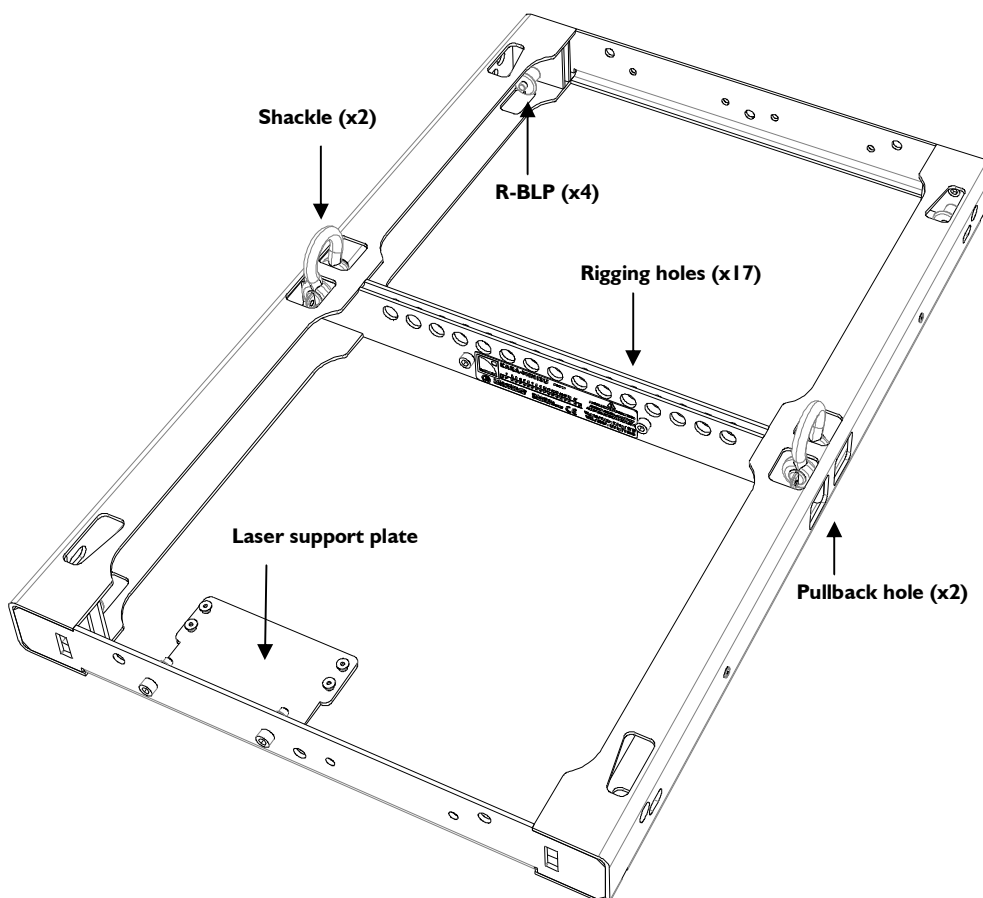
The L-ACOUSTICS® **KARA-MINIBU** rigging structure has been designed to fly or stack the **KARA®** enclosures as a variable-curvature, vertical line source array. KARA-MINIBU also allows KARA to be attached to an **SB18** subwoofer array.

**Note:** KARA-MINIBU also can fly straight vertical SB18 arrays.

The KARA-MINIBU is a **rectangular frame** fitted with the following elements:

- Four 5/16" **R-BLP** (round-shaped ball-locking pins) for KARA rigging.
- One **laser support plate** with four **bolts** for optional TEQSAS® LAP-TEQ laser/inclinometer device mounting. The LAP-TEQ is part of the **L-ACOUSTICS® TECH TOOLCASE** (refer to the **TECH TOOLCASE Product spec sheet** [3.4]).
- Two **shackles** fitted with 12 mm/0.47 inch-diameter bolts and safety pins.
- 17 shackle **holes** for rigging.
- 2 shackle **holes** for pullback configurations.

**Note:** Refer to [9.2.1] for distance between shackles.



**Figure 3: KARA-MINIBU rigging structure**

## 5.2 KARA-MINIBUEX, KARA-ANGARMEX

The L-ACOUSTICS® **KARA-MINIBUEX** is a set of two complementary rigging plates for KARA-MINIBU to adapt to the SB18 enclosure or to stack KARA.

The L-ACOUSTICS® **KARA-ANGARMEX** is a set of two angle arm extensions providing extra 10° downwards site angle for the bottom KARA in stacked configurations.

The KARA-MINIBUEX package comprises the following elements:

- Two **rigging plates** featuring two **rubber feet** each.
- Six **bolts** to assemble the KARA-MINIBU frame and two KARA-MINIBUEX plates.
- Four 5/16" **T-BLP** (T-shaped ball-locking pins) to attach an SB18 enclosure to the KARA-MINIBU/KARA-MINIBUEX structure.

The KARA-ANGARMEX package comprises two **angle arm extensions** with 5/16" **T-BLP**.

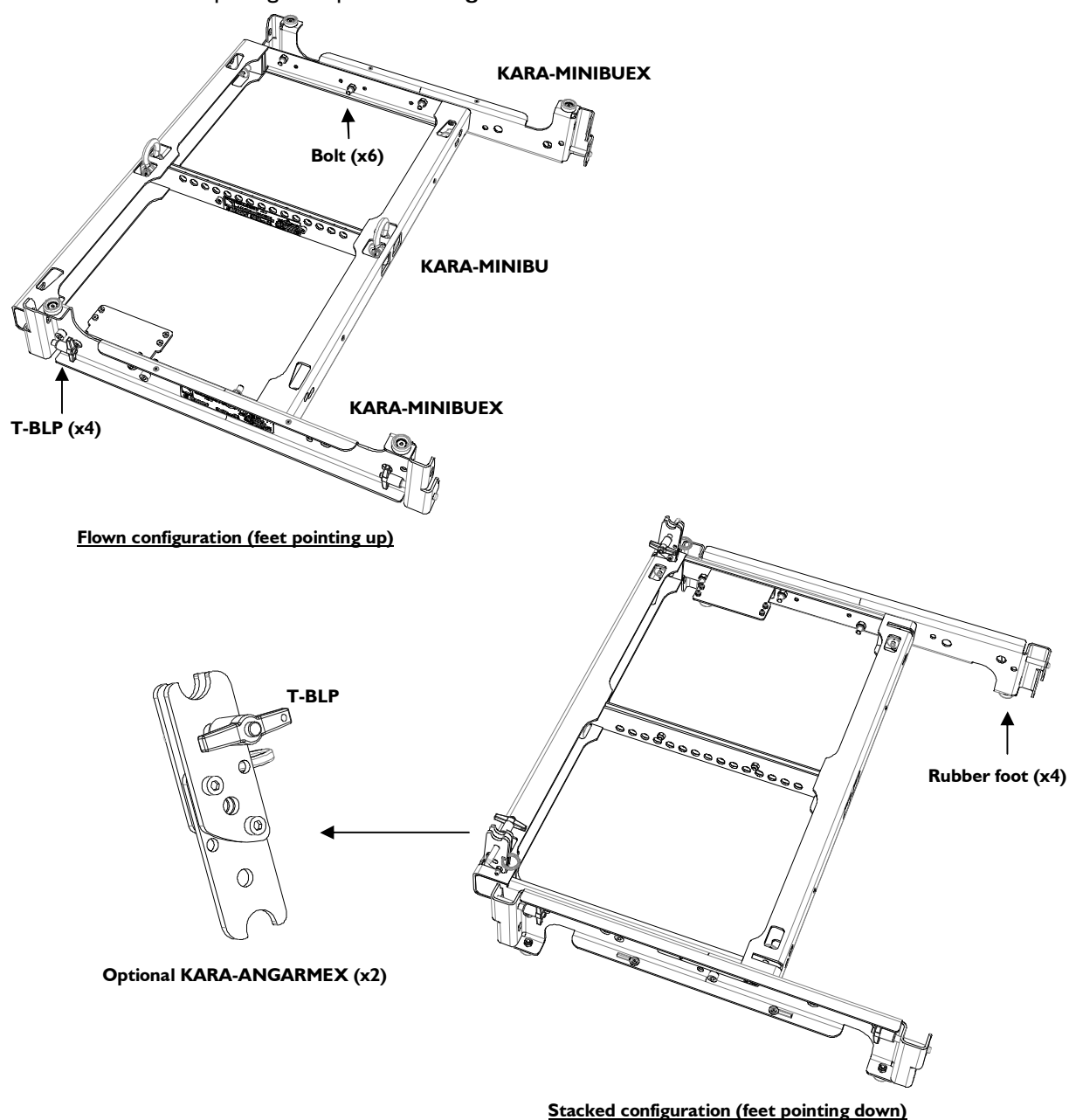
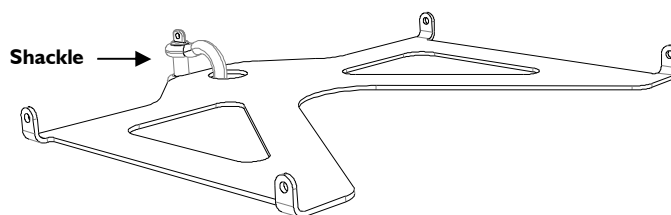


Figure 4: KARA-MINIBU/KARA-MINIBUEX rigging structure

### 5.3 KARA-PULLBACK

The L-ACOUSTICS® **KARA-PULLBACK** rigging accessory will allow setting the KARA array in a pullback configuration. It attaches to the bottom enclosure of the array and to the hook or stinger of an additional motor.

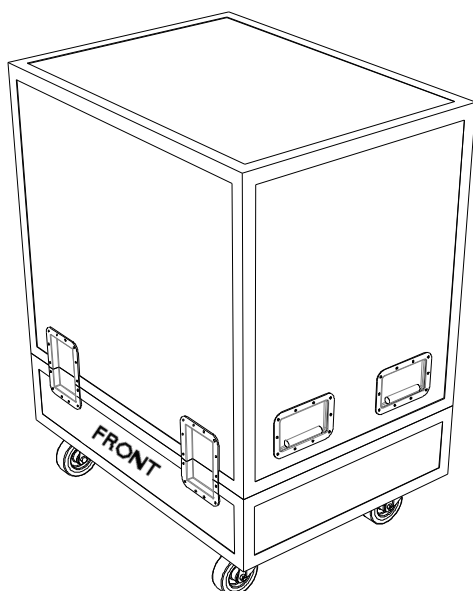
The KARA-PULLBACK is a **plate** on which is attached one **shackle** fitted with 19 mm/0.75 inch-diameter bolt and a safety pin.



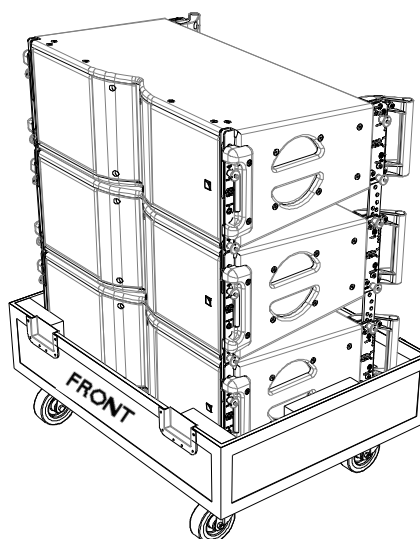
**Figure 5: KARA-PULLBACK rigging accessory**

### 5.4 Flight-case

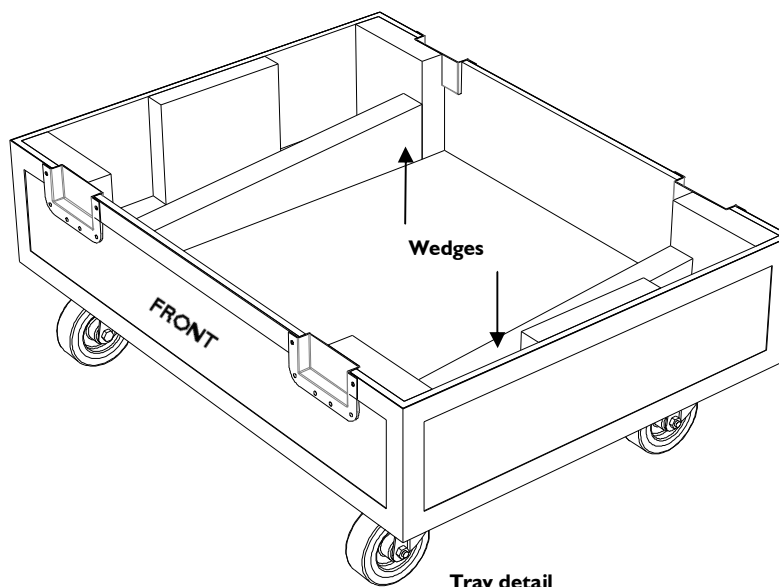
It is recommended to use a flight-case designed to ship a 3-KARA vertical array. It should contain foam inserts to prevent array movement and the tray should be fitted with 2 wedges to keep the array vertical.



**Complete flight-case**



**Tray supporting a 3-KARA array**



**Tray detail**

**Figure 6: Recommended flight-case for KARA**



## 6 INSTALLATION

### 6.1 Flying a KARA standalone array

#### 6.1.1 Modeling and safety

Any loudspeaker assembly must be modeled before installation so as to ensure acoustical and mechanical conformity. This can be done using **L-ACOUSTICS® SOUNDVISION Software** [3.4] which will assist the user to:

- Determine the number of required KARA enclosures.
- Calculate the KARA-MINIBU site angle and the inter-enclosure angles.
- Check the mechanical conformity of the loudspeaker assembly.



The KARA-MINIBU can nominally fly an array of up to **6 KARA** along with all loudspeaker cables (refer to the **KARA User manual** [3.4]). However, this maximum number can decrease in line with the array curvature.

ALWAYS refer to the mechanical data and warning indications provided in SOUNDVISION software (**Mechanical Data** section) to verify the mechanical conformity of the loudspeaker assembly before installation.

The KARA and KARA-MINIBU fully integrated rigging systems allow assembling the array with no need for any external accessory.

The following first procedure describes how to fly a vertical KARA array under a KARA-MINIBU. It is recommended to assemble the KARA by successively adding arrays of 3 enclosures (called ARRAY#1 and ARRAY#2 in the order of appearance in the procedure).

The second procedure describes how to disassemble the array.

#### 6.1.2 Array assembling procedure



All along the procedure:

STRICTLY follow the sequence of the successive steps.

SYSTEMATICALLY verify that each BLP is fully inserted.

SYSTEMATICALLY verify that the bolt is fully driven and secured by a safety pin on each shackle.



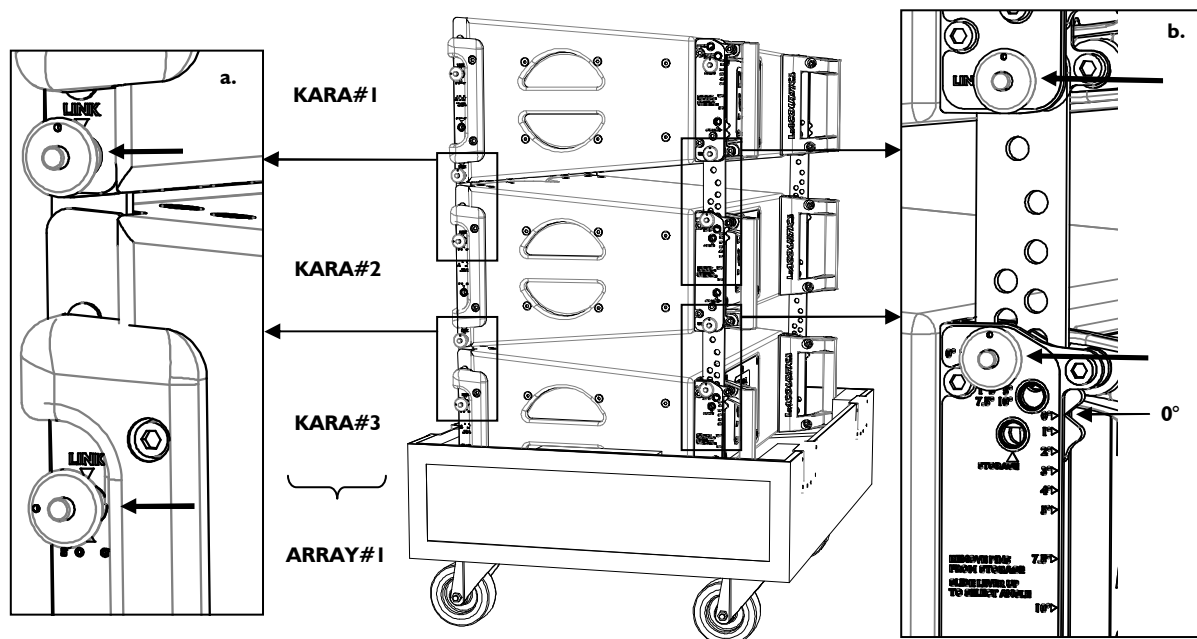
For clarity purposes the loudspeaker cabling procedure will not be described.

The loudspeaker cables will not be represented in the figures.

Use a strain relief to avoid mechanical stress at the connector locations due to cable weight.

The motor hooks or stingers will not be represented in the figures.

1. Bring a full KARA flight-case to the rigging location and remove the lid. Direct the front face of the KARA array towards the audience. In the following, the array will be designated as ARRAY#1 and the enclosures as KARA#1 to KARA#3 from top to bottom.
2. Check the inter-enclosure attachments in ARRAY#1 as follows (repeat on both sides of the array):
  - a. Verify that each front arm (x2) is open and secured to the **link** holes of two KARA by two R-BLP. **Note:** A link hole is indicated by a yellow circle.
  - b. Verify that each angle arm (x2) has the cursor aligned with the **0°** angle label and is secured to two KARA by two R-BLP, the top one being inserted into the **link** hole and the bottom one into angle hole **0°/2°/4°**.

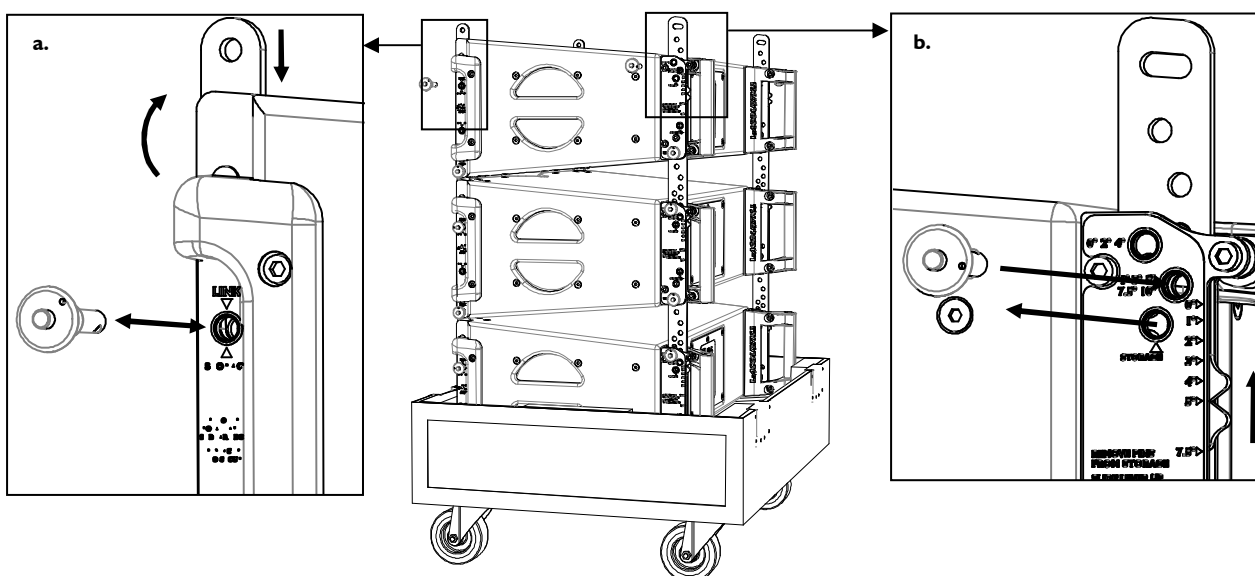


**Figure 7: Checking the ARRAY#1 inter-enclosure attachments**

3. Open the four KARA#1 arms as follows (repeat on both sides of the enclosure):
  - a. Remove the front top R-BLP from its **storage** hole, rotate the front arm up, slide it down, and lock it in place by re-inserting the R-BLP into its **link** hole. **Note:** The front top **storage** and **link** holes are the same.
  - b. Remove the rear top R-BLP from its **storage** hole, slide the angle arm so as to align the cursor with angle label **5°**, and lock it in place by re-inserting the R-BLP into angle hole **1°/3°/5°/7.5°/10°**.



It is recommended to select the 5° angle on the KARA intended to be attached to the KARA-MINIBU; in that way the KARA#1 axis will be parallel to the KARA-MINIBU.



**Figure 8: Opening the KARA#1 arms**

4. Attach a KARA-MINIBU to KARA#1 as follows:

- a. Remove the four R-BLP from the KARA-MINIBU.
- b. Turn the KARA-MINIBU so that the text of the identification plate is readable and the laser plate is placed at the front (towards audience).
- c. While keeping this orientation, align the four link points of KARA-MINIBU with the four arms of KARA#1 and secure each pair together by re-inserting the four R-BLP into the same holes (insert both rear R-BLP first).

**Note:** If KARA-MINIBUEX extension accessories are already mounted to the KARA-MINIBU (see [6.2.2, step 1]), it is not necessary to remove them: the KARA-MINIBU/KARA-MINIBUEX rigging structure can also be used in place of the KARA-MINIBU.

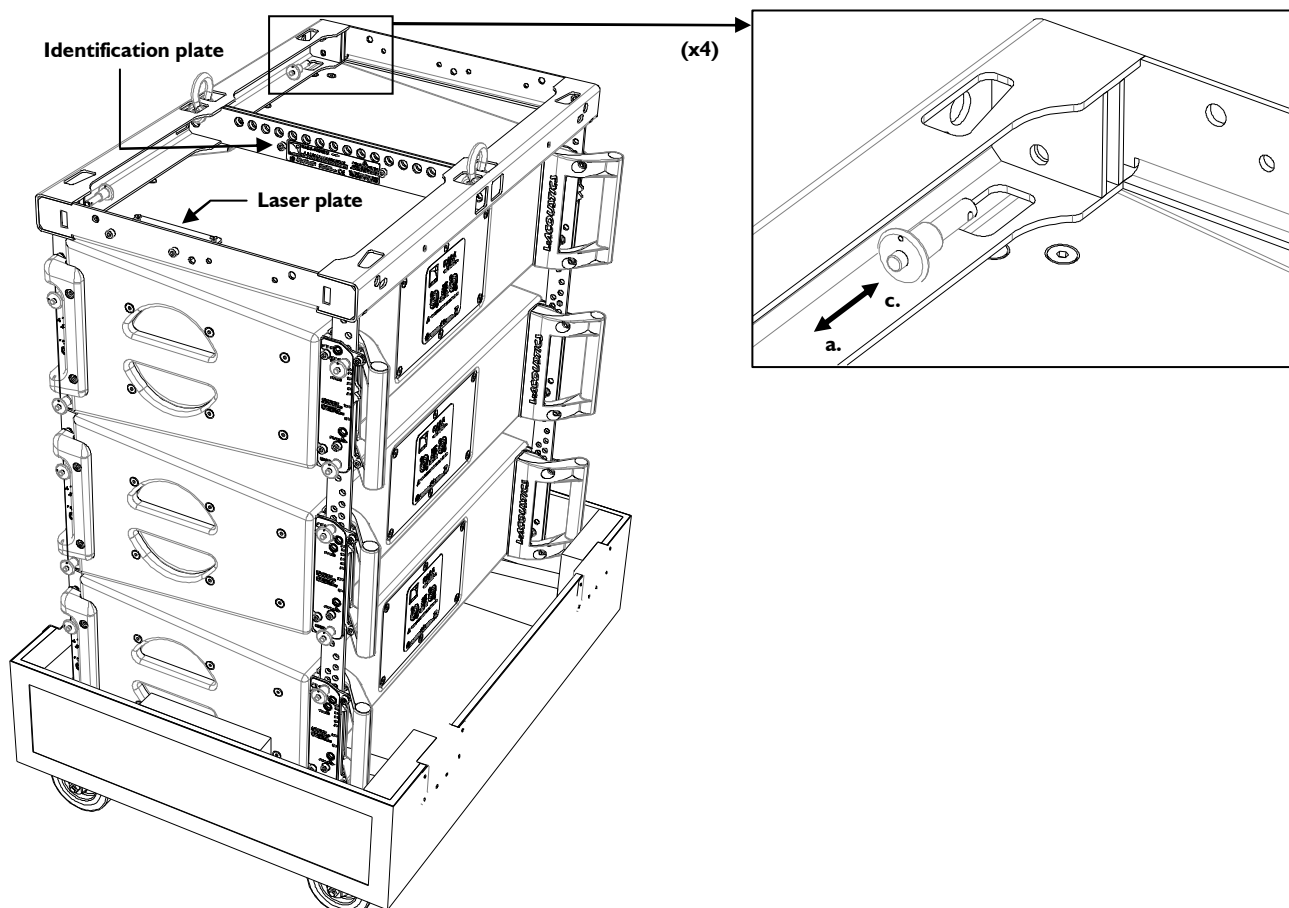
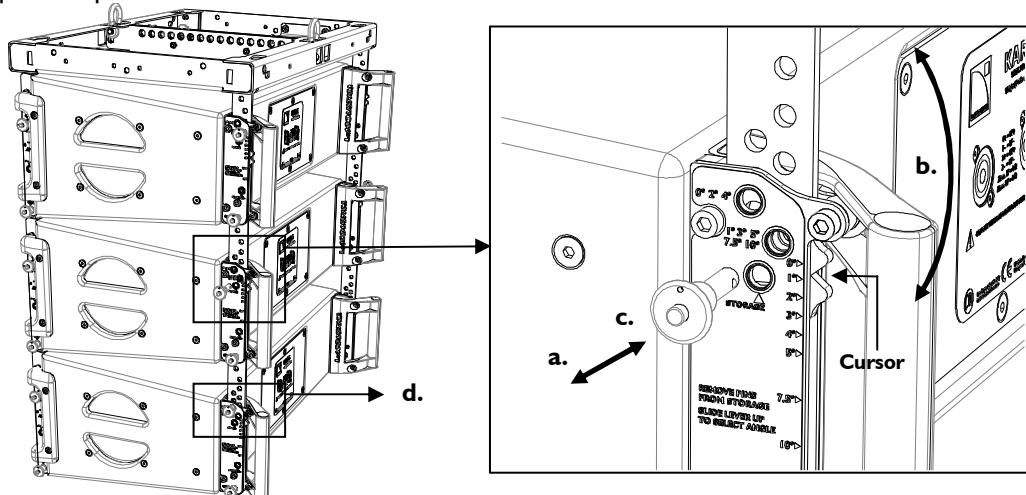


Figure 9: Attaching KARA-MINIBU to ARRAY#1

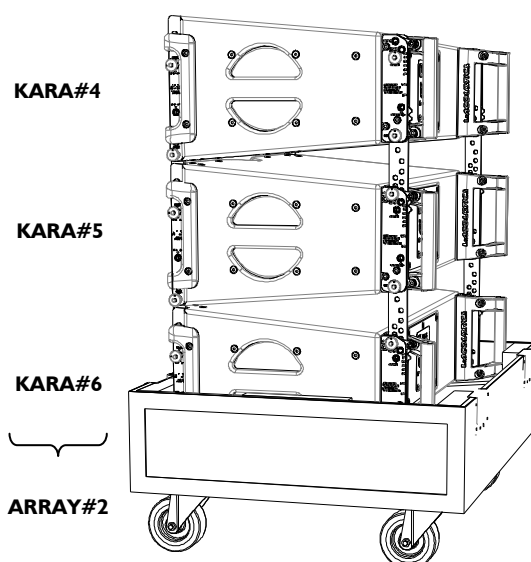
5. Attach the shackle(s) to the KARA-MINIBU [9.4] according to the chosen configuration [9.2]. **Note:** If the array is intended to be flown in pullback configuration, attach a single shackle to the rear pullback hole [5.1].
6. Place ARRAY#1 beneath the rigging points and attach the motor hook(s) or stinger(s) to the shackle(s).
7. Raise the array to a height for which the angle arms of ARRAY#1 are within comfortable reach and remove the flight-case from the rigging location.

8. With 2 people working simultaneously on each side of ARRAY#1, set the inter-enclosure angles as follows:
  - a. While grabbing the back handle of KARA#3, remove the KARA#2 rear top R-BLP from angle hole  $0^{\circ}/2^{\circ}/4^{\circ}$ .
  - b. Rotate KARA#2 so as to align the angle arm cursor with the chosen angle label.
  - c. Lock KARA#2 in place by re-inserting the R-BLP into the corresponding angle hole ( $0^{\circ}/2^{\circ}/4^{\circ}$  or  $1^{\circ}/3^{\circ}/5^{\circ}/7.5^{\circ}/10^{\circ}$ ).
  - d. Repeat the procedure for KARA#3.



**Figure 10: Setting the ARRAY#1 inter-enclosure angles**

9. Bring another full KARA flight-case to the rigging location and remove the lid. Direct the front face of the KARA array towards the audience. In the following, the array will be designated as ARRAY#2 and the enclosures as KARA#4 to KARA#6 from top to bottom.
10. Check the inter-enclosure attachments in ARRAY#2 by applying step 2.



**Figure 11: ARRAY#2 enclosure numbering convention**

11. On KARA#4, open both front arms as follows (repeat for each one): remove the front top R-BLP from its **storage** hole, rotate the front arm up, and slide it down. Do NOT re-insert the R-BLP.
12. Raise ARRAY#1 slightly higher than the front arms of ARRAY#2 and place ARRAY#2 beneath ARRAY#1.

13. Secure the front link points between ARRAY#1 and ARRAY#2 as follows:

- Slide each KARA#4 front arm up and align it with the KARA#3 front bottom link point.
- Secure each KARA#4 front arm to KARA#3 by removing the KARA#3 front bottom R-BLP from its **storage** hole and re-inserting it into its **link** hole.
- Lower the array until KARA#3 and KARA#4 front corners are in contact (keep the front arms vertical).
- Secure each front arm to KARA#4 by inserting the KARA#4 front top R-BLP into its **link** hole.

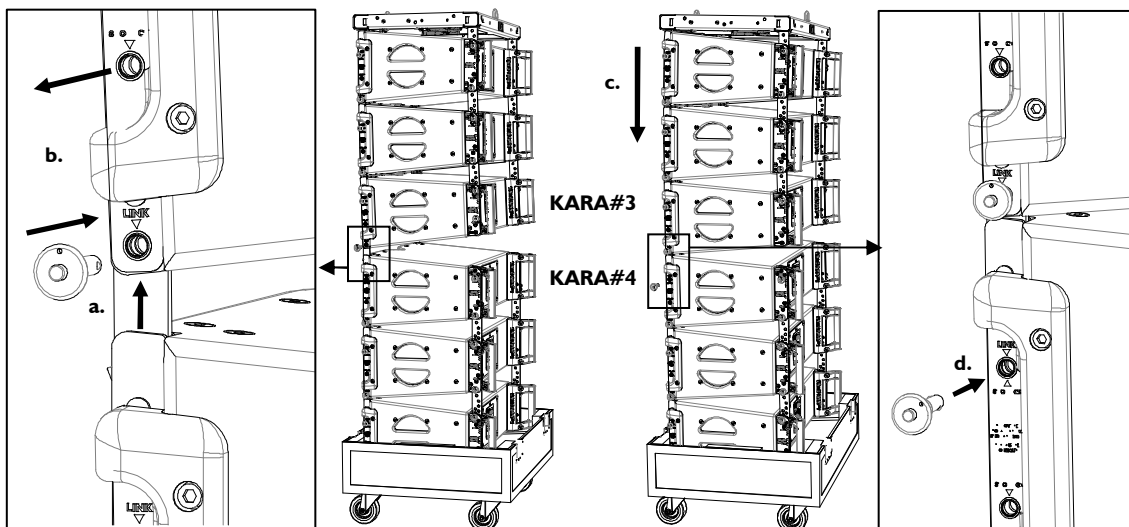


Figure 12: Securing the ARRAY#1 and ARRAY#2 front link points together

14. Raise the array to a height for which the angle arms of ARRAY#2 are within comfortable reach and remove the flight-case from the rigging location.

15. With 2 people working simultaneously on each side of the array, secure the rear link points between ARRAY#1 and ARRAY#2 as follows:

- Remove the KARA#4 rear top R-BLP from its **storage** hole, slide the angle arm so as to align the cursor with the chosen angle label, and lock it in place by re-inserting the R-BLP into the corresponding angle hole ( $0^{\circ}/2^{\circ}/4^{\circ}$  or  $1^{\circ}/3^{\circ}/5^{\circ}/7.5^{\circ}/10^{\circ}$ ).
- While grabbing the back handle of KARA#6, rotate ARRAY#2 so as to align the KARA#3 and KARA#4 rear link points.
- Lock ARRAY#2 in place by removing the KARA#3 rear bottom R-BLP from its **storage** hole and re-inserting it into its **link** hole.

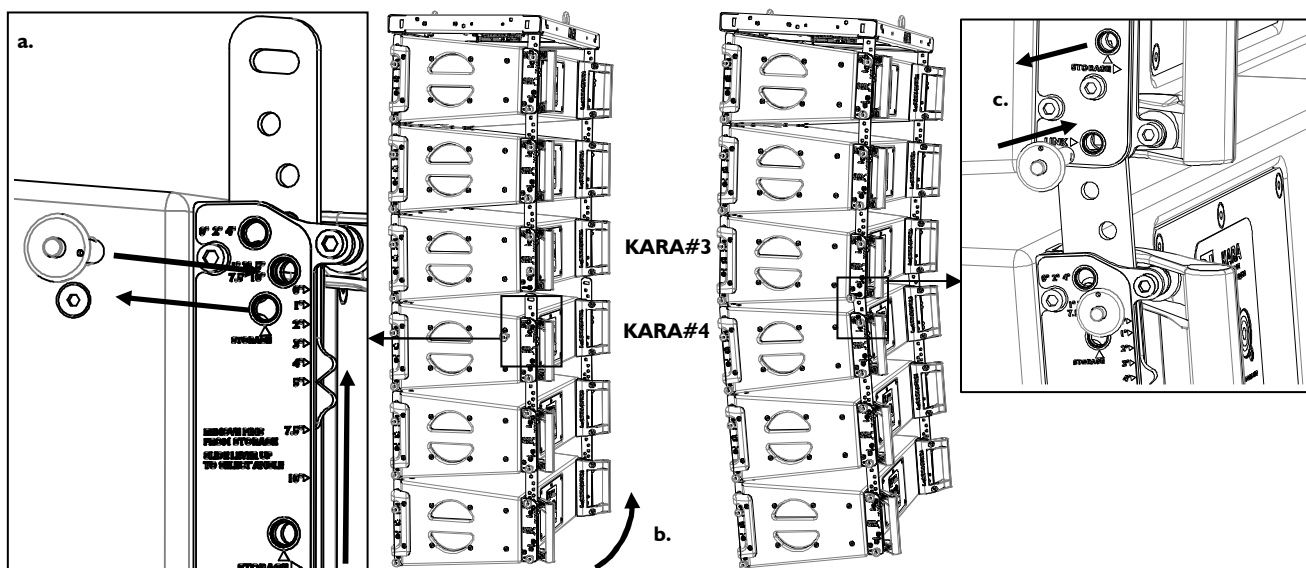
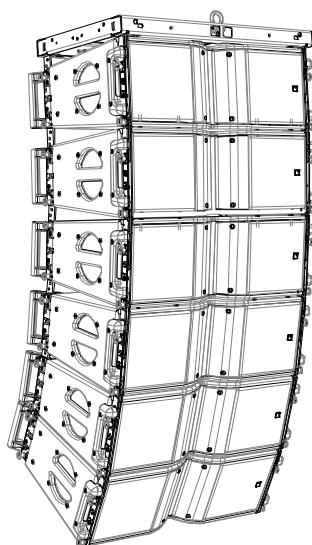


Figure 13: Securing the ARRAY#1 and ARRAY#2 rear link points together

16. Set the inter-enclosure angles in ARRAY#2 by applying step 8.

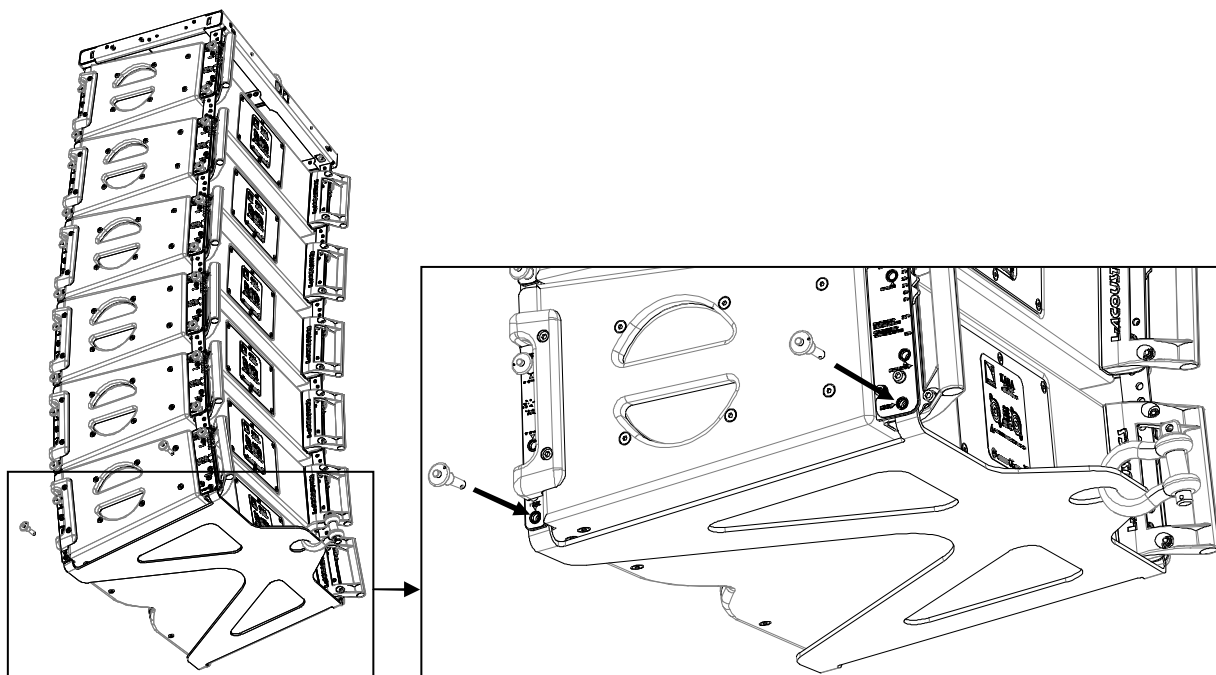


**Figure 14: Example of flown KARA homogeneous array**

17. If the array is intended to be flown in pullback configuration, attach a KARA-PULLBACK to the bottom KARA as follows:
- Align the KARA-PULLBACK studs with the KARA link points (long studs at the back).
  - Remove the four KARA bottom R-BLP from their **storage** holes and re-insert them into their **link** holes.
  - Attach the hook or stinger of an additional motor to the KARA-PULLBACK shackle.





Refer to [9.2.3] for KARA-PULLBACK setup safety limits.



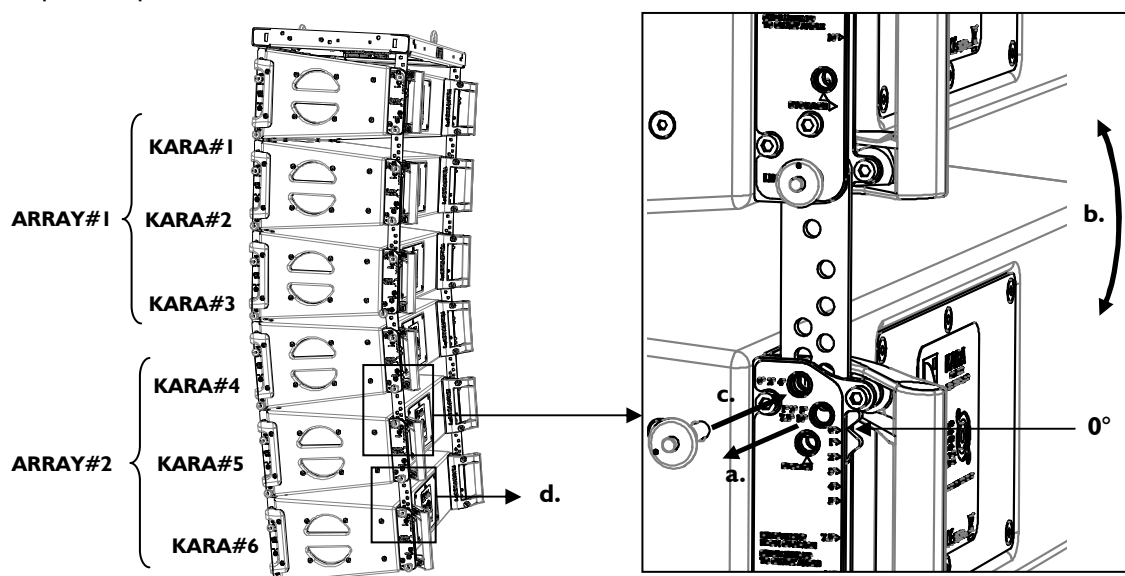
**Figure 15: Attaching KARA-PULLBACK to KARA**

18. Raise the array to the chosen height and adjust the site angle [9.2.2].
19. Secure the KARA-MINIBU to the main rigging structure by using two safety slings (not included).

### 6.1.3 Array disassembling procedure


 <small>WARNING</small>	<p>All along the procedure:  <b>STRICTLY</b> follow the sequence of the successive steps.  <b>SYSTEMATICALLY</b> verify that each BLP is fully inserted.</p>
 <small>CAUTION</small>	<p>For clarity purposes the loudspeaker cable removal procedure will not be described.          The loudspeaker cables will not be represented in the figures.</p>

1. Detach both safety slings from the KARA-MINIBU.
2. Lower the array to a height for which the angle arms of ARRAY#2 are within comfortable reach.
3. If the array to disassemble has been flown in pullback configuration, separate the KARA-PULLBACK from the bottom KARA as follows:
  - a. Lower the pullback chain so as to release tension and detach the motor hook or stinger from the shackle.
  - b. While holding the KARA-PULLBACK, remove the four KARA bottom R-BLP from their **link** holes and re-insert them into their **storage** holes.
  - c. Remove the KARA-PULLBACK.
4. With 2 people working simultaneously on each side of ARRAY#2, set the inter-enclosure angles to 0° as follows:
  - a. While grabbing the back handle of KARA#6, remove the KARA#5 rear top R-BLP from its angle hole.
  - b. Rotate KARA#5 so as to align the cursor of the angle arm with angle label 0°.
  - c. Lock KARA#5 in place by re-inserting the R-BLP into angle hole 0°/2°/4°.
  - d. Repeat the procedure for KARA#6.



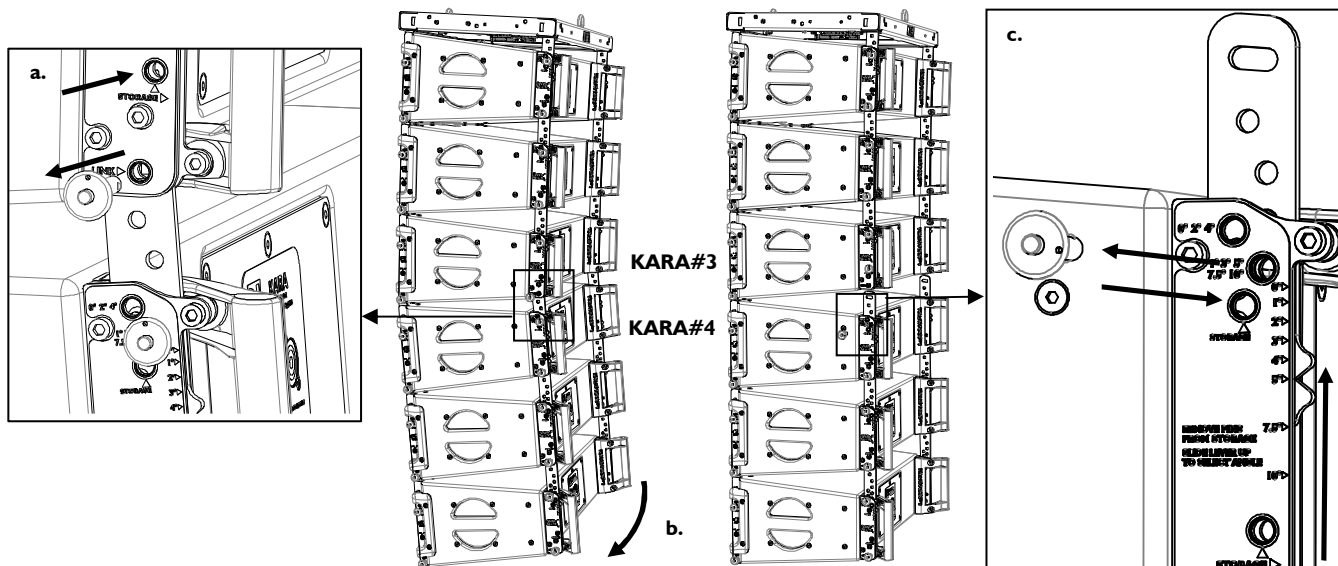
**Figure 16: Setting the ARRAY#2 inter-enclosure angles**

5. Bring an empty KARA flight-case to the rigging location, remove the lid, and place the tray beneath ARRAY#2.

 <small>WARNING</small>	<p>Pay attention to the tray position: both wedges must slope upwards from front to rear [5.4].</p>
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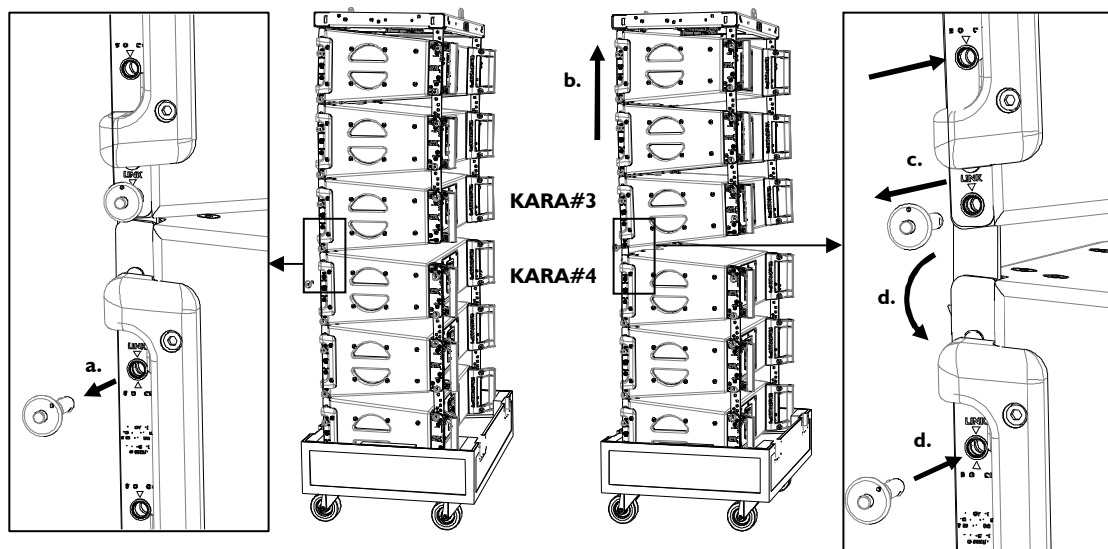
6. Lower the array slightly higher than the tray.

7. With 2 people working simultaneously on each side of the array, disconnect the rear link points between ARRAY#1 and ARRAY#2 as follows:
  - a. While grabbing the back handle of KARA#5, remove the KARA#3 rear bottom R-BLP from its **link** hole and re-insert it into its **storage** hole.
  - b. Rotate ARRAY#2 downwards and position the rear corners into the tray while still suspended from the front link points.
  - c. Remove the KARA#4 rear top R-BLP from its angle hole, slide the angle arm so as to align the cursor with the **storage** label, and re-insert the R-BLP into its **storage** hole.



**Figure 17: Disconnecting the ARRAY#1 and ARRAY#2 rear link points**

8. Lower the array until ARRAY#2 rests in the tray and the front link points between ARRAY#2 and ARRAY#1 are in contact.
9. Disconnect the front link points between ARRAY#1 and ARRAY#2 as follows:
  - a. Remove both KARA#4 front top R-BLP from their **link** holes.
  - b. Slightly raise ARRAY#1 so that it is no longer in contact with ARRAY#2.
  - c. Remove both KARA#3 front bottom R-BLP from their **link** holes and re-insert them into their **storage** holes.
  - d. Rotate both KARA#4 front arms down and re-insert both front top R-BLP into their **storage** holes. **Note:** The front top **storage** and **link** holes are the same.



**Figure 18: Disconnecting the ARRAY#1 and ARRAY#2 front link points**



10. Remove ARRAY#2 from the rigging location and put the flight-case lid on.
11. Lower the array to a height for which the angle arms of ARRAY#1 are within comfortable reach and set the angles to 0° by applying step 4.
12. Bring another empty flight-case to the rigging location, remove the lid, and place the tray beneath ARRAY#1.



Pay attention to the tray position: both wedges must slope upwards from front to rear [5.4].

13. Lower ARRAY#1 into the tray. Lower the motor chain(s) so as to release tension.
14. Separate the KARA-MINIBU from KARA#1 as follows:
  - a. Detach the motor hook(s) or stinger(s) from the KARA-MINIBU.
  - b. Remove the four R-BLP from the KARA-MINIBU.
  - c. Separate the KARA-MINIBU from KARA#1 and re-insert the four R-BLP into the same holes.

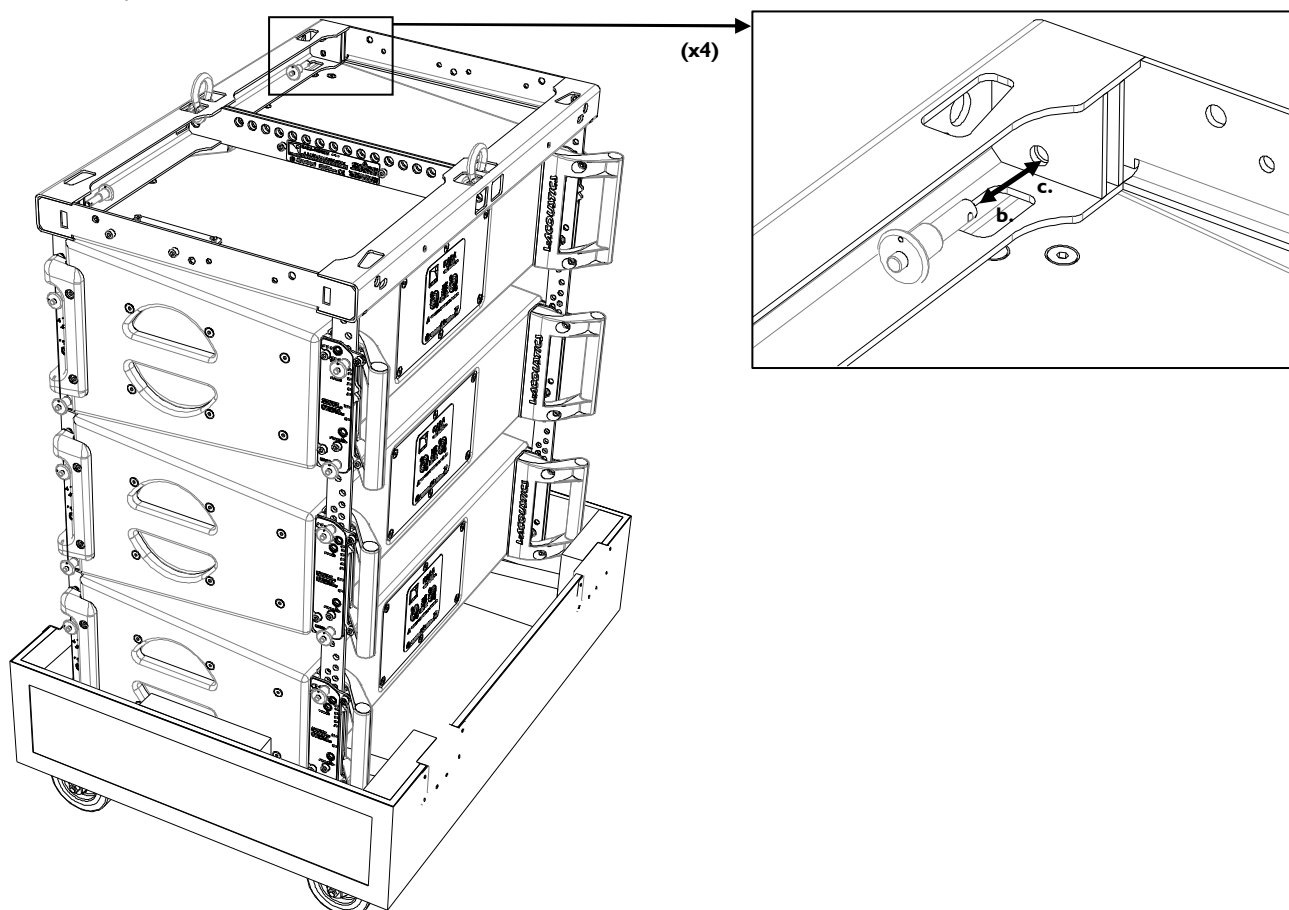
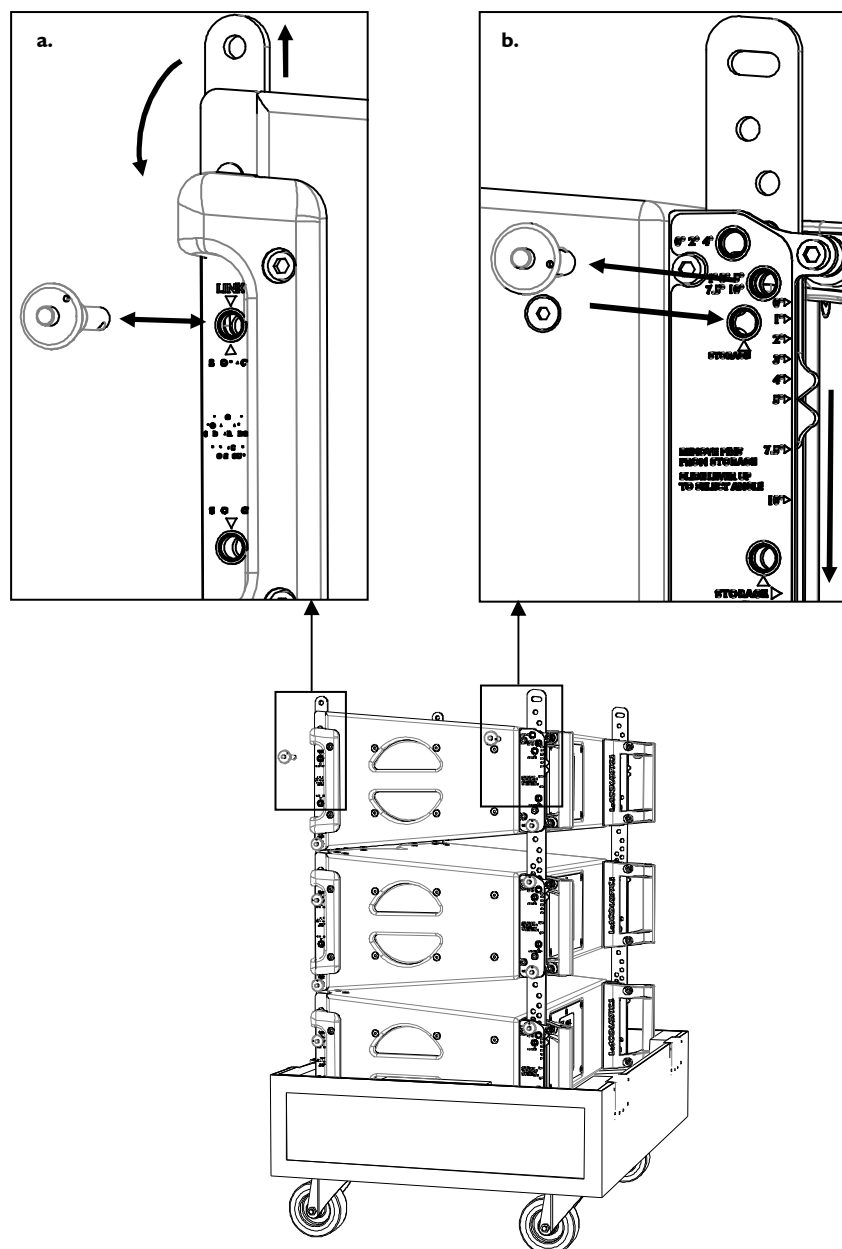


Figure 19: Separating KARA-MINIBU from KARA#1

**15.** Close the four KARA#1 arms as follows (repeat on both sides of the enclosure):

- a. Remove the front top R-BLP from its **link** hole, slide the front arm up, rotate it down, and lock it in place by re-inserting the R-BLP into its **storage** hole.
- b. Remove the rear top R-BLP from its angle hole, slide the angle arm so as to align the cursor with the **storage** label, and lock it in place by re-inserting the R-BLP into its **storage** hole.



**Figure 20: Closing the KARA#1 arms**


**16.** Put the flight-case lid on.


## 6.2 Flying a SB18/KARA mixed array or a SB18 standalone array

### 6.2.1 Modeling and safety

Any loudspeaker assembly must be modeled before installation so as to ensure acoustical and mechanical conformity. This can be done using **L-ACOUSTICS® SOUNDVISION Software** [3.4] which will assist the user to:

- Determine the number of required KARA enclosures (acoustic data not available for subwoofers).
- Calculate the array site angle and the inter-enclosure angles.
- Check the mechanical conformity of the loudspeaker assembly.


	<p>The KARA-MINIBU/KARA-MINIBUEX structure can nominally fly an array of up to <b>2 SB18/6 KARA</b> or <b>4 SB18</b> along with all loudspeakers cables (refer to the <b>KARA and SB18 User manuals</b> [3.4]). However, this maximum number can decrease in line with the array curvature.</p> <p>ALWAYS refer to the mechanical data and warning indications provided in SOUNDVISION software (<b>Mechanical Data</b> section) to verify the mechanical conformity of the loudspeaker assembly before installation.</p>
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	<p>NEVER assemble an array containing an M-BUMP on top and a KARA-MINIBU/KARA-MINIBUEX between SB18 and KARA for mechanical stress purposes (refer to the <b>KARA Rigging procedures pack</b> [3.4] for M-BUMP description).</p> <p>On the contrary, it is possible to assemble an array containing a KARA-MINIBU/KARA-MINIBUEX on top and an M-BUMP between SB18 and KARA. In such a case, select the KARA-MINIBU/KARA-MINIBUEX structure in SOUNDVISION to verify the mechanical conformity of the loudspeaker assembly.</p>
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The KARA, SB18, KARA-MINIBU, and KARA-MINIBUEX fully integrated rigging systems allow assembling the array with no need for any external accessory.

The following first procedure describes how to fly a vertical SB18/KARA array using two KARA-MINIBU/KARA-MINIBUEX rigging structures. It is recommended to assemble the KARA by successively adding arrays of 3 enclosures (called ARRAY#1, ARRAY#2 in the order of appearance in the procedure). The second procedure describes how to disassemble the array.

### 6.2.2 Array assembling procedure

	<p>All along the procedure: STRICTLY follow the sequence of the successive steps. SYSTEMATICALLY verify that each BLP is fully inserted. SYSTEMATICALLY verify that the bolt is fully driven and secured by a safety pin on each shackle. SYSTEMATICALLY verify that each bolt is fully driven on the KARA-MINIBUEX.</p>
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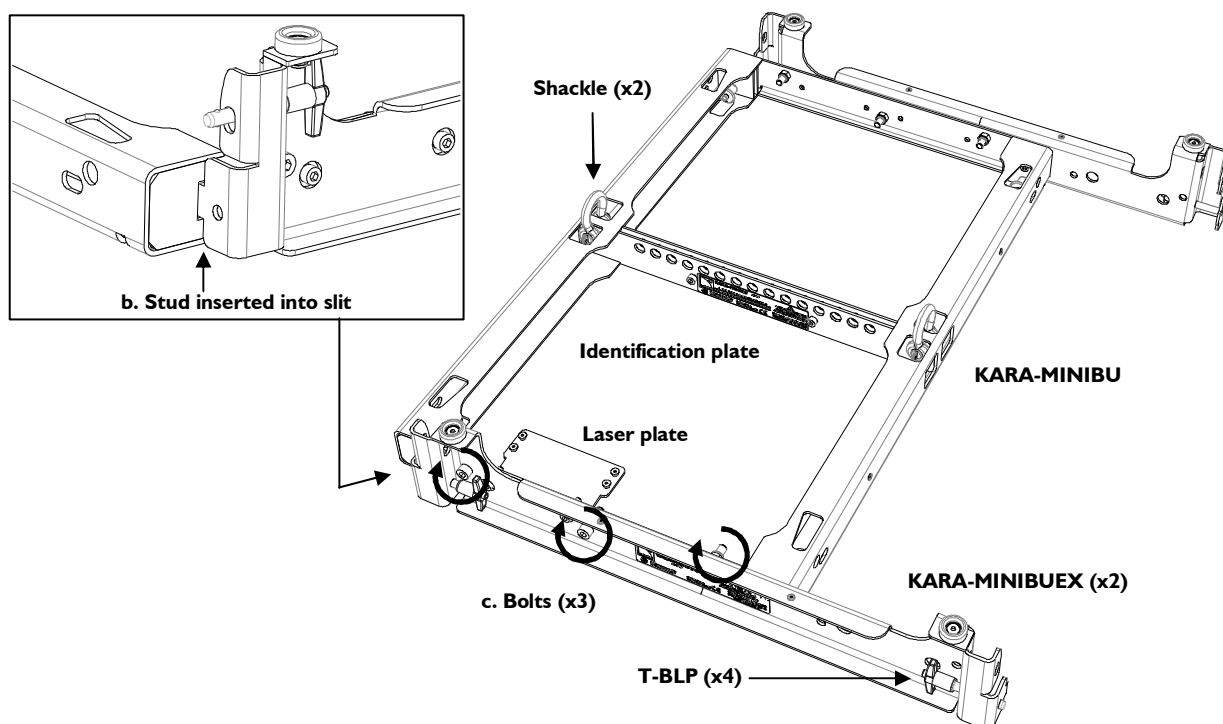
	<p>For clarity purposes the loudspeaker cabling procedure will not be described. The loudspeaker cables will not be represented in the figures. Use a strain relief to avoid mechanical stress at the connector locations due to cable weight. The motor hooks or stingers will not be represented in the figures.</p>
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#### Required tools

Electric screwdriver with torque selector (N.m or in.lb<sub>f</sub>), 6 mm hex bit, 13 mm hex key.

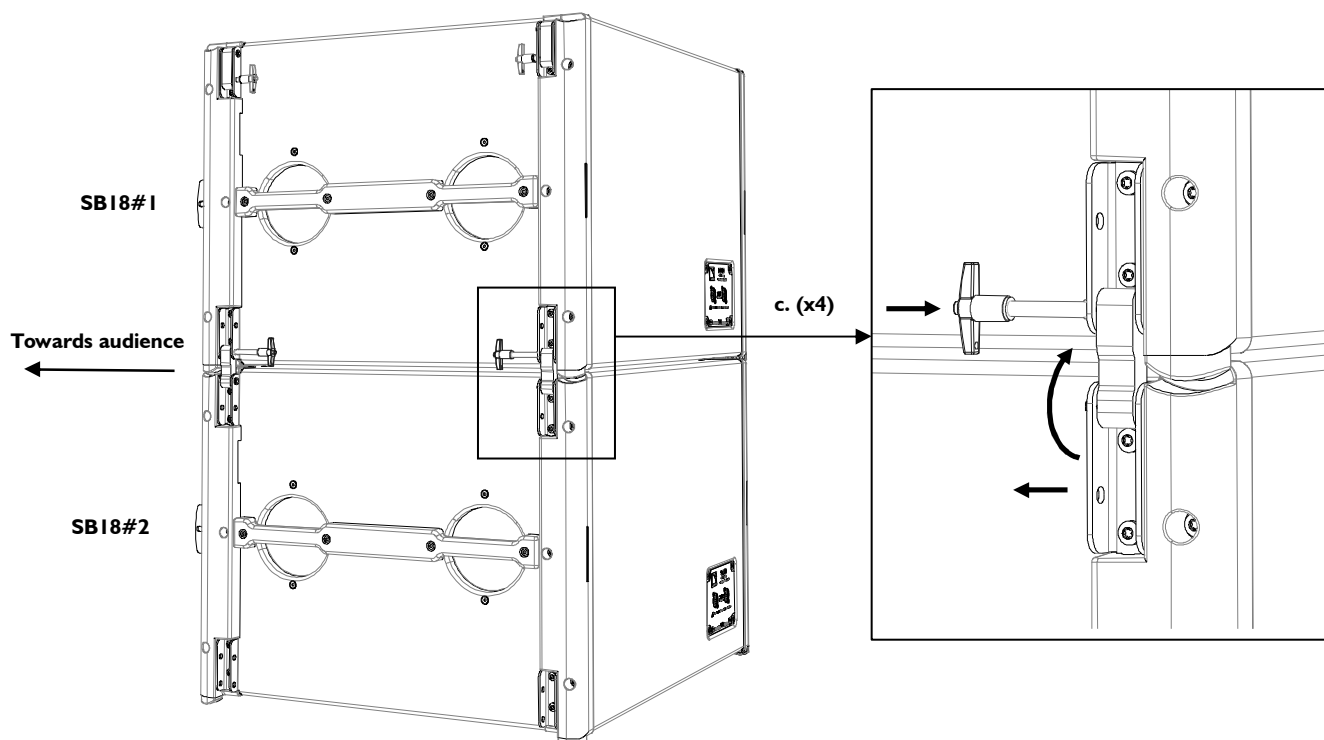
#### Procedure

- I. Assemble a KARA-MINIBU/KARA-MINIBUEX rigging structure as follows:
  - a. Turn the KARA-MINIBU so that the text of the identification plate is readable.
  - b. Position a first KARA-MINIBUEX on the laser plate side of the KARA-MINIBU by turning it feet pointing up and inserting the stud into the slit of the KARA-MINIBU located near the laser plate.
  - c. Drive 3 bolts into the 3 holes shown in Figure 21 (6 mm hex bit, 13 mm hex key, 7 N.m/63 in.lb<sub>f</sub>).
  - d. Repeat the procedure with a second KARA-MINIBUEX on the other side of the KARA-MINIBU.
  - e. Attach the shackle(s) to the KARA-MINIBU [9.4] according to the chosen configuration [9.2]. **Note:** If the array is intended to be flown in pullback configuration, attach a single shackle to the rear pullback hole [5.1].



**Figure 21: Assembling a KARA-MINIBU/KARAMINIBUEX rigging structure**

2. Assemble two SB18 (hereafter called SB18#1 and SB18#2) at the rigging location as follows:
  - a. Bring two SB18 to the rigging location and remove the dolly boards.
  - b. Arrange both SB18 in a vertical array, front faces towards audience and logos down. In the following, SB18#1 will designate the top subwoofer and SB18#2 the bottom one.
  - c. Remove a T-BLP from SB18#2, rotate the link arm up, and re-insert the T-BLP into the SB18#1 link point and the link arm. Repeat this procedure until all four arms are secured.



**Figure 22: Assembling two SB18**

3. Attach the rigging structure to SB18#1 as follows:
  - a. Remove the four T-BLP from the top part of SB18#1 and turn the four link arms up.
  - b. According to the chosen configuration [9.2], position the rigging structure above SB18#1 and lower it so as to slide the SB18#1 link arms into the KARA-MINIBUEX arm guides.
  - c. Re-insert the four T-BLP into the KARA-MINIBUEX link points and the SB18#1 link arms.

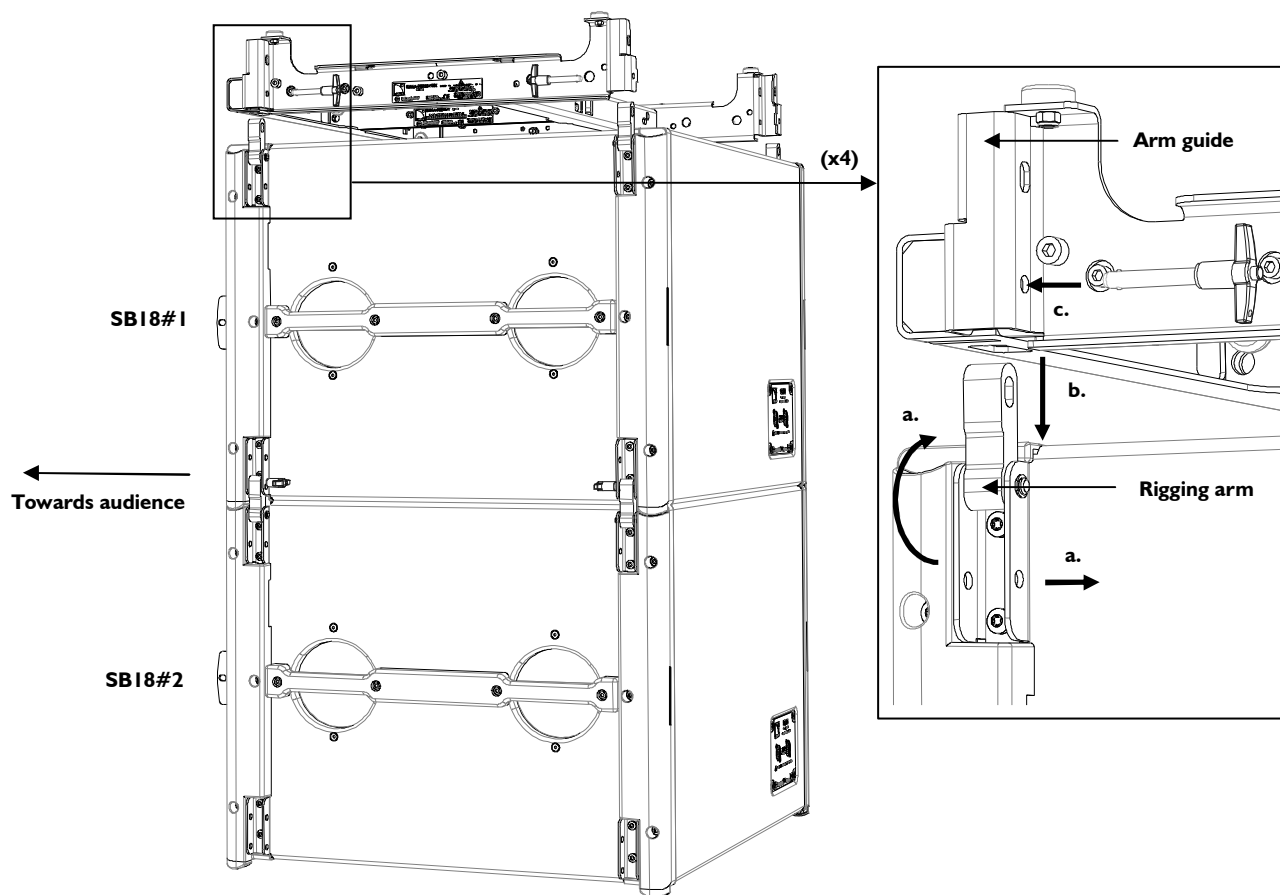


Figure 23: Attaching the rigging structure to SB18#1

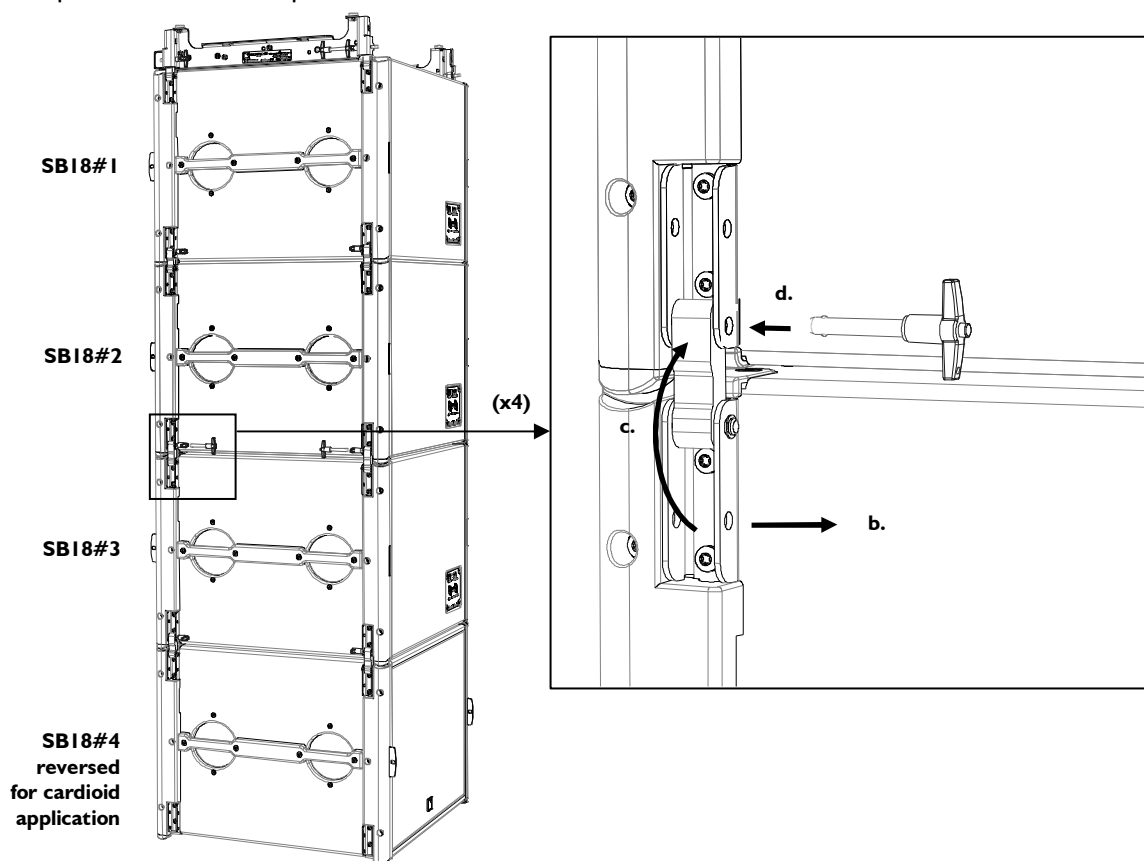
4. Attach the motor hook(s) or stinger(s) to the shackle(s) and raise the array to a height of 1.3 m/4.3 ft.
5. If the array is intended to be a SB18/KARA mixed array, directly go to step 9.

If the array is intended to be a SB18 standalone array, assemble two additional SB18 enclosures (hereafter called SB18#3 and SB18#4) under the array by applying step 2 and then continue the procedure from step 6 below.



Turn the front faces of all SB18 composing the array towards the audience to obtain an **omnidirectional** acoustic pattern or turn one SB18 every fourth from front to rear to obtain a **cardioid** acoustic pattern (refer to the **SB18 User manual** [3.4]). As an example, Figure 24 shows a cardioid array.

6. Attach SB18#3 to SB18#2 as follows:
  - a. While aligning the four link points between SB18#2 and SB18#3, lower the array onto SB18#3.
  - b. Remove a T-BLP from SB18#3.
  - c. Rotate the link arm up.
  - d. Secure the link arm to SB18#2 by re-inserting the T-BLP into the SB18#2 bottom link point.
  - e. Repeat the last three steps until all four arms are secured to SB18#2.



**Figure 24: Attaching SB18#3 to SB18#2**

7. Raise the array to the chosen height.
8. Secure the KARA-MINIBU to the main rigging structure by using two safety slings (not included).

**END OF THE PROCEDURE**

9. Bring a full KARA flight-case to the rigging location and remove the lid. Direct the front face of the KARA array towards the audience. In the following, the array will be designated as ARRAY#1 and the enclosures as KARA#1 to KARA#3 from top to bottom.

10. Check the inter-enclosure attachments in ARRAY#1 as follows (repeat on both sides of the array):
- Verify that each front arm (x2) is open and secured to the **link** holes of two KARA by two R-BLP. **Note:** A link hole is indicated by a yellow circle.
  - Verify that each angle arm (x2) has the cursor aligned with angle label  $0^\circ$  and is secured to two KARA by two R-BLP, the top one being inserted into the **link** hole and the bottom one into angle hole  $0^\circ/2^\circ/4^\circ$ .

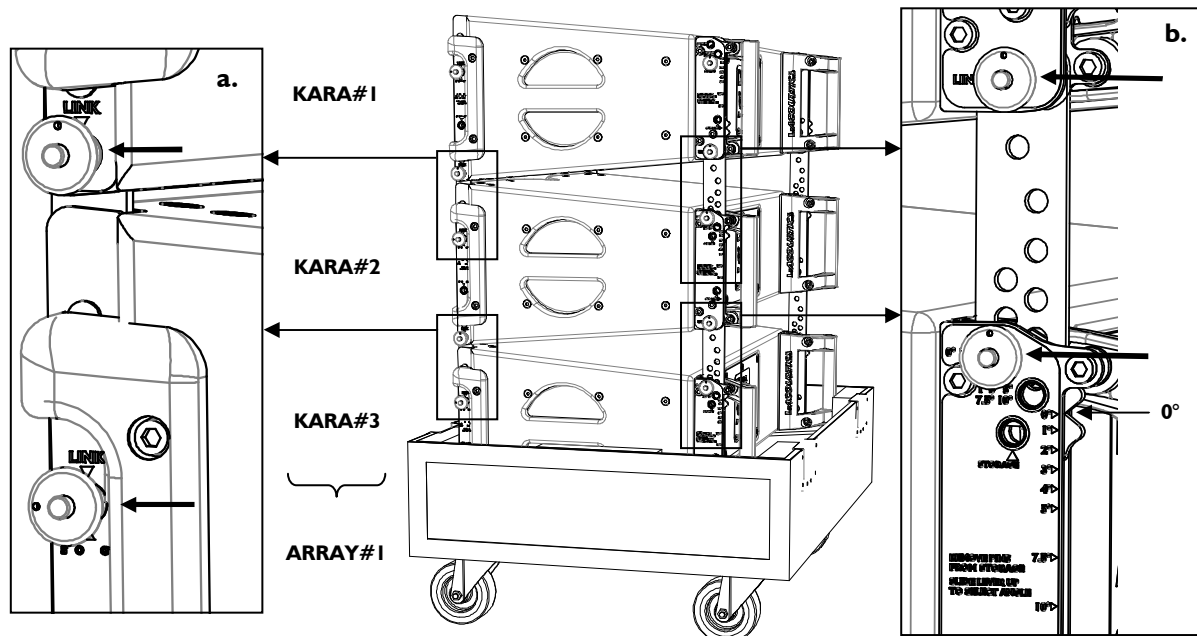



Figure 25: Checking the ARRAY#1 inter-enclosure attachments

11. Open the four KARA#1 arms as follows (repeat on both sides of the enclosure):
- Remove the front top R-BLP from its **storage** hole, rotate the front arm up, slide it down, and lock it in place by re-inserting the R-BLP into the front top **link** hole. **Note:** The front top **storage** and **link** holes are the same.
  - Remove the rear top R-BLP from its **storage** hole, slide the angle arm so as to align the cursor with angle label  $5^\circ$ , and lock it in place by re-inserting the R-BLP into angle hole  $1^\circ/3^\circ/5^\circ/7.5^\circ/10^\circ$ .

 It is recommended to select the  $5^\circ$  angle on the KARA intended to be attached to the KARA-MINIBU; in that way the KARA#1 axis will be parallel to the KARA-MINIBU.

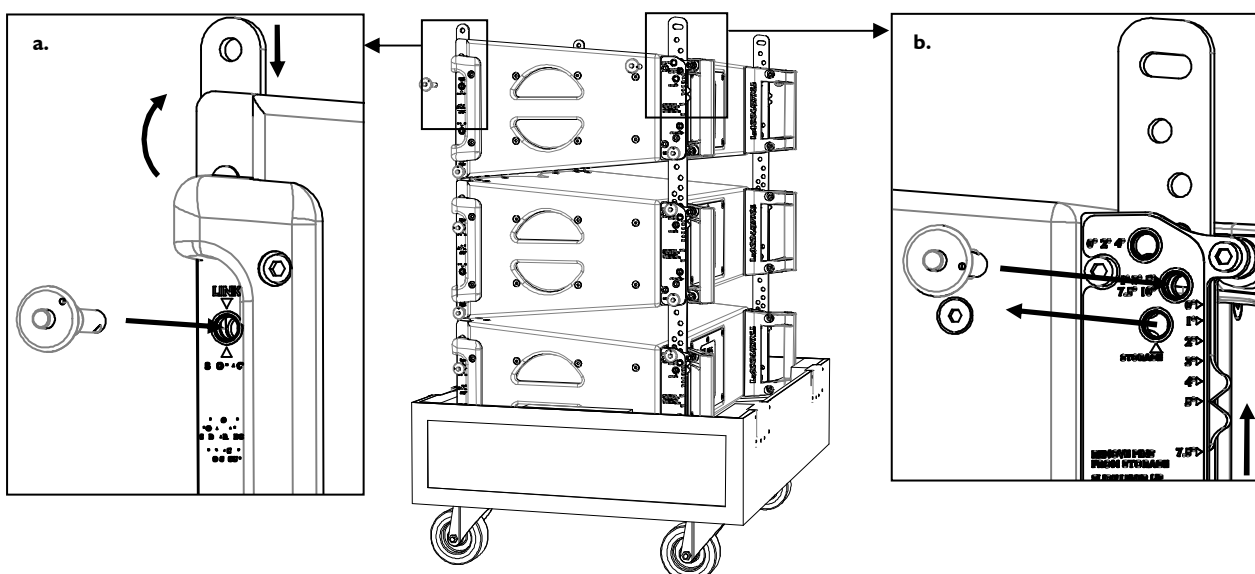
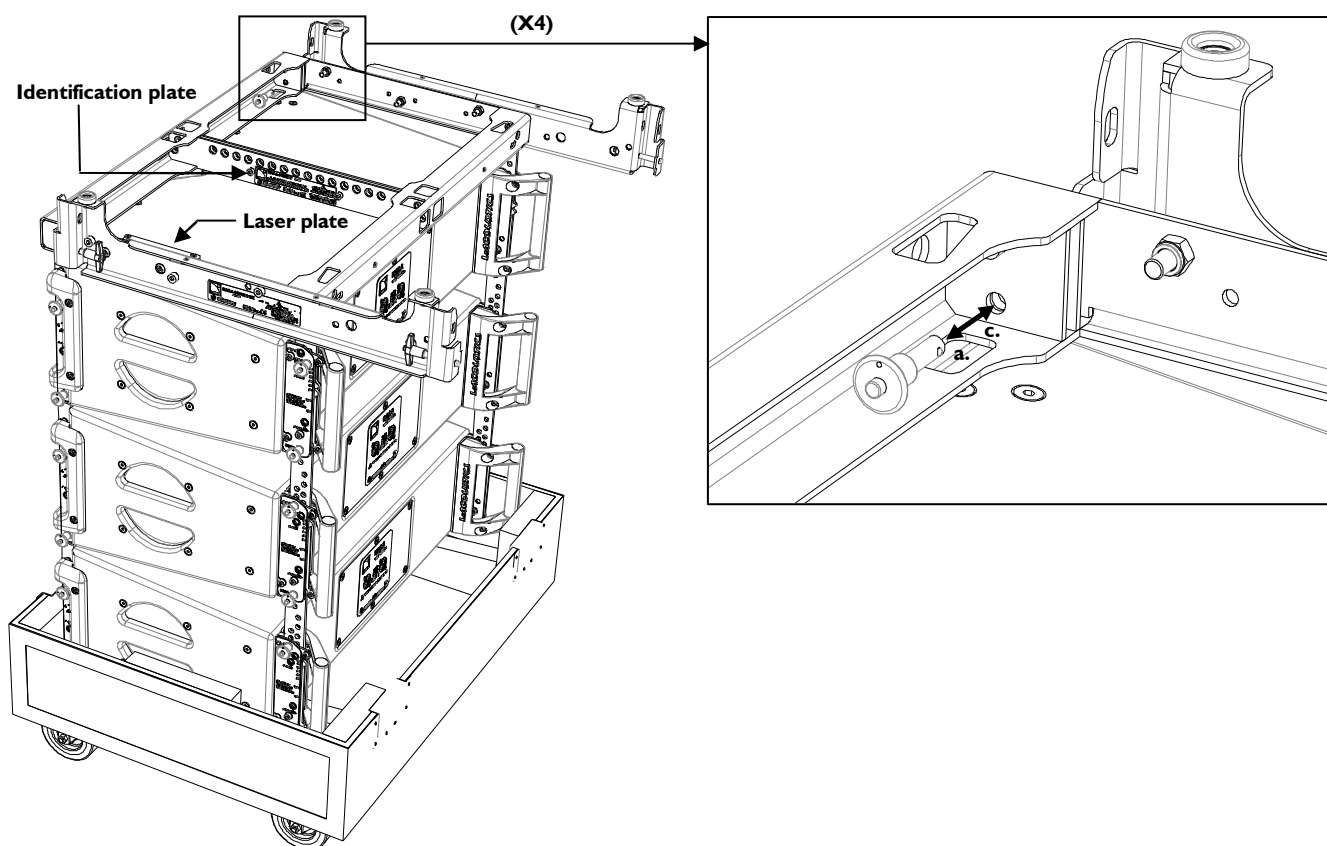


Figure 26: Opening the KARA#1 arms

12. Assemble another KARA-MINIBU/KARA-MINIBUEX rigging structure by applying step 1 WITHOUT attaching shackles.
13. Attach the rigging structure to KARA#1 as follows:
  - a. Remove the four R-BLP from the KARA-MINIBU.
  - b. Turn the KARA-MINIBU so that the text of the identification plate is readable and the laser plate is placed at the front (towards the audience).
  - c. While keeping this orientation, align the four link points of KARA-MINIBU with the four arms of KARA#1 and secure each pair together by re-inserting the four R-BLP into the same holes (insert both rear R-BLP first).

**Note:** The KARA-MINIBUEX elements must extend beyond the rear of the array.



**Figure 27: Attaching the rigging structure to ARRAY#1**

14. Place ARRAY#1 beneath the SB18 array.



15. Attach ARRAY#1 to the SB18 array as follows:

- Remove the four T-BLP from the storage holes of both KARA-MINIBUEX.
- Lower the SB18 array so as to align its four bottom link points with those of both KARA-MINIBUEX. **Note:** Do NOT stack the SB18 array onto the KARA array.
- Secure the link points together by re-inserting the four T-BLP into the KARA-MINIBUEX and bottom SB18 link holes.

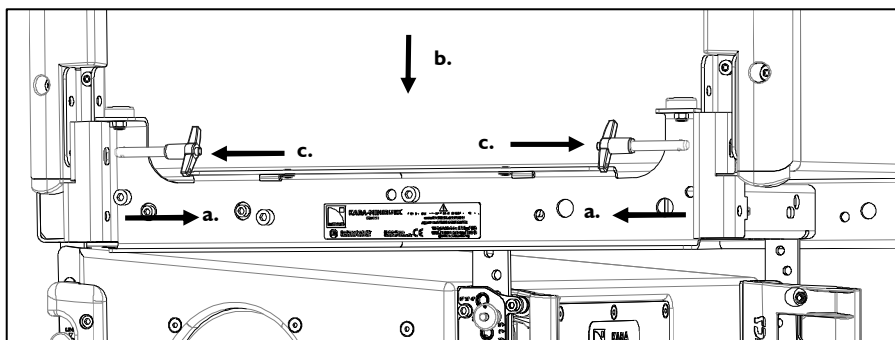
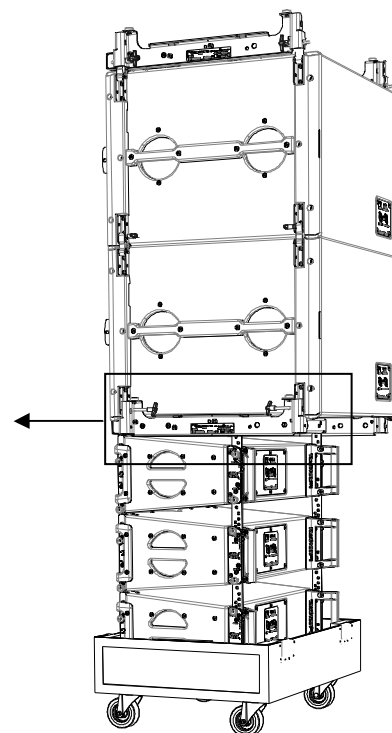


Figure 28: Attaching ARRAY#1 to the SB18 array



16. Continue the procedure by applying [6.1.2, steps 7 to 19].

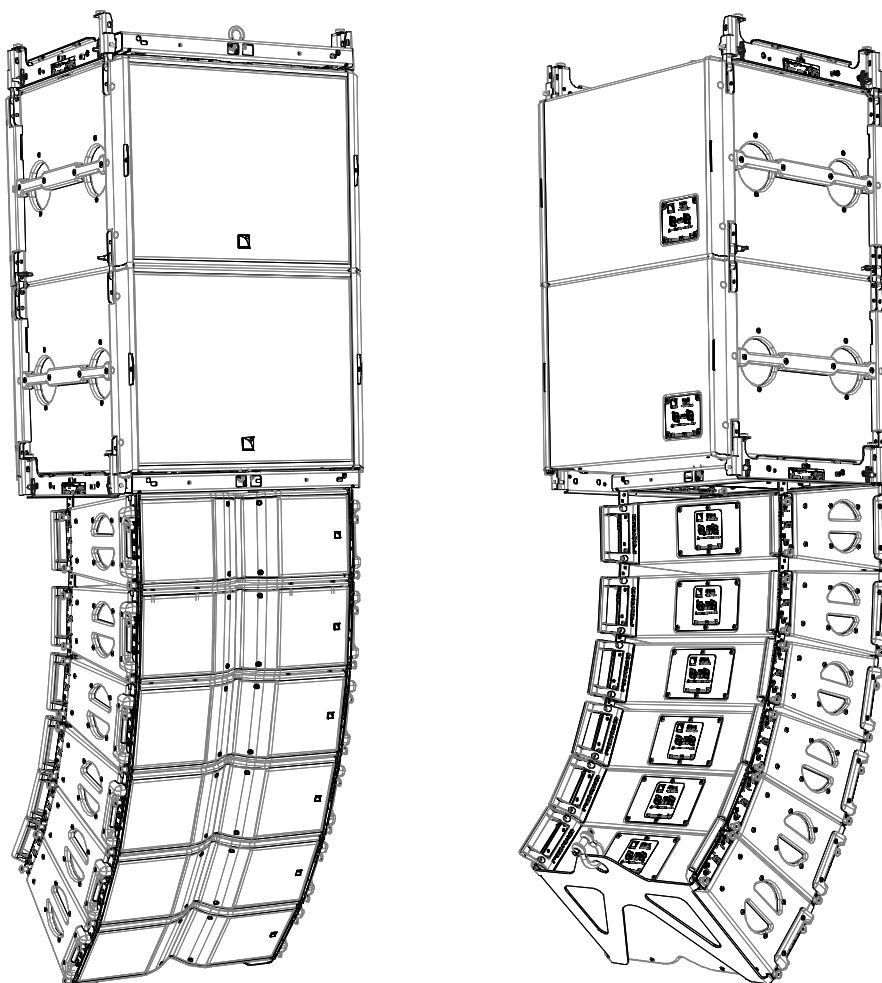


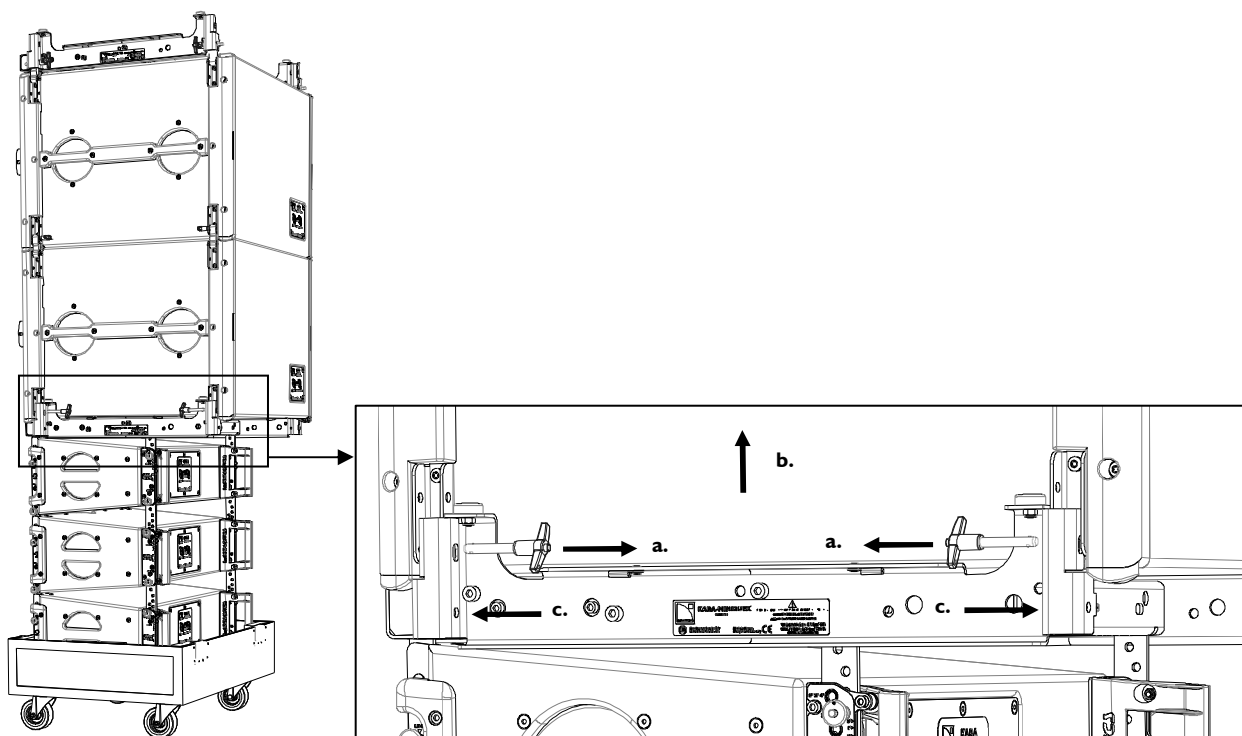


Figure 29: Examples of flown SB18/KARA mixed arrays

### 6.2.3 Array disassembling procedure

	<p>All along the procedure:  <b>STRICTLY</b> follow the sequence of the successive steps.  <b>SYSTEMATICALLY</b> verify that each BLP is fully inserted.</p>
	<p>For clarity purposes the loudspeaker cable removal procedure will not be described.  The loudspeaker cables will not be represented in the figures.</p>

1. If the array to disassemble is a SB18 standalone array, directly go to step 8.  
If the array to disassemble is a SB18/KARA mixed array, begin the procedure by applying [6.1.3, steps 1 to 12] and then continue from step 2 below.
2. Lower ARRAY#1 into the tray. The bottom SB18 must be resting on both KARA-MINIBUEX.
3. Separate ARRAY#1 from the SB18 array as follows:
  - a. Remove the four T-BLP from the link holes of both KARA-MINIBUEX.
  - b. Raise the SB18 array until it is separated from ARRAY#1.
  - c. Re-insert the four T-BLP into the KARA-MINIBUEX storage holes.



**Figure 30: Separating ARRAY#1 from the SB18 array**

4. Remove ARRAY#1 from under the SB18 array.

5. Separate the KARA-MINIBU/KARA-MINIBUEX rigging structure from KARA# I as follows:
  - a. Remove the four R-BLP from the KARA-MINIBU.
  - b. Separate the rigging structure from ARRAY# I.
  - c. Re-insert the four R-BLP into the same KARA-MINIBU holes.

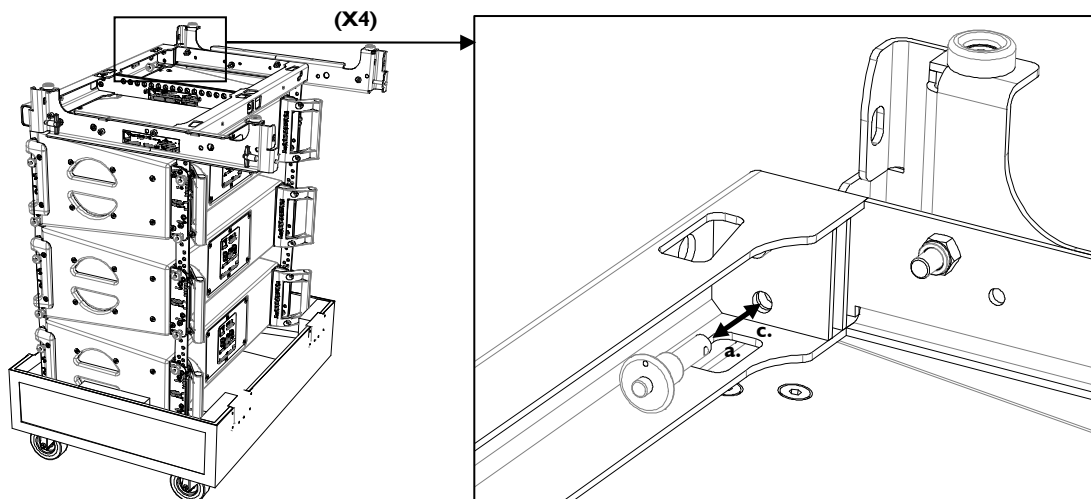


Figure 31: Separating the rigging structure from KARA# I

6. Close the four KARA# I arms as follows (repeat on both sides of the enclosure):
  - a. Remove the front top R-BLP from its **link** hole, slide the front arm up, rotate it down, and lock it in place by re-inserting the R-BLP into its **storage** hole.
  - b. Remove the rear top R-BLP from its angle hole, slide the angle arm so as to align the cursor with the **storage** label, and lock it in place by re-inserting the R-BLP into its **storage** hole.

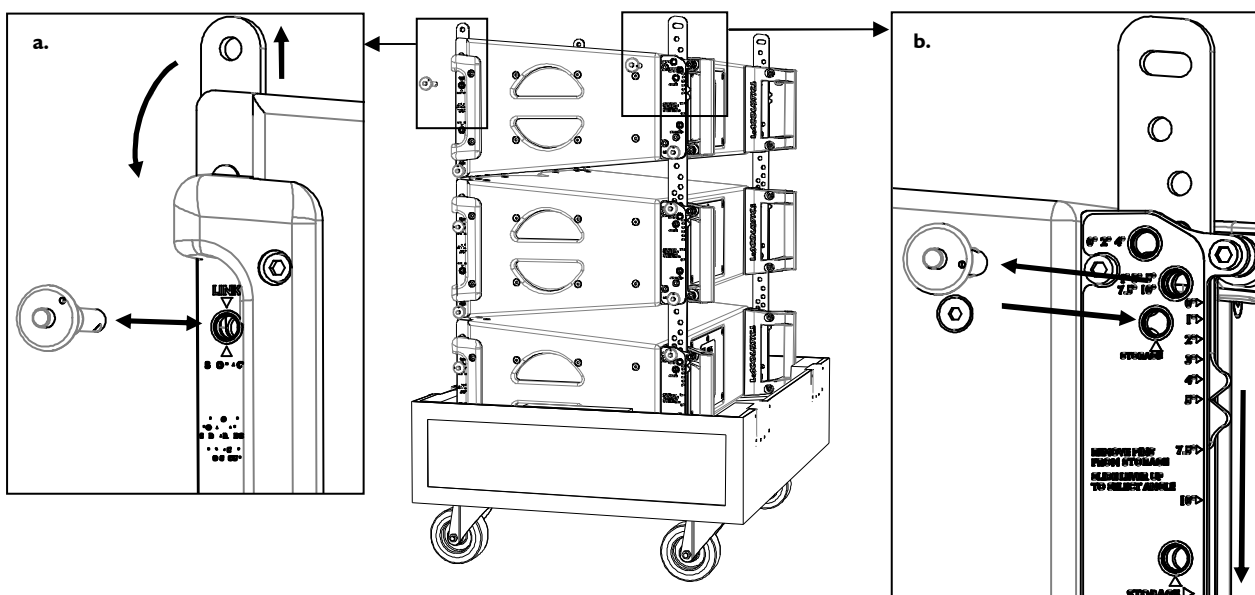
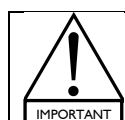


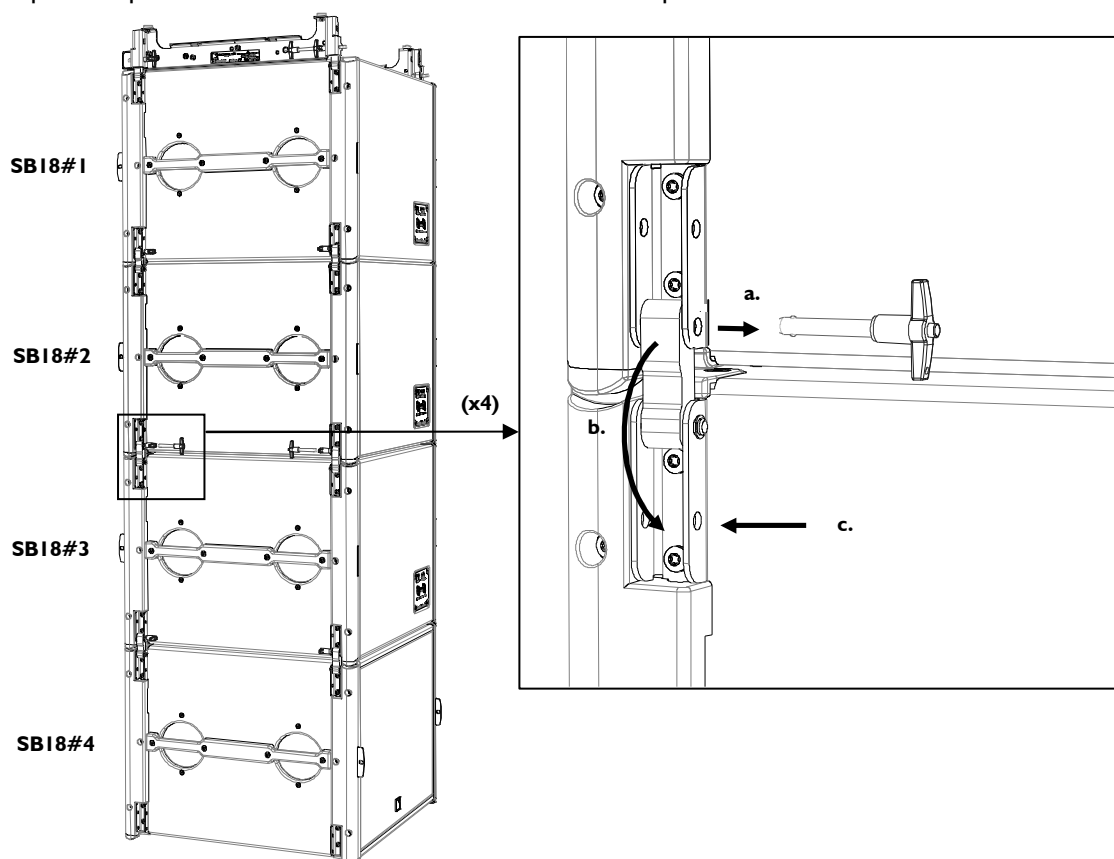
Figure 32: Closing the KARA# I arms

7. Put the flight-case lid on.



The procedure is continued with an array composed of four SB I8 enclosures to cover all possible cases.

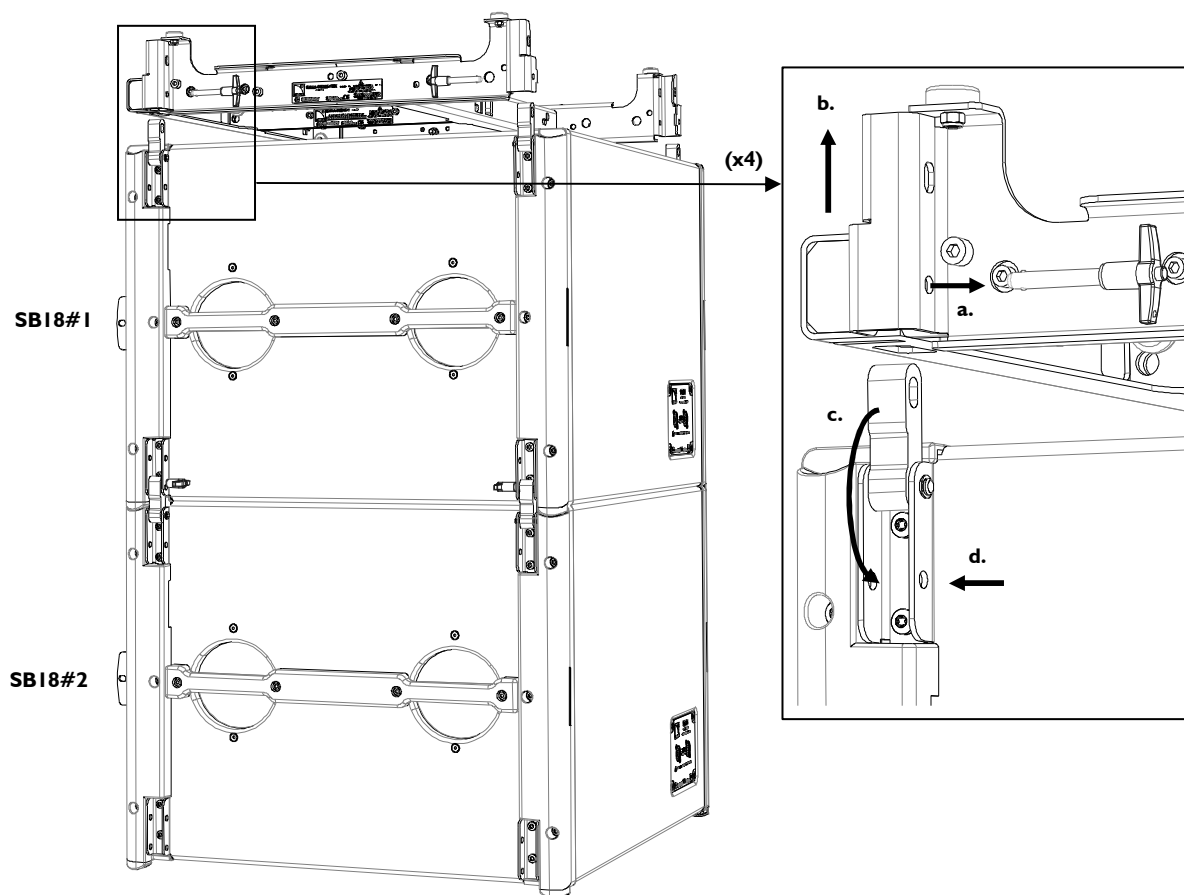
8. If not already done, detach both safety slings from the KARA-MINIBU.
9. Lower the array until the bottom SB18 (SB18#4 for example) rests on the ground and the SB18 above (SB18#3 for example) rests onto it.
10. Separate SB18#3 from SB18#2 as follows:
  - a. Remove a T-BLP from a SB18#2 bottom link point.
  - b. Rotate the link arm down.
  - c. Lock the link arm in closed position by re-inserting the T-BLP into SB18#3.
  - d. Repeat this procedure until all four arms are locked in closed position.



**Figure 33: Separating SB18#3 from SB18#2**

11. Raise the array until SB18#2 is separated from SB18#3.
12. Attach a dolly board to each of the SB18#3 and SB18#4 subwoofers.
13. Separate SB18#4 from SB18#3 by applying steps 10.
14. Remove SB18#3 and SB18#4 from the rigging location.
15. Lower the array until it rests on the ground.
16. Detach the motor hook(s) or stinger(s) from the KARA-MINIBU shackle(s).

17. Separate the KARA-MINIBU/KARA-MINIBUEX rigging structure from SB18#1 as follows:
  - a. Remove the four T-BLP from both KARA-MINIBUEX.
  - b. Lift the rigging structure up and separate it from SB18#1.
  - c. Rotate the four SB18#1 link arms down.
  - d. Lock the link arms in closed position by re-inserting the four T-BLP into the top SB18#1 link points.



**Figure 34: Separating the rigging structure from SB18#1**

18. Attach a dolly board to each subwoofer.
19. Separate SB18#2 from SB18#1 by applying step 10 and remove both subwoofers from the rigging location.

## 6.3 Stacking a KARA standalone array

### 6.3.1 Modeling and safety

A KARA array must be stacked onto a KARA-MINIBU/KARA-MINIBUEX platform (**platform stacked array**).

Any **platform stacked array** must be modeled before installation so as to ensure acoustical conformity. This can be done using **L-ACOUSTICS® SOUNDVISION Software** [3.4] which will assist the user to:

- Determine the number of required KARA enclosures.
- Calculate the inter-enclosure angles.



A **platform stacked array** requires to be installed on a perfectly horizontal and regular surface. It can be composed of a maximum of **6 KARA** enclosures along with all loudspeaker cables (refer to the **KARA User manual** [3.4]) within the following setup safety limits:

- If the KARA array is **flat** (all inter-enclosure angles are close to 0°), the platform must be installed in **front extension configuration** (refer to [9.3.1]) and the site angle of the bottom KARA must be set within the range given in Table 2 (refer to [9.3.2] for angle settings):

**Table 2: Platform stacked KARA array safe configurations**

Number of KARA	Bottom KARA authorized angle range
1 - 3	From -15° to +5°
4	From -11° to +5°
5 - 6	From -7.5° to +5°

- If the KARA array is **strongly curved** (all inter-enclosure angles are close to 10°), the platform must be installed in **rear extension configuration** (refer to [9.3.1]).

The KARA, KARA-MINIBU, and KARA-MINIBUEX fully integrated rigging systems allow assembling the array with no need for any external accessory. The following first procedure describes how to assemble a vertical KARA **platform stacked array**. The second procedure describes how to disassemble the array.

### 6.3.2 Array assembling procedure



All along the procedure:

STRICTLY follow the sequence of the successive steps.

SYSTEMATICALLY verify that each BLP is fully inserted.

SYSTEMATICALLY verify that each bolt is fully driven on the KARA-MINIBUEX.



For clarity purposes the loudspeaker cabling procedure will not be described.

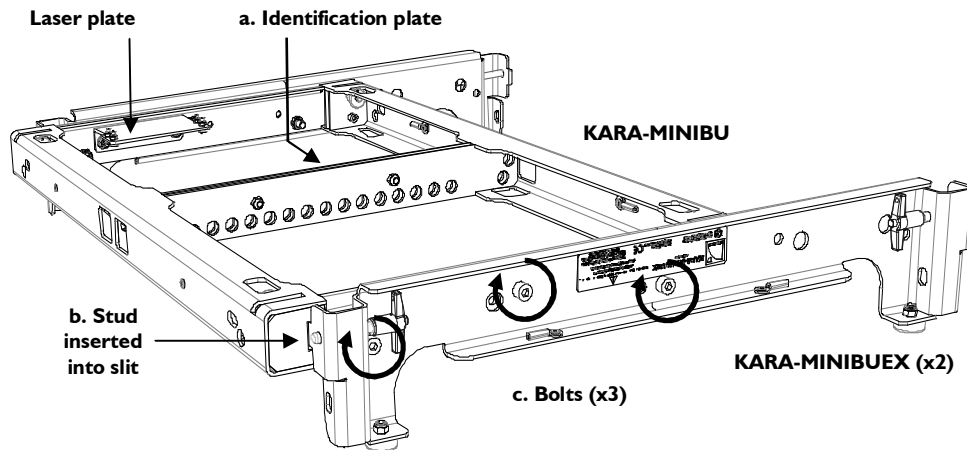
The loudspeaker cables will not be represented in the figures.

#### Required tools

Electric screwdriver with torque selector (N.m or in.lb<sub>f</sub>), 6 mm hex bit, 13 mm hex key.

#### Procedure

- I. Assemble a KARA-MINIBU/KARA-MINIBUEX stacking platform as follows:
  - a. Turn the KARA-MINIBU so that the text of the identification plate is upside down.
  - b. Position a first KARA-MINIBUEX on the laser plate side of the KARA-MINIBU by turning the KARA-MINIBUEX feet pointing down and inserting the stud into the slit of the KARA-MINIBU located near the laser plate.
  - c. Drive 3 bolts to the 3 holes shown in Figure 35 (6 mm hex bit, 13 mm hex key, 7 N.m/63 in.lb<sub>f</sub>).
  - d. Repeat the procedure with a second KARA-MINIBUEX on the other side of the KARA-MINIBU.



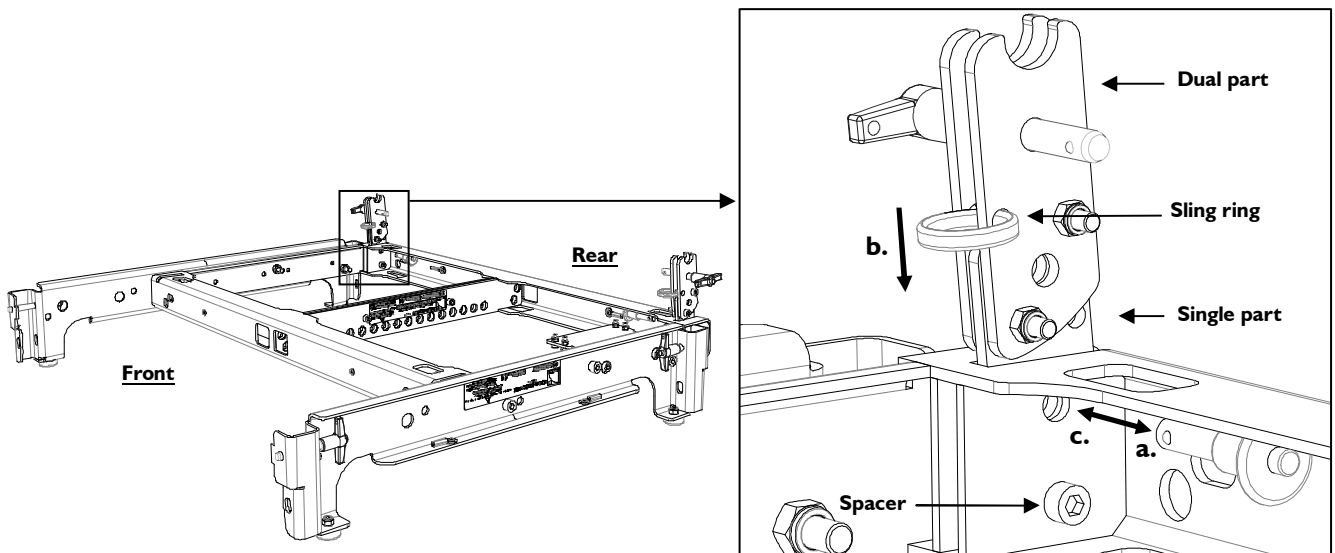
**Figure 35: Assembling a KARA-MINIBU/KARAMINIBUEX stacking platform**

2. If KARA-ANGARMEX are intended to be used [9.3.2], attach two KARA-ANGARMEX to the platform as follows:
  - a. Remove an R-BLP from a rear corner of the KARA-MINIBU.



When using KARA-ANGARMEX the platform must be put in **front extension configuration** [9.3.1].

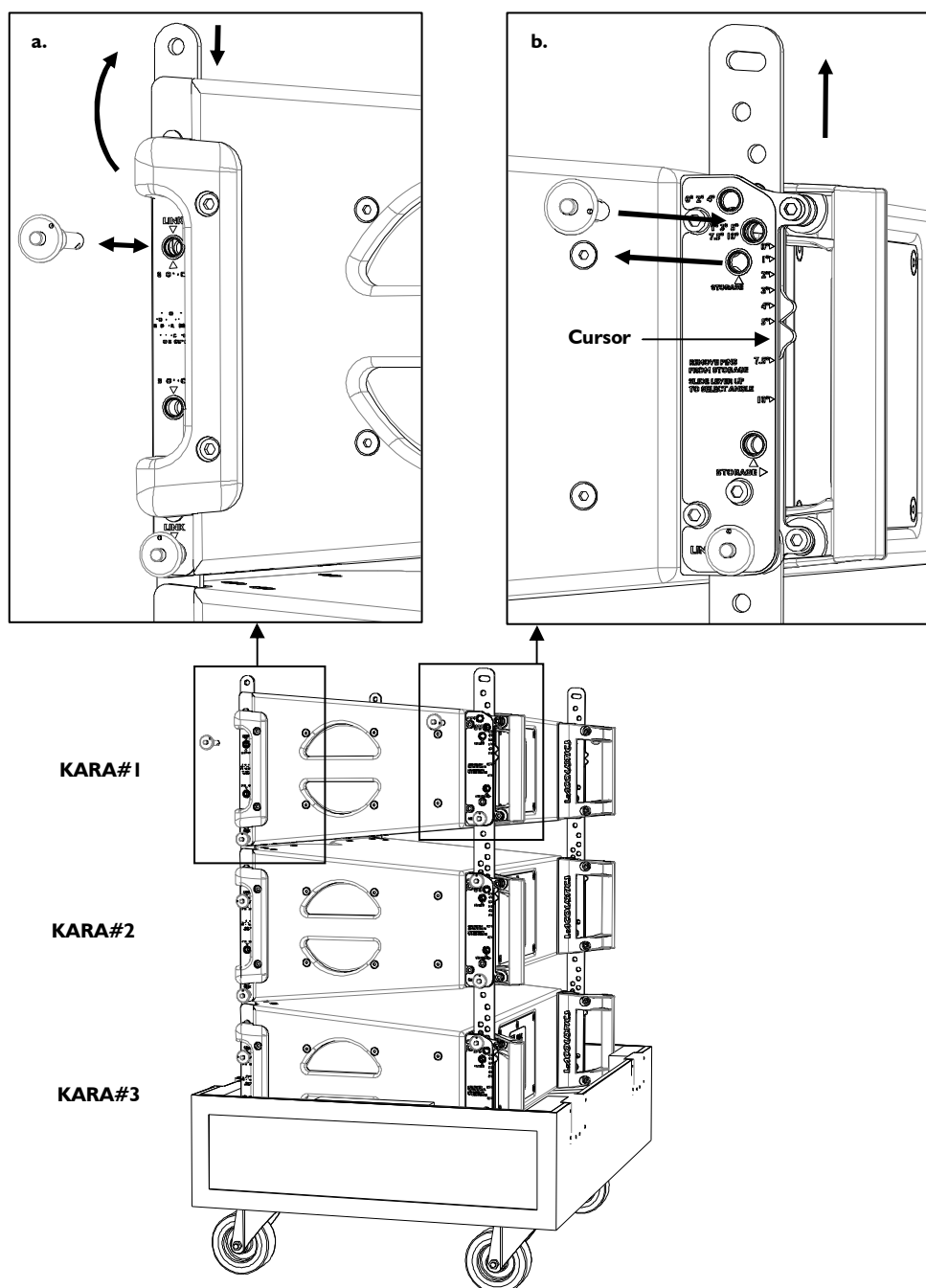
- b. Insert the single part of a first KARA-ANGARMEX into the corner slit: position it vertically with sling ring towards the front and indentation resting on the spacer.
- c. Align the KARA-ANGARMEX and KARA-MINIBU holes and secure them together by re-inserting the R-BLP.
- d. Repeat the procedure with a second KARA-ANGARMEX on the other rear corner of the KARA-MINIBU.



**Figure 36: Attaching two KARA-ANGARMEX to the platform (front extension configuration)**

3. Remove both front R-BLP from the KARA-MINIBU. **Note:** The front and rear sides are defined according to the chosen configuration.
4. If KARA-ANGARMEX are attached to the KARA-MINIBU, remove both T-BLP from them.  
Otherwise, remove both rear R-BLP from the KARA-MINIBU.
5. Bring a full KARA flight-case to the stacking location and remove the lid. In the following, the enclosures will be designated as KARA#1 to KARA#3 from top to bottom.

6. Open the four KARA#1 arms as follows (repeat on both sides of the enclosure):
  - a. Remove the front top R-BLP from its **storage** hole, rotate the front arm up, slide it down, and lock it in place by re-inserting the R-BLP into its **link** hole. **Note 1:** A **link** hole is indicated by a yellow circle. **Note 2:** The front top **storage** and **link** holes are the same.
  - b. Remove the rear top R-BLP from its **storage** hole, slide the angle arm so as to align the cursor with the chosen angle label, and lock it in place by re-inserting the R-BLP into the corresponding angle hole ( $0^\circ/2^\circ/4^\circ$  or  $1^\circ/3^\circ/5^\circ/7.5^\circ/10^\circ$ ). **Note:** Refer to [9.3.2] to obtain the array site angle corresponding to the chosen angle value.



**Figure 37: Opening the KARA#1 arms**



7. Attach the platform to KARA#1 as follows:

- Turn the platform feet pointing up and position it above KARA#1 according to the chosen configuration [9.3.1].
- Lower the platform to slide the four KARA-MINIBU slits along the KARA#1 arms. **Note:** If KARA-ANGARMEX are attached to the KARA-MINIBU, the rear slits are located on both KARA-ANGARMEX.
- Secure the front link points together by inserting both R-BLP into the KARA-MINIBU. Depending on the configuration, secure the rear link points together by inserting both R-BLP into the KARA-MINIBU or both T-BLP into both KARA-ANGARMEX.

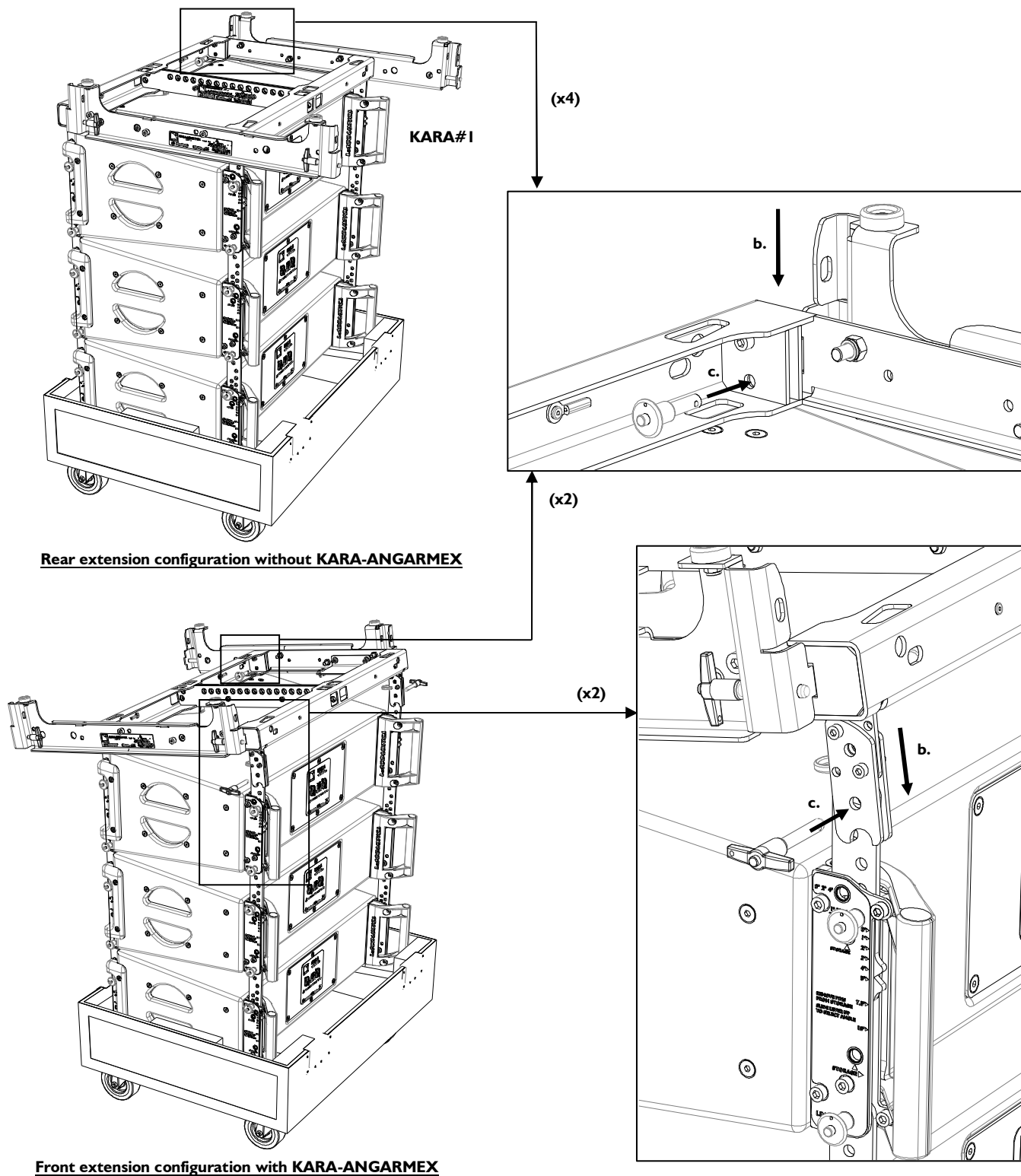
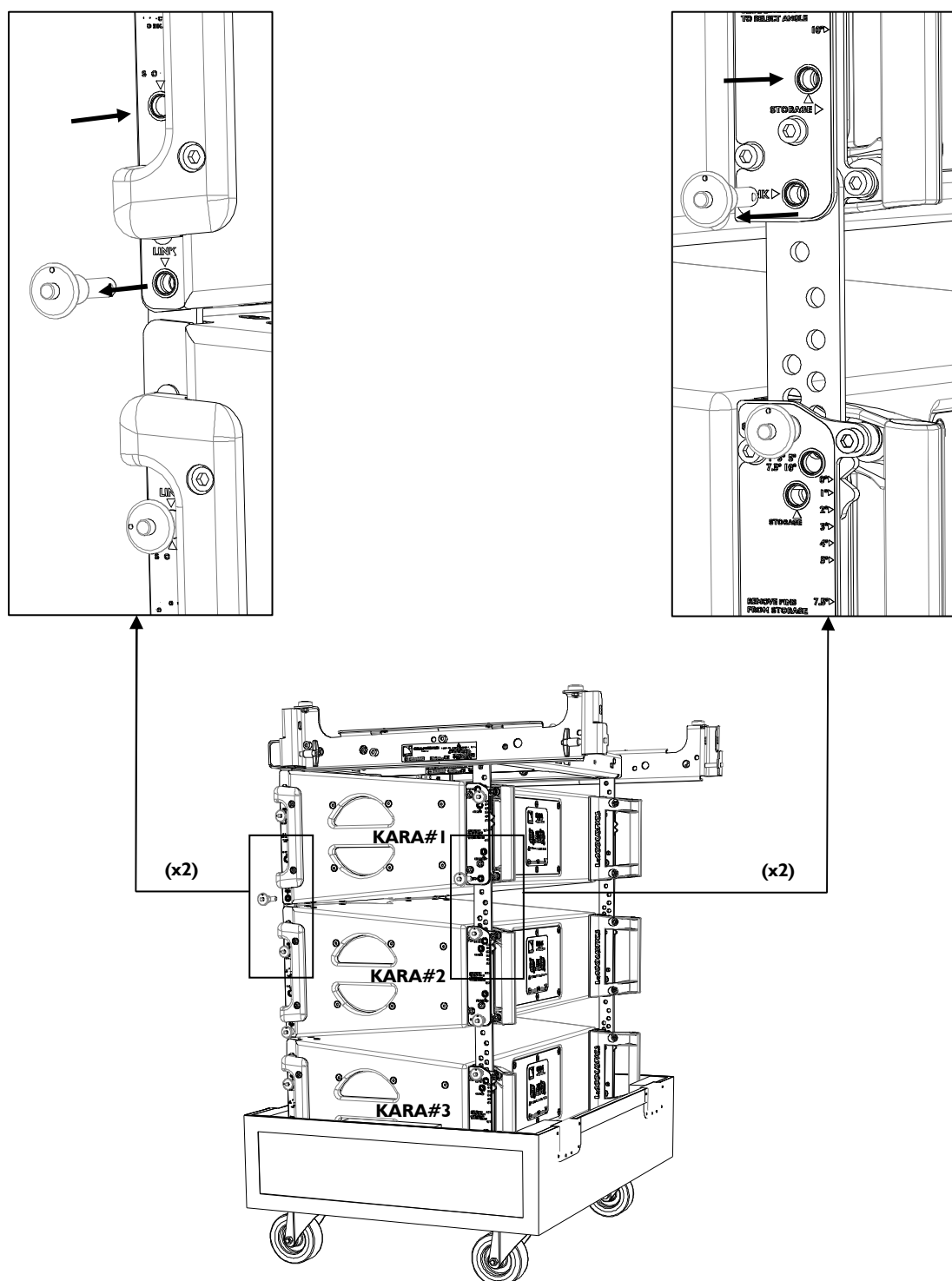


Figure 38: Attaching the platform to KARA#1

8. Remove the four KARA#1 bottom R-BLP from their **link** holes and re-insert them into their **storage** holes.

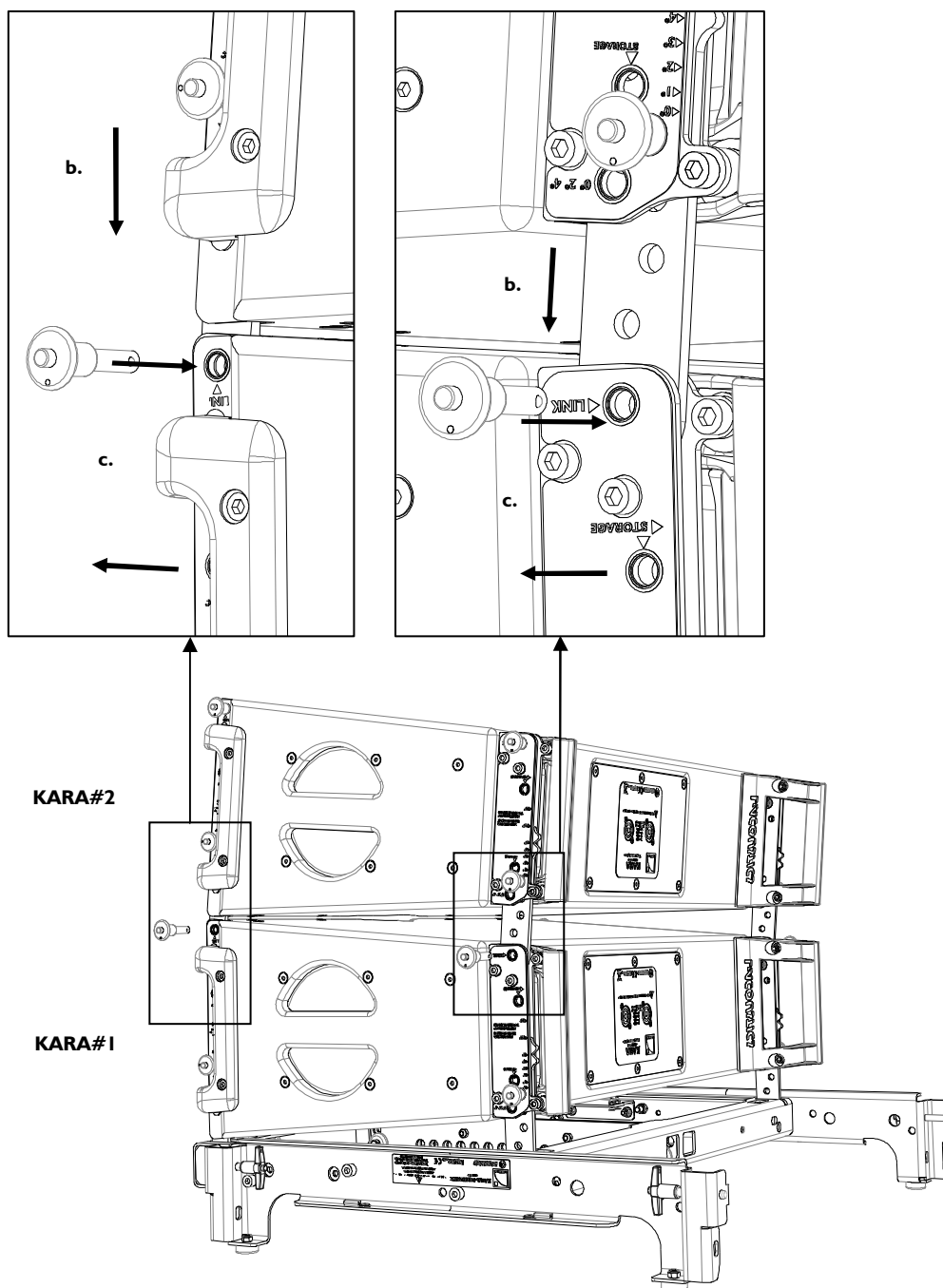


**Figure 39: Removing the bottom R-BLP from KARA#1**

9. Turn the KARA#1/platform assembly feet on the ground and front face towards audience.
10. Open the four KARA#2 arms by applying step 6.
11. Remove the four KARA#2 bottom R-BLP from their **link** holes and re-insert them into their **storage** holes (see step 8).

**12. Attach KARA#2 to KARA#1 as follows:**

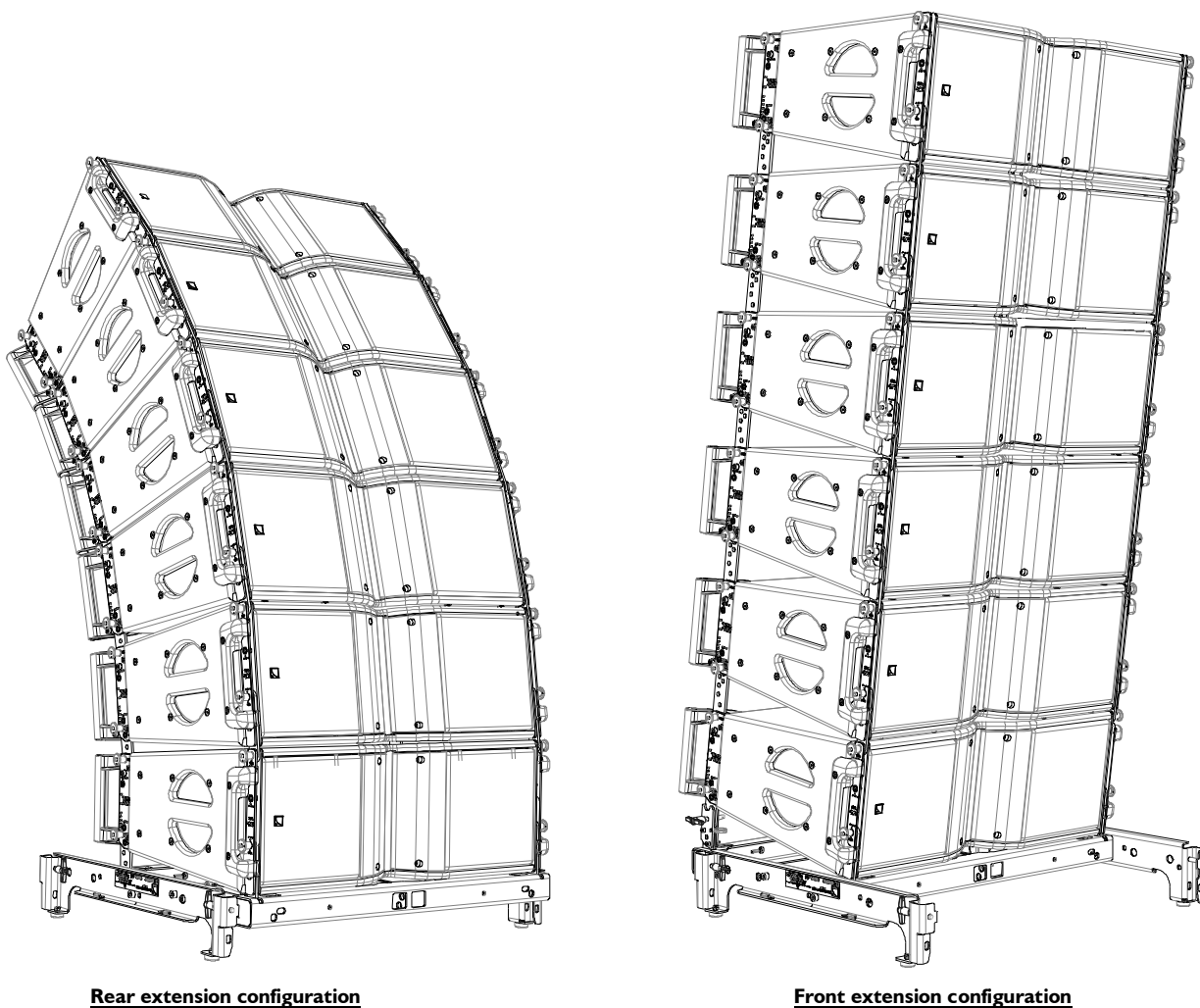
- a.** Turn KARA#2 arms pointing down and front face towards the audience.
- b.** Align the four arms with the KARA#1 link points.
- c.** Secure the link points together by removing the four KARA#1 top R-BLP from their **storage** holes and re-inserting them into their **link** holes.



**Figure 40: Attaching KARA#2 to KARA#1**

**13. Attach KARA#3 to KARA#2 by applying steps 10 to 12.**



14. Using another full KARA flight-case, repeat steps 10 to 12 until all KARA enclosures composing the array are assembled.



**Figure 41: Examples of stacked KARA homogeneous arrays**

15. Secure the loudspeaker assembly to a fixed point by using a ratchet strap or any other equivalent material (not included).

### 6.3.3 Array disassembling procedure

	<p>All along the procedure: STRICTLY follow the sequence of the successive steps. SYSTEMATICALLY verify that each BLP is fully inserted.</p>
	<p>For clarity purposes the loudspeaker cables removal procedure will not be described. The loudspeaker cables will not be represented in the figures.</p>

1. Detach the ratchet strap or other equivalent material from the stacked array.
2. Bring an empty KARA flight-case to the rigging location and remove the lid.
3. Separate the top KARA (KARA#3 for example) from the array by removing the four KARA#2 top R-BLP from their **link** holes and re-inserting them into their **storage** holes.

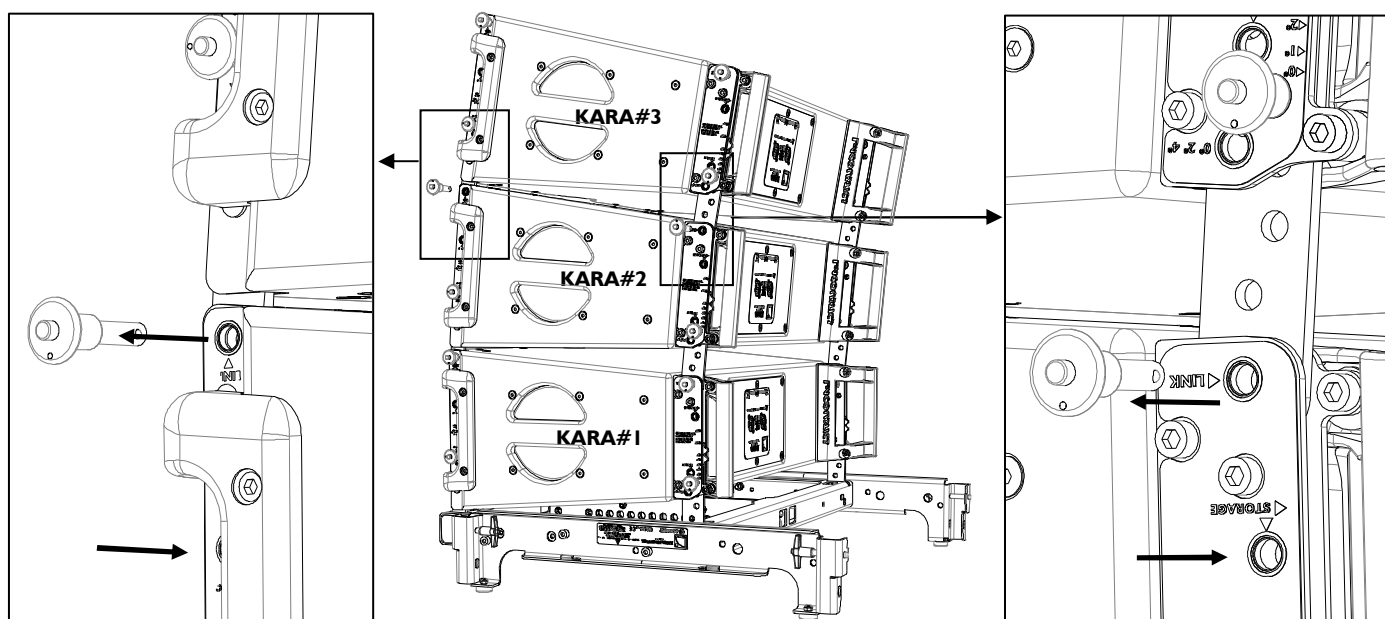



Figure 42: Separating KARA#3 from KARA#2

4. Lift up and turn KARA#3 arms pointing up. Put KARA#3 into the flight-case tray.

	<p>Pay attention to the tray position: both wedges must slope upwards from front to rear.</p>
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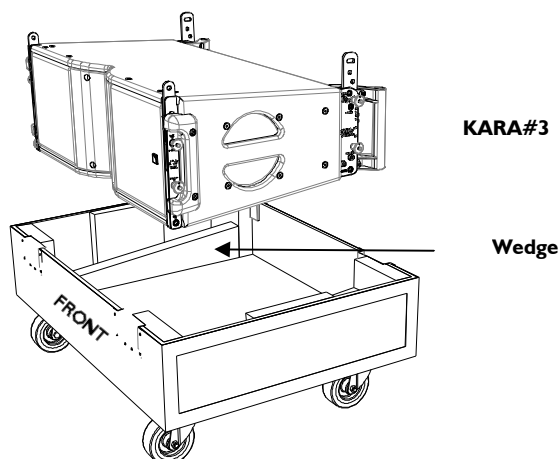
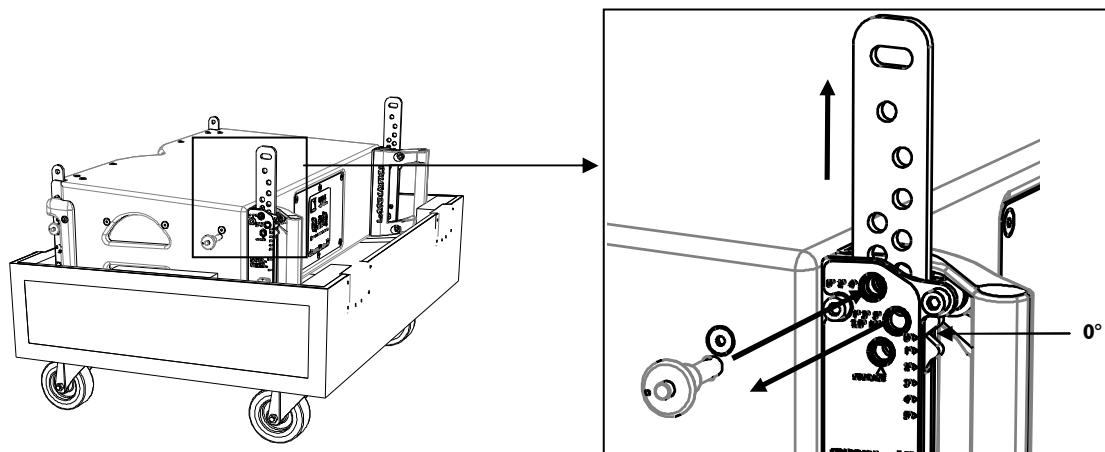


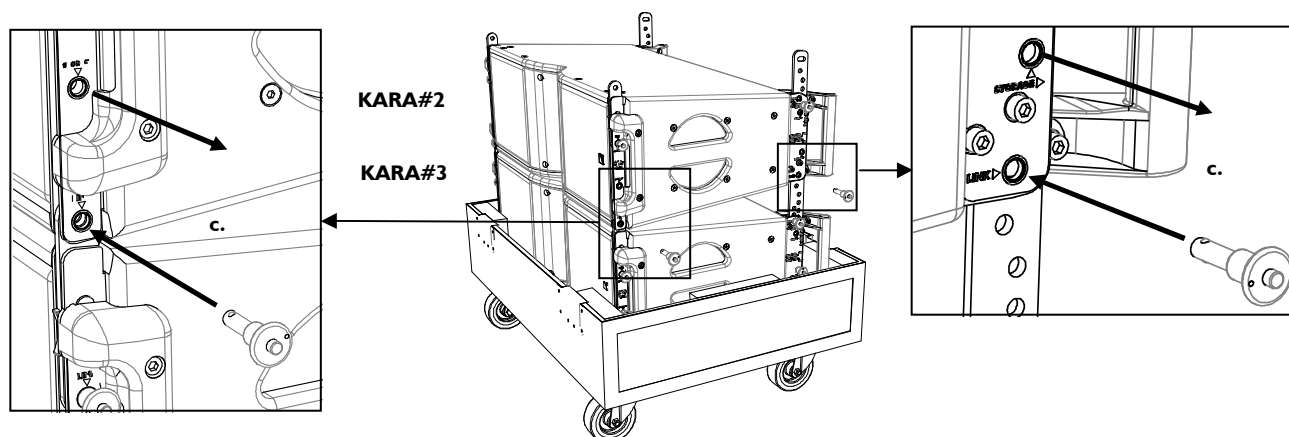
Figure 43: Placing KARA#3 into the flight-case tray

5. Set angle 0° on KARA#3 as follows (repeat on both sides of the enclosure):
  - a. Remove the rear top R-BLP from its angle hole.
  - b. Slide the angle arm so as to align the cursor with angle label 0°.
  - c. Lock the arm in place by re-inserting the R-BLP into angle hole 0°/2°/4°.



**Figure 44: Setting angle 0° on KARA#3**

6. Separate KARA#2 from KARA#1 by applying step 3.
7. Attach KARA#2 to KARA#3 as follows:
  - a. Lift up and turn KARA#2 arms pointing up.
  - b. Align the front and rear link points between both enclosures.
  - c. Secure the link points together by removing the four KARA#2 bottom R-BLP from their **storage** holes and re-inserting them into their **link** holes.



**Figure 45: Attaching KARA#2 to KARA#3**

8. Set angle 0° on KARA#2 by applying step 5.
9. If the last enclosure to be placed in the flight-case is not attached to the KARA-MINIBU (KARA#4), apply steps 3, 7, 11, and 12 for KARA#4 and then apply the procedure a new time from step 2 for array KARA#1-3.

If the last enclosure to be placed in the flight-case is attached to the KARA-MINIBU (KARA#1), attach the KARA#1/platform assembly to KARA#2 by applying step 7.

10. Separate the platform from KARA# I as follows:

- a. Remove both KARA-MINIBU front R-BLP.
- b. If KARA-ANGARMEX are attached to the platform, remove both T-BLP from them.  
Otherwise, remove both KARA-MINIBU rear R-BLP.
- c. Separate the platform from KARA# I.
- d. If KARA-ANGARMEX are attached to the platform, remove them by removing both KARA-MINIBU rear R-BLP.
- e. Re-insert the four R-BLP into the KARA-MINIBU holes.

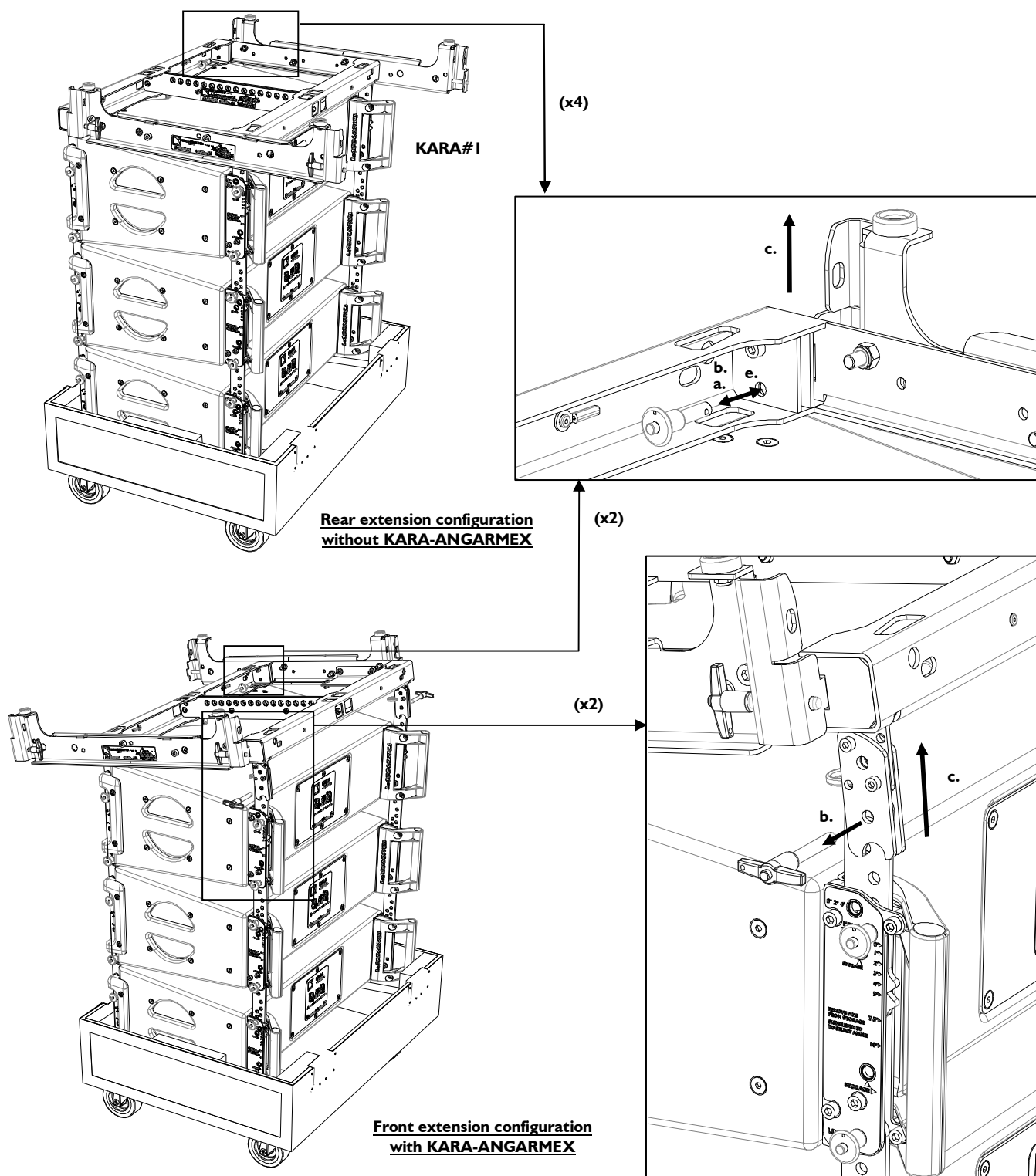
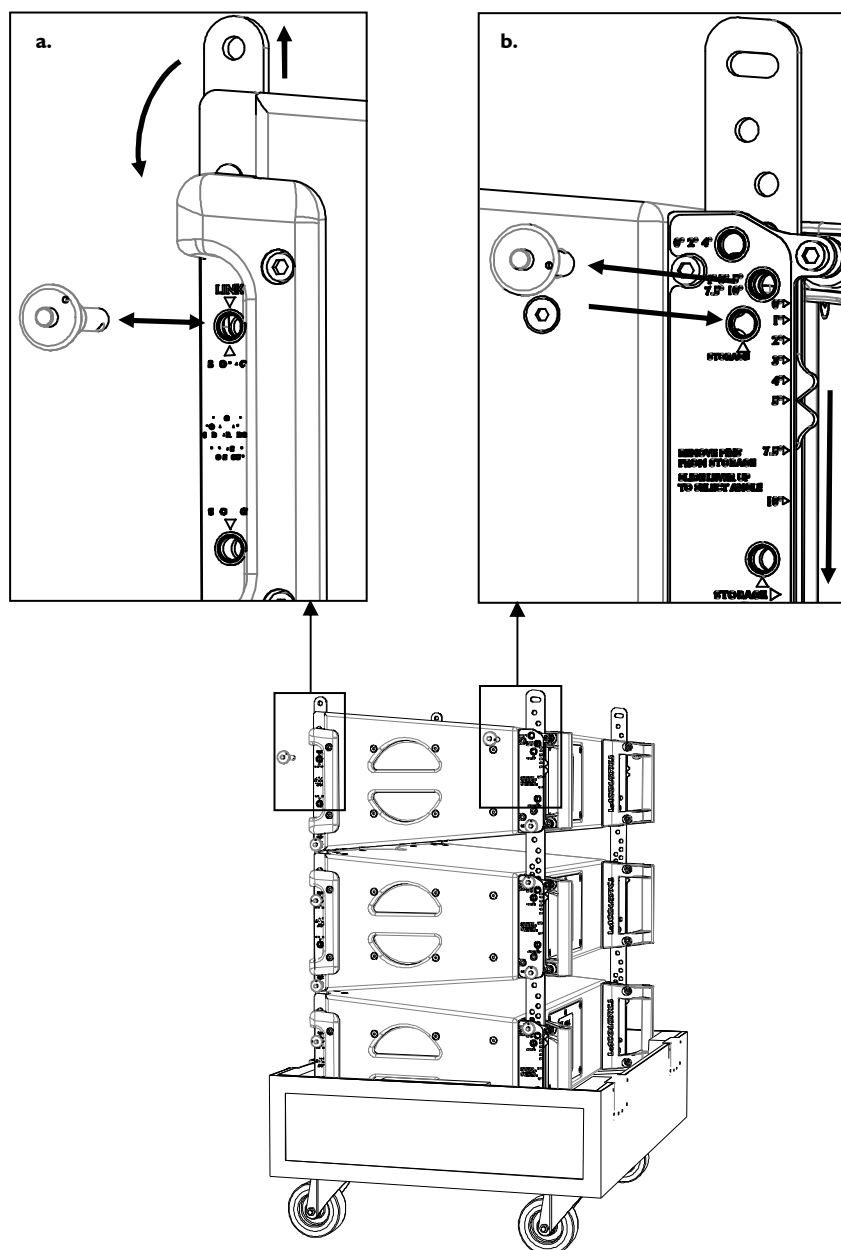


Figure 46: Separating KARA-MINIBU from KARA# I

**11. Close the four KARA#1 arms as follows (repeat on both sides of the enclosure):**

- a.** Remove the front top R-BLP from its **link** hole, slide the front arm up, rotate it down, and lock it in place by re-inserting the R-BLP into its **storage** hole. **Note:** The front top **link** and **storage** holes are the same.
- b.** Remove the rear top R-BLP from its angle hole, slide the angle arm so as to align the cursor with the **storage** label, and lock it in place by re-inserting the R-BLP into its **storage** hole.



**Figure 47: Closing the KARA#1 arms**

**12. Put the flight-case lid on.**




## 6.4 Stacking a SB18/KARA mixed array or a SB18 standalone array

### 6.4.1 Modeling and safety

A SB18/KARA mixed array or a SB18 standalone array must be stacked directly on the ground (**ground stacked array**).

Any SB18/KARA **ground stacked array** must be modeled before installation so as to ensure acoustical conformity. This can be done using **L-ACOUSTICS® SOUNDVISION Software** [3.4] which will assist the user to:

- Determine the number of required KARA enclosures (acoustic data not available for subwoofers).
- Calculate the inter-enclosure angles.



A **ground stacked array** must be installed on a perfectly horizontal and regular surface. It can be composed of a maximum of **4 SB18/6 KARA** or **8 SB18** enclosures within the setup safety limits given in Table 3 regarding the angle between the top SB18 and the bottom KARA (refer to [9.3.2] for angle settings):


**Table 3: Ground stacked SB18/KARA array safe configurations**

Number of SB18	Number of KARA	Bottom KARA authorized angle range
1	1 - 2	From -15° to +5°
	3	From -5° to +5°
	4 - 6	From -4° to +5°
2	1 - 5	From -15° to +5°
	6	From -12° to +5°
3 - 4	1 - 6	From -15° to +5°

SB18/KARA mixed array assembling procedure: Apply [6.4.2].

SB18 standalone array assembling procedure: Stack a first SB18 on the ground, front face logo down. Stack a second SB18 onto the first one and attach it by applying [6.2.2, step 2c]. Repeat the procedure until all SB18 composing the array are assembled. While installing, follow the IMPORTANT indication given below.

### 6.4.2 Array assembling procedure




All along the procedure:

STRICTLY follow the sequence of the successive steps.

SYSTEMATICALLY verify that each BLP is fully inserted.

SYSTEMATICALLY verify that each bolt is fully driven on the KARA-MINIBUEX.



For clarity purposes the loudspeaker cabling procedure will not be described.


The loudspeaker cables will not be represented in the figures.

#### Required tools

Electric screwdriver with torque selector (N.m or in.lb<sub>r</sub>), 6 mm hex bit, 13 mm hex key.

#### Procedure

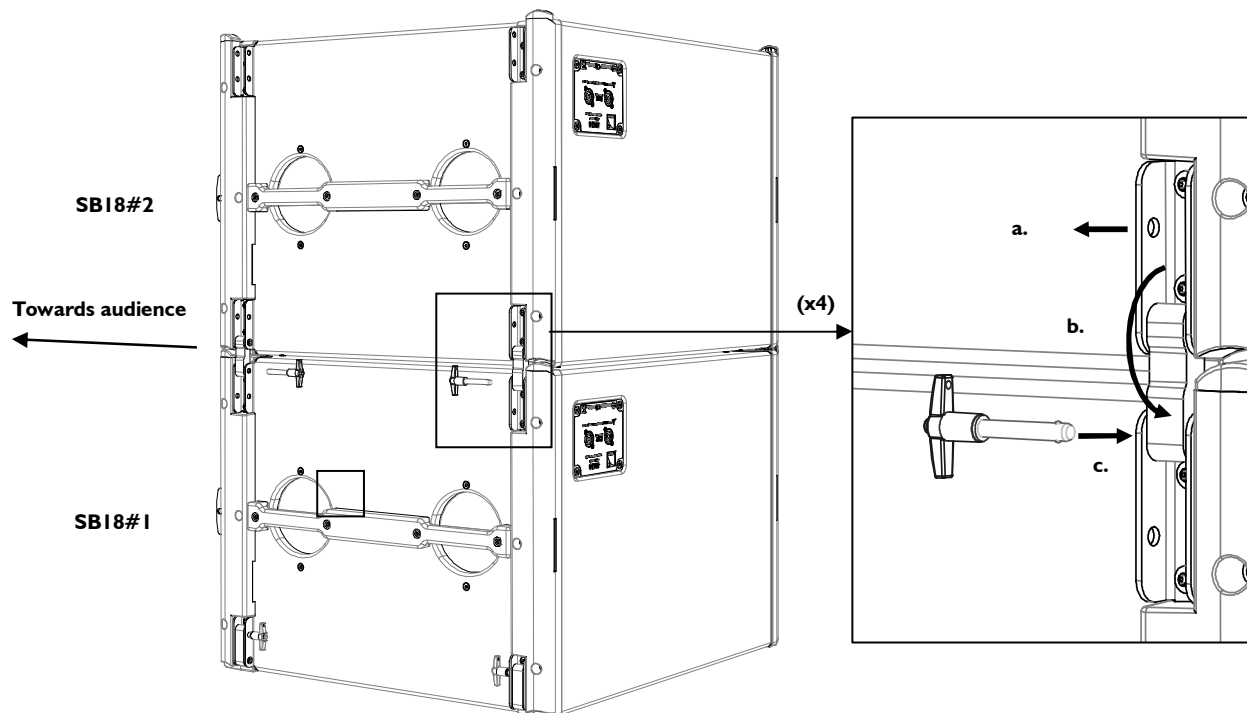
1. Bring a first SB18 (SB18#1) to the rigging location, remove the dolly board, and stack it on the ground logo up.



Turn the front faces of all SB18 composing the array towards the audience to obtain an **omnidirectional** acoustic pattern or turn one SB18 every fourth from front to rear to obtain a **cardioid** acoustic pattern (refer to the **SB18 User manual** [3.4]).

2. In the same way, stack a second SB18 (SB18#2) onto SB18#1.

3. Attach SB18#2 to SB18#1 as follows:
  - a. Remove a T-BLP from SB18#2.
  - b. Rotate the link arm down.
  - c. Secure the link arm to SB18#1 by re-inserting the T-BLP into the SB18#1 top link point.
  - d. Repeat this procedure until all four arms are secured to SB18#1.

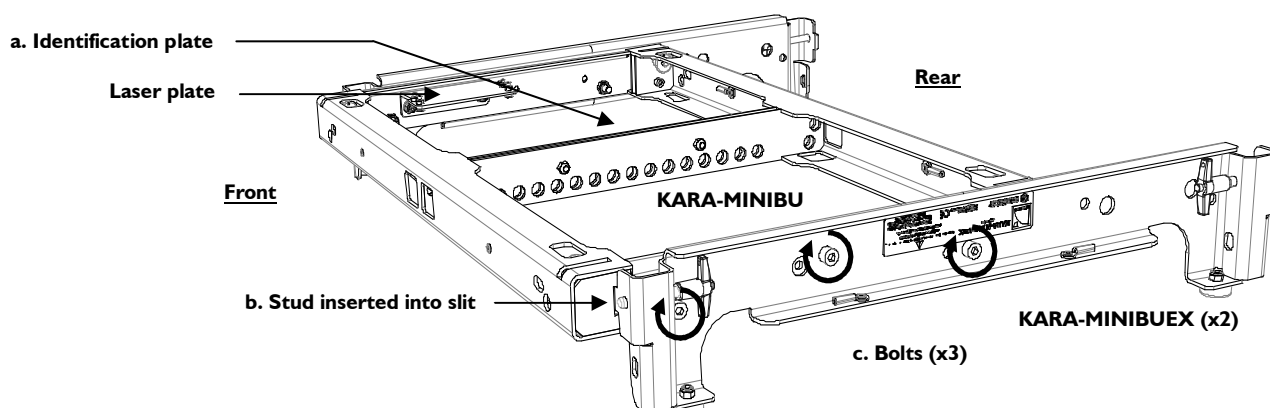


**Figure 48: Attaching SB18#2 to SB18#1**

4. Repeat steps 2 and 3 until all SB18 composing the array are assembled.
5. Assemble a KARA-MINIBU/KARA-MINIBUEX stacking platform as follows:
  - a. Turn the KARA-MINIBU so that the text of the identification plate is upside down.
  - b. Position a first KARA-MINIBUEX on the laser plate side of the KARA-MINIBU by turning it feet pointing down and inserting the stud into the slit of the KARA-MINIBU located near the laser plate.
  - c. Drive 3 bolts to the 3 holes shown in Figure 49 (6 mm hex bit, 13 mm hex key, 7 N.m/63 in.lbf).
  - d. Repeat the procedure with a second KARA-MINIBUEX on the other side of the KARA-MINIBU.

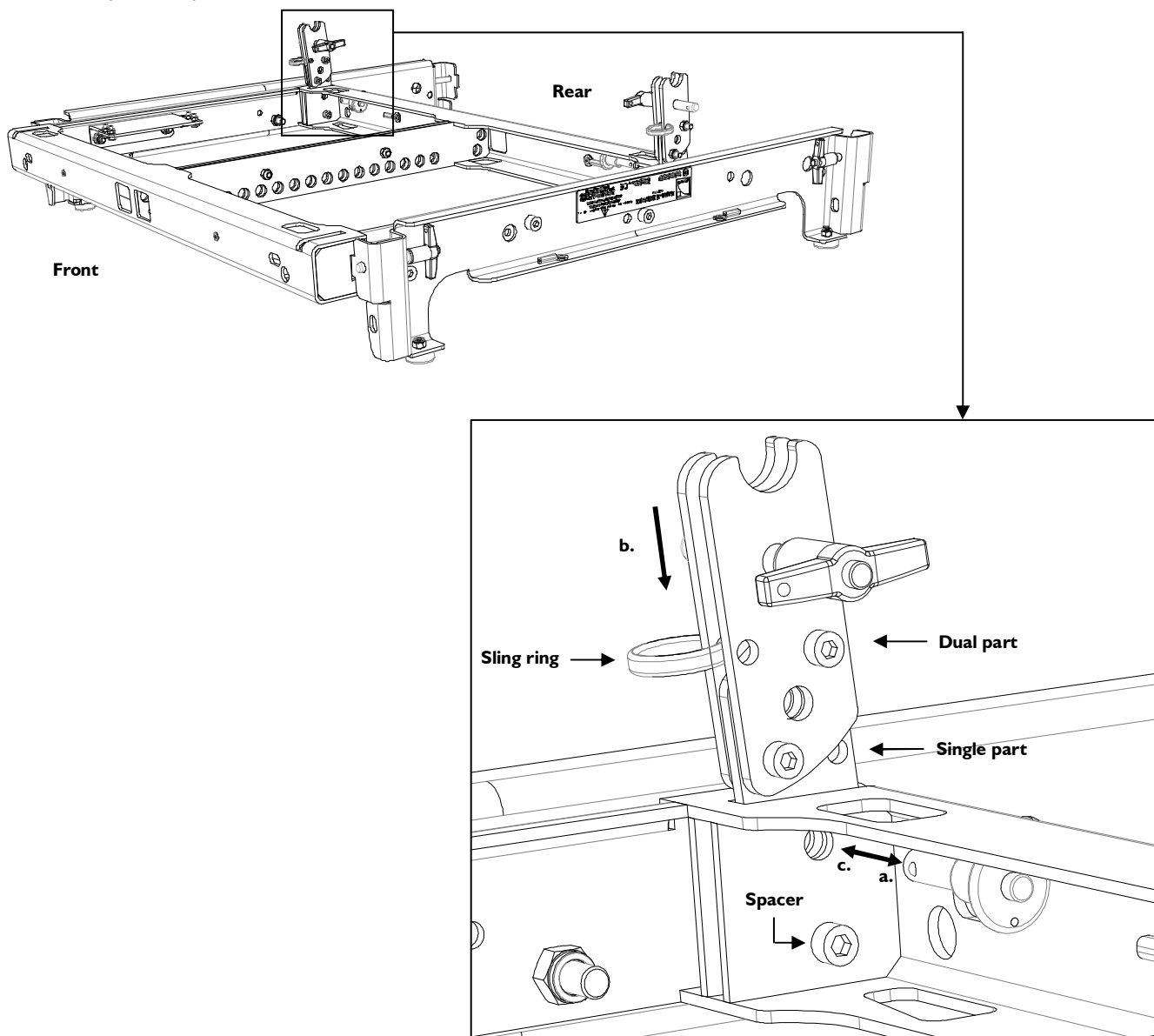


Place the stacking platform in **rear extension configuration** only [9.3.1].



**Figure 49: Assembling a KARA-MINIBU/KARAMINIBUEX stacking platform**

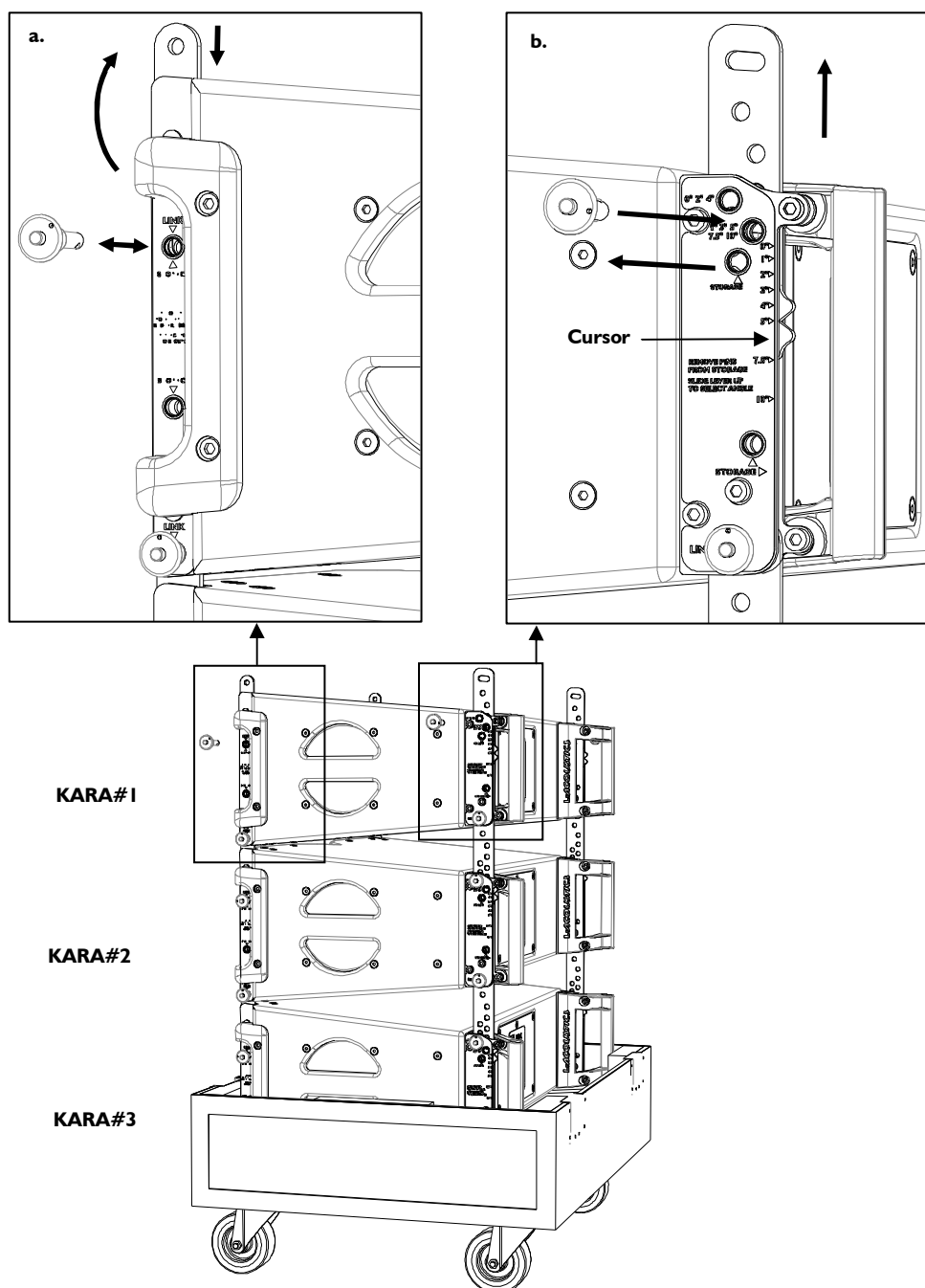
6. If KARA-ANGARMEX are intended to be used [9.3.2], attach two KARA-ANGARMEX to the platform as follows:
  - a. Remove an R-BLP from a rear corner of the KARA-MINIBU.
  - b. Insert the single part of a first KARA-ANGARMEX into the corner slit: position it vertically with sling ring towards the front and indentation resting on the spacer.
  - c. Align the KARA-ANGARMEX and KARA-MINIBU holes and secure them together by re-inserting the R-BLP.
  - d. Repeat the procedure with a second KARA-ANGARMEX on the other rear corner of the KARA-MINIBU.



**Figure 50: Attaching two KARA-ANGARMEX to the platform (rear extension configuration)**

7. Remove both front R-BLP from the KARA-MINIBU.
8. If KARA-ANGARMEX are attached to the KARA-MINIBU, remove both T-BLP from them.  
Otherwise, remove both rear R-BLP from the KARA-MINIBU.
9. Bring a full KARA flight-case to the stacking location and remove the lid. In the following, the enclosures will be designated as KARA#1 to KARA#3 from top to bottom.

10. Open the four KARA#1 arms as follows (repeat on both sides of the enclosure):
- Remove the front top R-BLP from its **storage** hole, rotate the front arm up, slide it down, and lock it in place by re-inserting the R-BLP into its **link** hole. **Note 1:** A **link** hole is indicated by a yellow circle. **Note 2:** The front top **storage** and **link** holes are the same.
  - Remove the rear top R-BLP from its **storage** hole, slide the angle arm so as to align the cursor with the chosen angle label, and lock it in place by re-inserting the R-BLP into the corresponding angle hole (**0°/2°/4°** or **1°/3°/5°/7.5°/10°**). **Note:** Refer to [9.3.2] to obtain the array site angle corresponding to the chosen angle value.



**Figure 51: Opening the KARA#1 arms**

## II. Attach the platform to KARA#1 as follows:

- Turn the platform feet pointing up and position it above KARA#1 in **rear extension configuration** [9.3.1].
- Lower the platform to slide the four KARA-MINIBU slits along the KARA#1 arms. **Note:** If KARA-ANGARMEX are attached to the KARA-MINIBU, the rear slits are located on both KARA-ANGARMEX.
- Secure the front link points together by inserting both R-BLP into the KARA-MINIBU. Depending on the configuration, secure the rear link points together by inserting both R-BLP into the KARA-MINIBU or both T-BLP into both KARA-ANGARMEX.

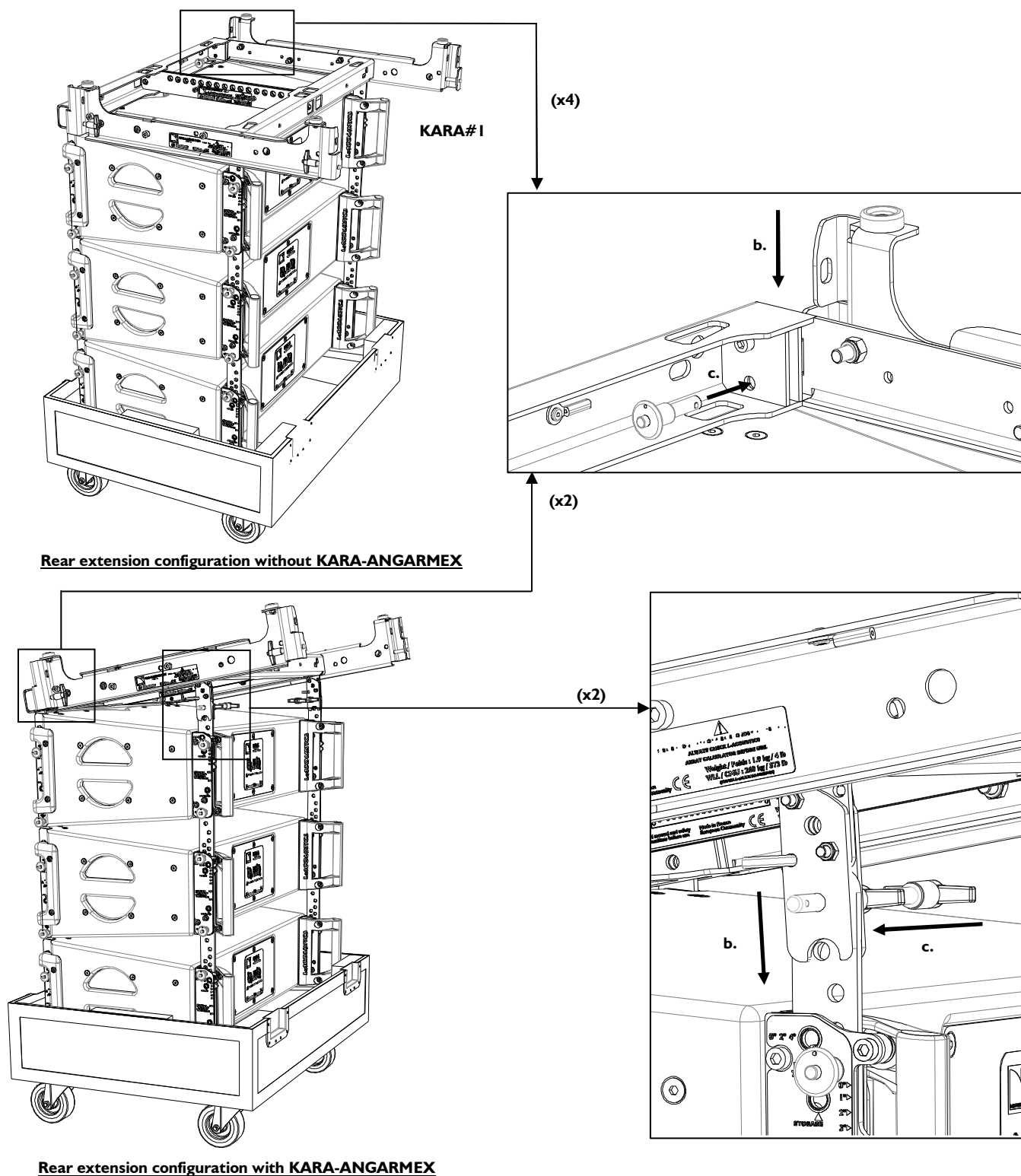
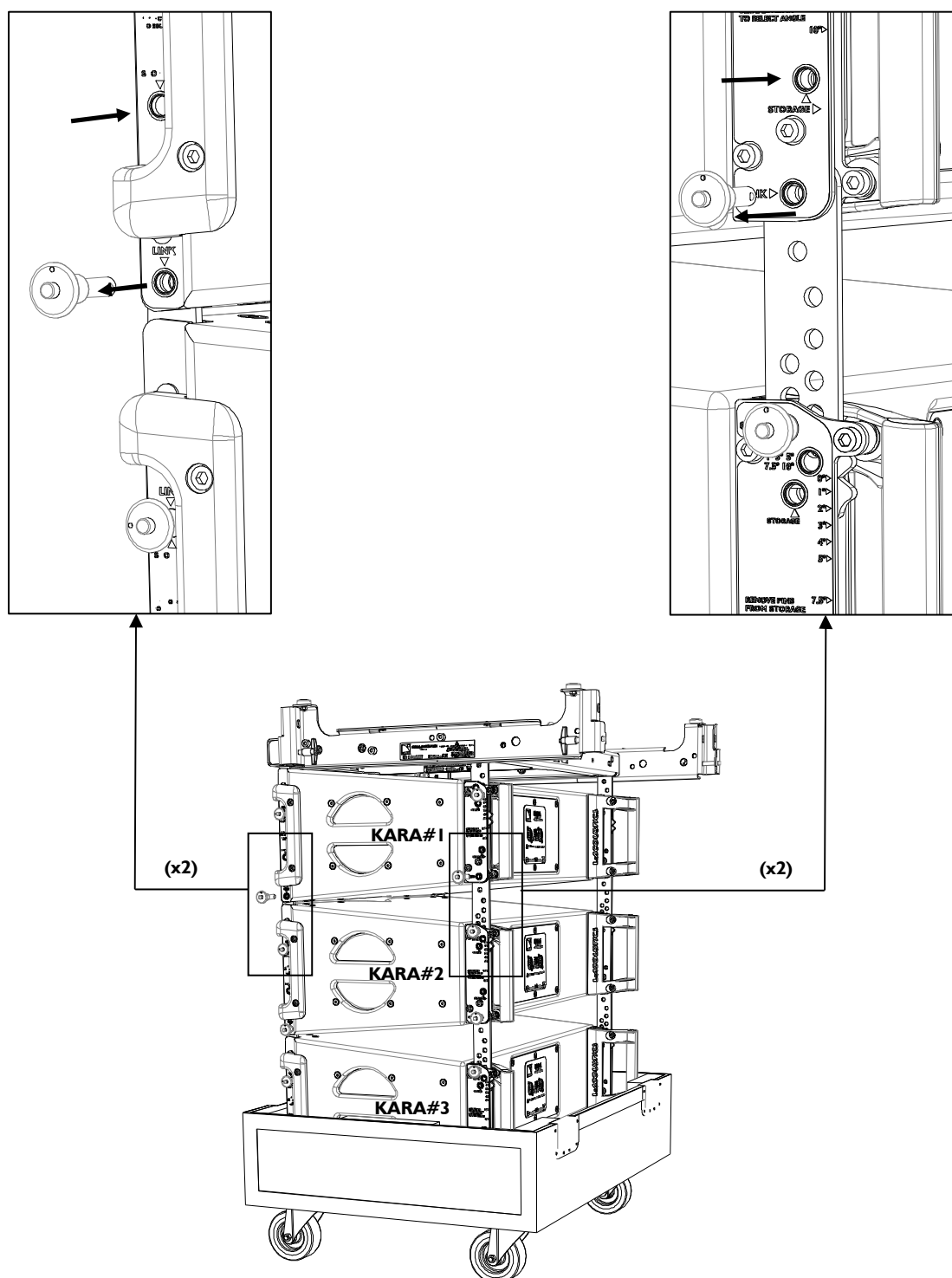


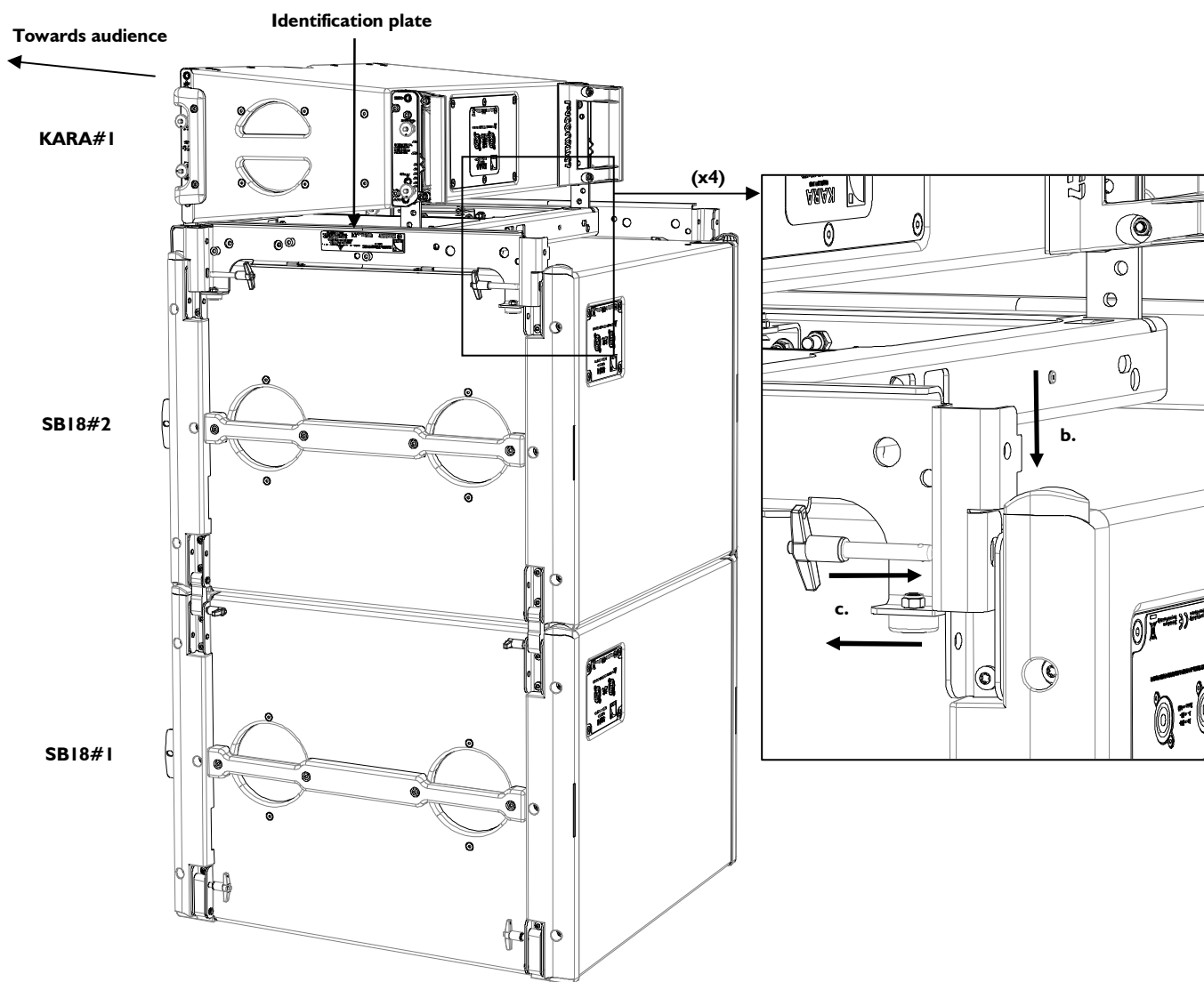
Figure 52: Attaching the platform to KARA#1

**12.** Remove the four KARA#1 bottom R-BLP from their **link** holes and re-insert them into their **storage** holes.



**Figure 53: Removing the bottom R-BLP from KARA#1**

13. Attach the KARA#1/platform assembly to the top SB18 (SB18#2 for example) as follows:
  - a. Turn the assembly feet pointing down and KARA#1 front face towards audience.
  - b. Position the assembly onto SB18#2 by sliding it downwards into the link arms.
  - c. Secure the assembly and SB18#2 link points together by removing the four KARA-MINIBUEX T-BLP from their storage holes and re-inserting them into their link holes.

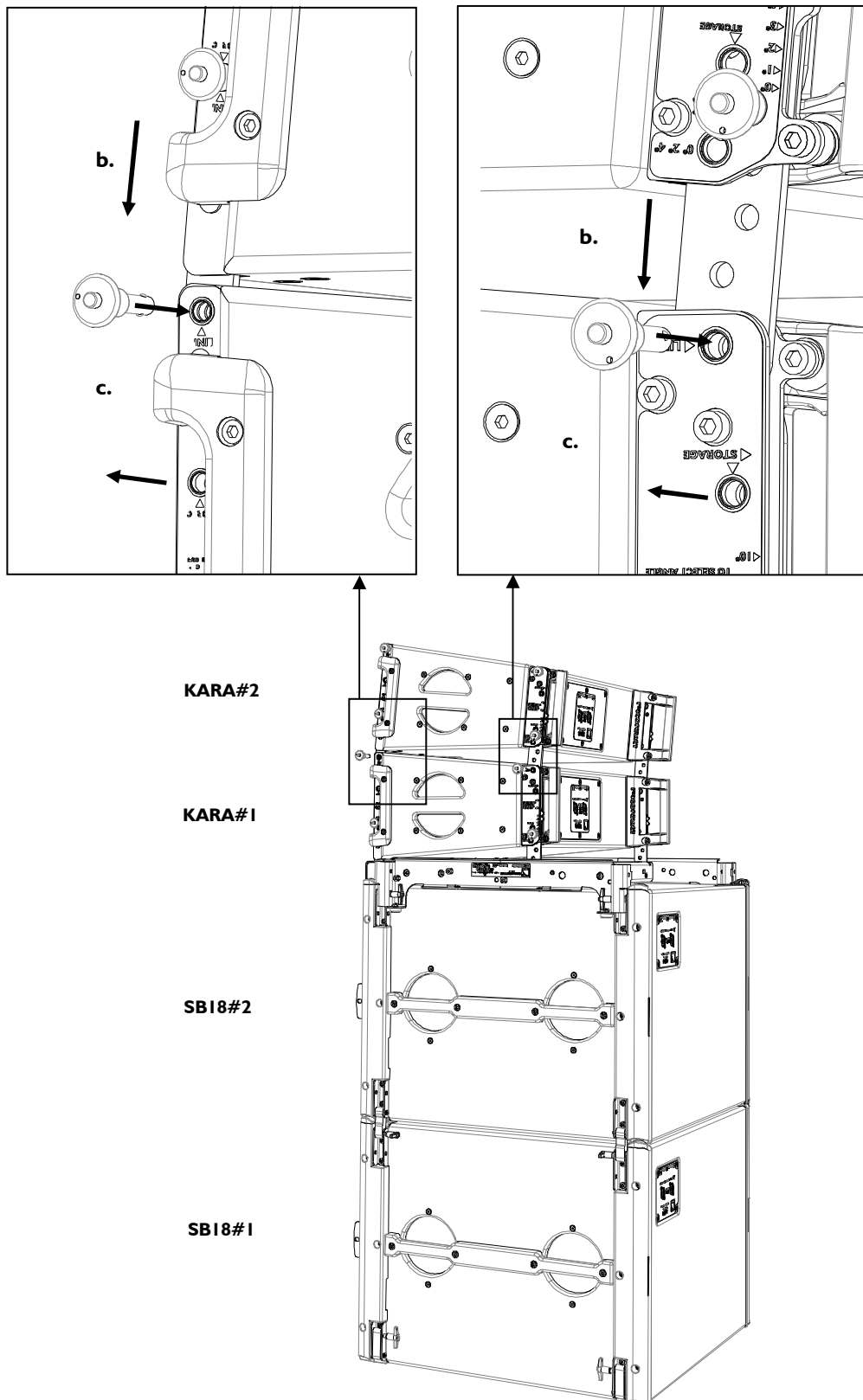


**Figure 54: Attaching the KARA#1/platform assembly to SB18#2**

14. Open the four KARA#2 arms by applying step 10.
15. Remove the four KARA#2 bottom R-BLP from their **link** holes and re-insert them into their **storage** holes (see step 12).

**16. Attach KARA#2 to KARA#1 as follows:**

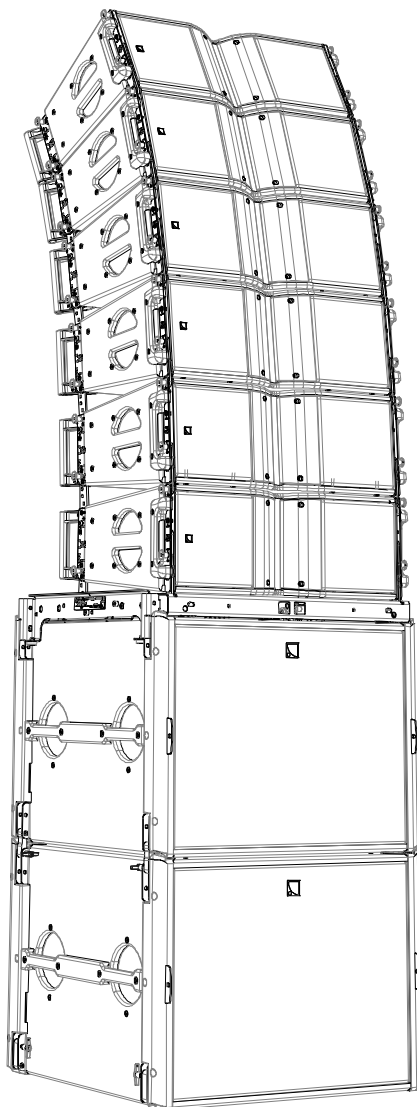
- a. Turn KARA#2 arms pointing down and front face towards the audience.
- b. Align the four arms with the KARA#1 link points.
- c. Secure the link points together by removing the four KARA#1 top R-BLP from their **storage** holes and re-inserting them into their **link** holes.



**Figure 55: Attaching KARA#2 to KARA#1**





17. Attach KARA#3 to KARA#2 by applying steps 14 to 16.
18. Using another full KARA flight-case, repeat steps 14 to 16 until all KARA enclosures composing the array are assembled.



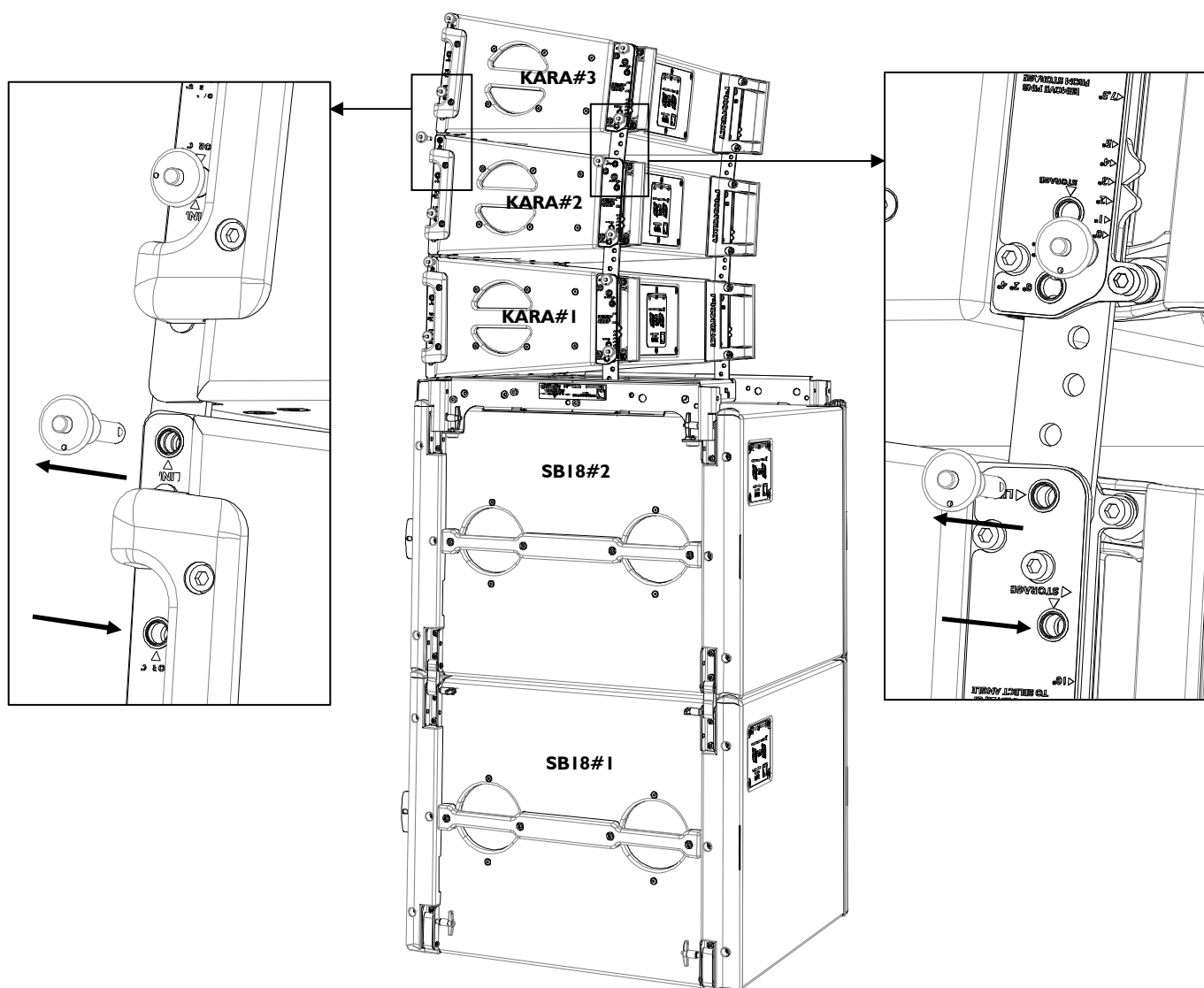
**Figure 56: Example of stacked SB18/KARA mixed array**

19. Secure the loudspeaker assembly to a fixed point using a ratchet strap or any other equivalent material (not included).

### 6.4.3 Array disassembling procedure

	<p>All along the procedure:  <b>STRICTLY</b> follow the sequence of the successive steps.  <b>SYSTEMATICALLY</b> verify that each BLP is fully inserted.</p>
	<p>For clarity purposes the loudspeaker cables removal procedure will not be described.  The loudspeaker cables will not be represented in the figures.</p>

1. Detach the ratchet strap or other equivalent material from the stacked array.
2. Bring an empty KARA flight-case to the rigging location and remove the lid.
3. Separate the top KARA (KARA#3 for example) from the array by removing the four KARA#2 top R-BLP from their **link** holes and re-inserting them into their **storage** holes.

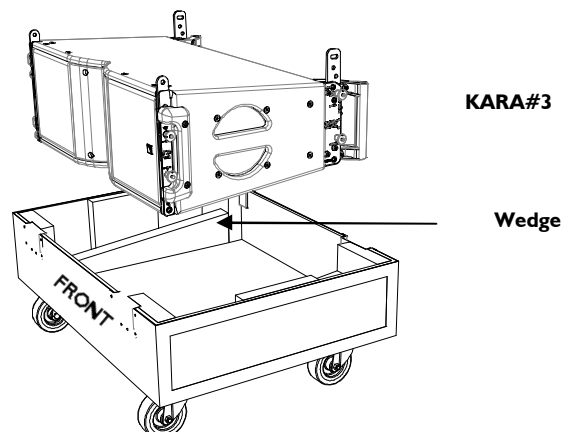


**Figure 57: Separating KARA#3 from KARA#2**

4. Lift up and turn KARA#3 arms pointing up. Put KARA#3 into the flight-case tray.

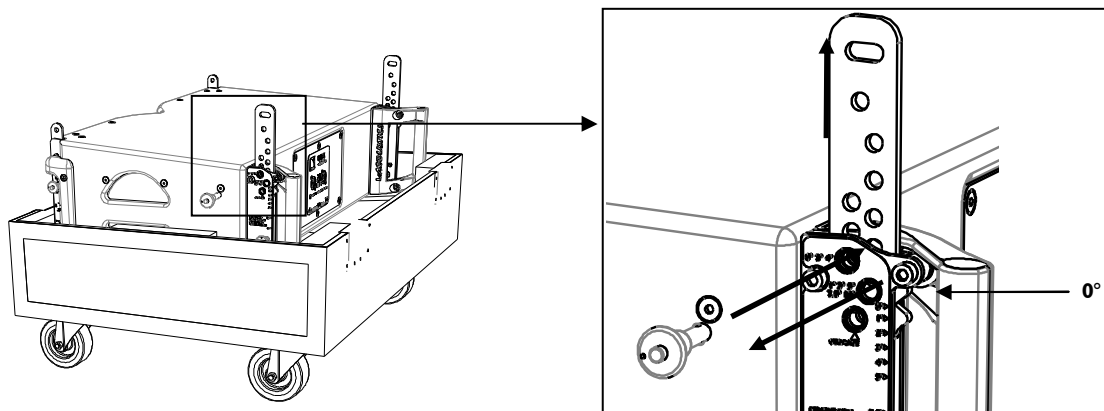


Pay attention to the tray position: both wedges must slope upwards from front to rear.



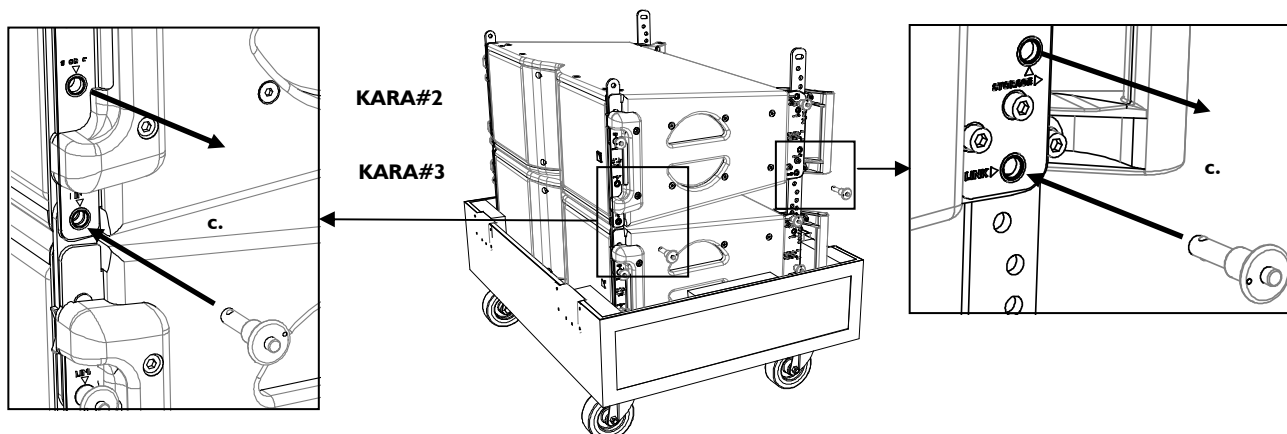
**Figure 58: Putting KARA#3 into the tray**

5. Set angle 0° on KARA#3 as follows (repeat on both sides of the enclosure):
  - a. Remove the rear top R-BLP from its angle hole.
  - b. Slide the angle arm so as to align the cursor with angle label 0°.
  - c. Lock the arm in place by re-inserting the R-BLP into angle hole 0°/2°/4°.



**Figure 59: Setting angle 0° on KARA#3**

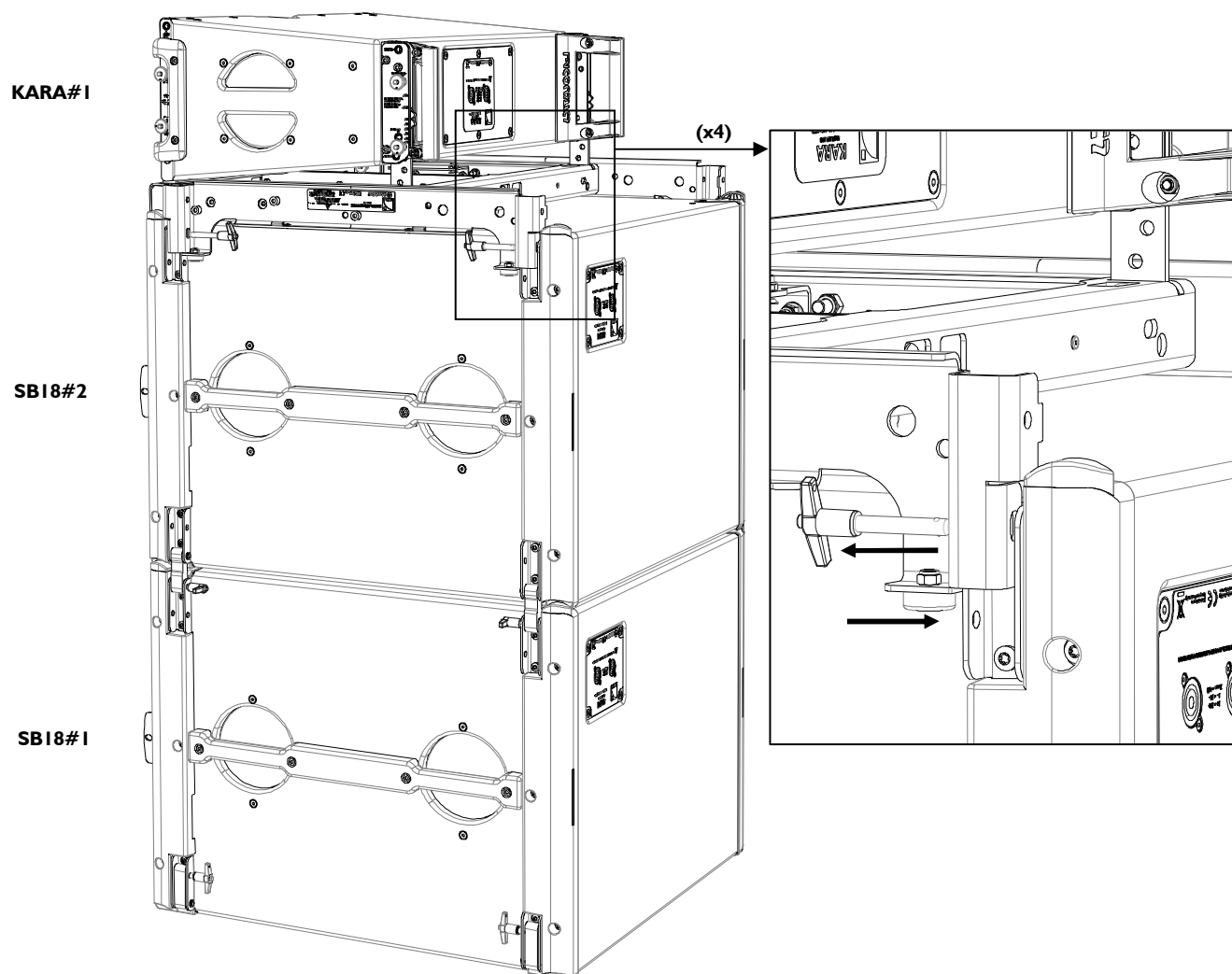
6. Separate KARA#2 from KARA#1 by applying step 3.
7. Attach KARA#2 to KARA#3 as follows:
  - a. Lift up and turn KARA#2 arms pointing up.
  - b. Align the front and rear link points between both enclosures.
  - c. Secure the link points together by removing the four KARA#2 bottom R-BLP from their **storage** holes and re-inserting them into their **link** holes.



**Figure 60: Attaching KARA#2 to KARA#3**

8. Set angle 0° on KARA#2 by applying step 5.
9. If the last enclosure to be placed in the flight-case is not attached to the KARA-MINIBU (KARA#4), apply steps 3, 7, 12, and 13 for KARA#4 and then apply the procedure a new time from step 2 for array KARA#1-3.

If the last enclosure to be placed in the flight-case is attached to the KARA-MINIBU (KARA#1), disconnect the link points between the KARA-MINIBUEX stacking platform and SB18#2 by removing the four KARA-MINIBUEX T-BLP from their link holes and re-inserting them into their storage holes.

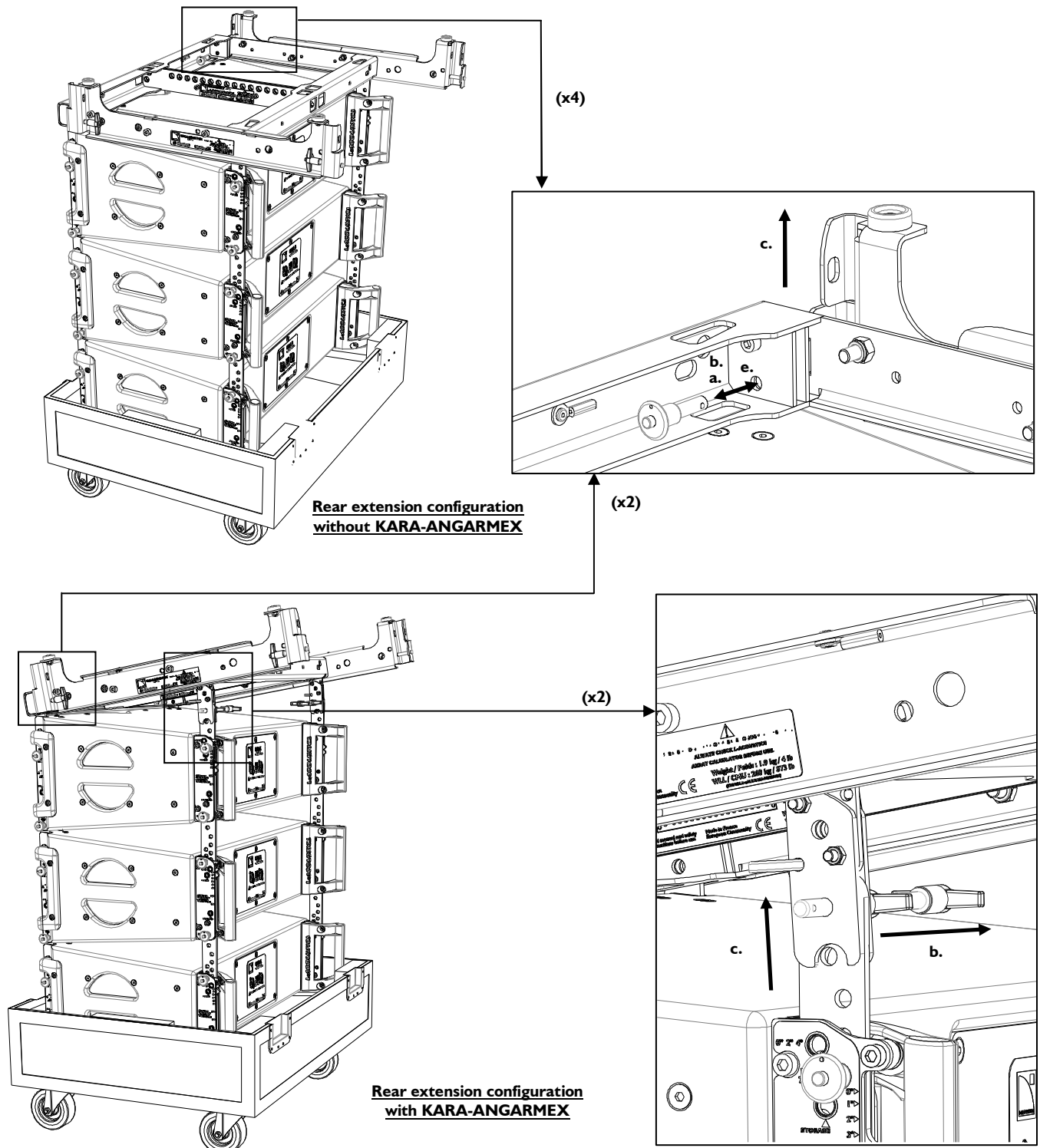


**Figure 61: Disconnecting the link points between KARA-MINIBUEX and SB18#2**

10. Attach the KARA#1/platform assembly to KARA#2 by applying step 7.

**II. Separate the platform from KARA# I as follows:**

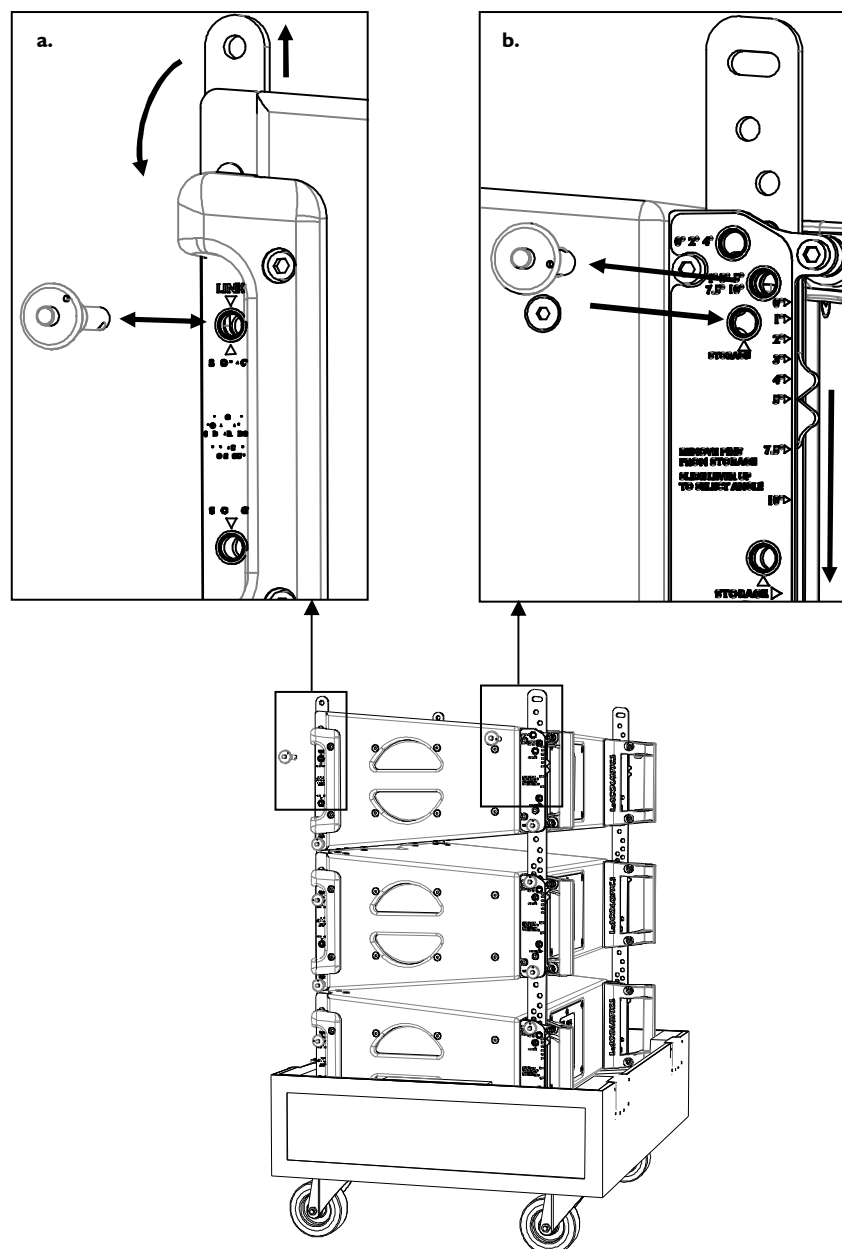
- a. Remove both KARA-MINIBU front R-BLP.
- b. If KARA-ANGARMEX are attached to the platform, remove both T-BLP from them.  
Otherwise, remove both KARA-MINIBU rear R-BLP.
- c. Separate the platform from KARA# I.
- d. If KARA-ANGARMEX are attached to the platform, remove them by removing both KARA-MINIBU rear R-BLP.
- e. Re-insert the four R-BLP into the KARA-MINIBU holes.



**Figure 62: Separating KARA-MINIBU from KARA# I**

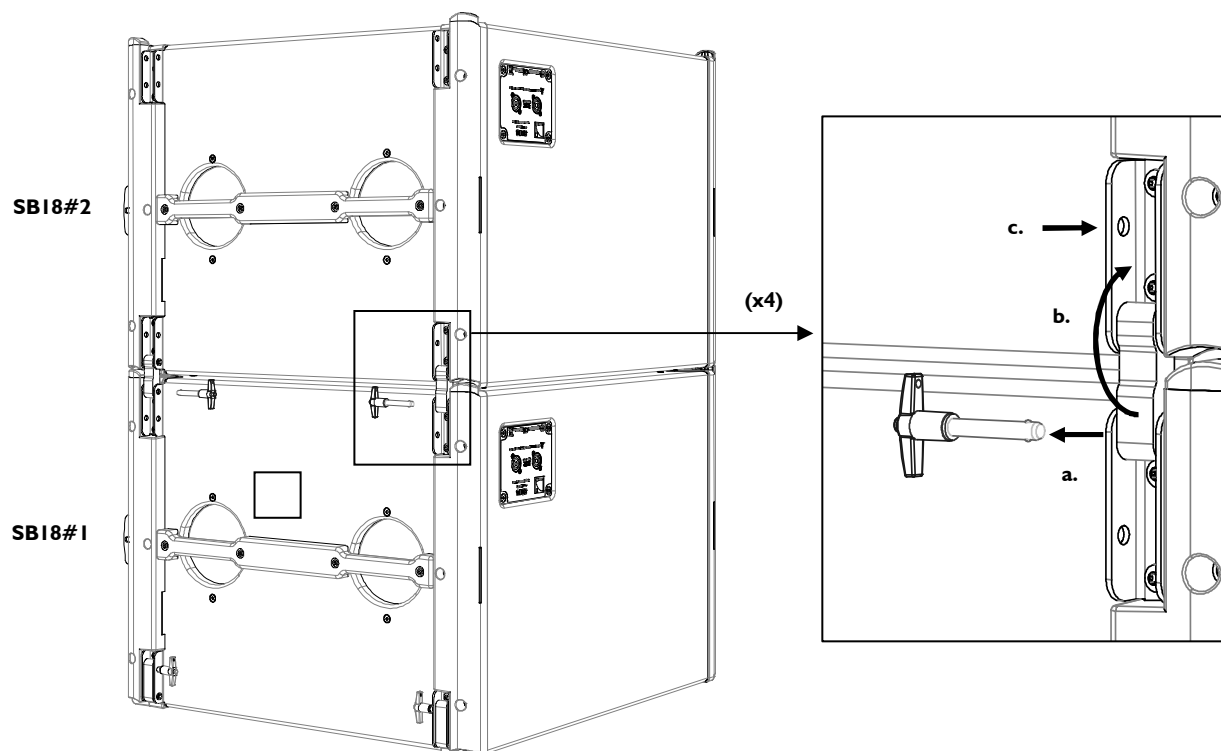
**12. Close the four KARA#1 arms as follows (repeat on both sides of the enclosure):**

- a.** Remove the front top R-BLP from its **link** hole, slide the front arm up, rotate it down, and lock it in place by re-inserting the R-BLP into its **storage** hole. **Note:** The front top **link** and **storage** holes are the same.
- b.** Remove the rear top R-BLP from its angle hole, slide the angle arm so as to align the cursor with the **storage** label, and lock it in place by re-inserting the R-BLP into its **storage** hole.



**Figure 63: Closing the KARA#1 arms**

13. Put the flight-case lid on.
14. Separate the top SB18 (SB18#2 for example) from the SB18 below (SB18#1 for example) as follows:
  - a. Remove a T-BLP from an SB18#1 top link point.
  - b. Rotate the link arm up.
  - c. Lock the link arm in closed position by re-inserting the T-BLP into SB18#2.
  - d. Repeat this procedure until all four arms are locked in closed position.



**Figure 64: Separating SB18#2 from SB18#1**

15. Attach a dolly board to SB18#2 and remove SB18#2 from the rigging location.
16. Repeat steps 14 and 15 until all SB18 are separated from the array.

## 7 CARE AND MAINTENANCE


### 7.1 Maintenance information


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The KARA® system assembling components are the following:

- KARA-MINIBU rigging structure.
- KARA-MINIBUEX extension bars.
- KARA-ANGARMEX angle arm extensions with bolts.
- KARA-PULLBACK rigging accessory.
- KARA® enclosures with rotating arms and angle arms.
- SB18 enclosures with link arms.
- Shackles with bolts and safety pins.
- Ball locking pins (R-BLP and T-BLP).

If these components are used as it is described in this manual they will remain fully operational over the enclosures' life. However, it is necessary to regularly check the following points in order to guarantee the system durability:

	<p>The KARA-MINIBU, KARA-MINIBUEX, KARA-ANGARMEX, and KARA-PULLBACK elements (including shackles, BLP, and bolts) should not show any deformation, fissure, or oxidation.</p> <p>Any component incorporating a part showing signs of defect must immediately be replaced.</p>
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	<p>The metal components of the KARA® and SB18 enclosures should not show any signs of deformation, fissure, or oxidation. They must be firmly fixed to the enclosure.</p> <p>Any enclosure incorporating a part showing signs of defect must immediately be put aside and withdrawn from use to be inspected by qualified service personnel.</p>
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	<p>Verify that each BLP operates normally by moving its mechanism and checking that it automatically returns to nominal position.</p> <p>Verify the screwing mechanism on each shackle. Verify that the safety pin is present and that it secures properly to the shackle.</p> <p>Verify that each bolt secures properly to the KARA-MINIBU and KARA-MINIBUEX.</p>
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## 7.2 Authorized service procedures

### 7.2.1 Replacement kits and recommended tools

The replacement kits (KR) available for the customer are listed in Table 4. Table 5 is a list of all tools and material needed for rigging and service (not included).



Service and repair work for any other part must be carried out by an L-ACOUSTICS® authorized representative. Otherwise, the customer may be exposed to dangerous situations and the warranty will no longer apply.

**Table 4: Replacement kits and utilities**

Reference	Kit description	Kit contents (fixing material included)	Service procedure
	<b>KARA-MINIBU</b>		
KR MBUMPLAS	Laser support plate	1 plate	[7.2.2]
KR CAMANI 2L	12 mm shackle with safety pin	2 shackles	—
KR PIN62I	5/16" R-BLP	10 pins	—
KR LOCKBLUE	Medium-strength thread-locker (blue)	1 bottle of 50 g	—
	<b>KARA-MINIBUEX</b>		
KR PIN60I	5/16" T-BLP	10 pins	—
KR SB18iPAT	Rubber feet	4 feet	[7.2.3]
	<b>KARA-ANGARMEX</b>		
KR PIN60I	5/16" T-BLP	10 pins	—
	<b>KARA-PULLBACK</b>		
KR MANI 9L	19 mm shackle with safety pin	4 shackles	—

**Table 5: Recommended tools (not included)**

Electric screwdriver with torque selector (N.m or in.lb <sub>i</sub> )
5 mm hex bit
7 mm hex key
10 mm hex key
T20 Torx® bit
T30 Torx® bit

### **7.2.2     Laser support plate**

#### **Replacement kit and tools**

KR MBUMPLAS, handheld inclinometer<sup>1</sup>, electric screwdriver with torque selector (N.m or in.lb<sub>f</sub>), T20 Torx® bit, 5 mm hex bit, 7 mm hex key, KR LOCKBLUE.

<sup>1</sup> Available in the **L-ACOUSTICS® TECH TOOLCASE** (refer to the **TECH TOOLCASE Product spec sheet** [3.4]).

#### **Laser support plate replacement procedure**

1. Put the M-BUMP on a flat horizontal surface (verify with the handheld inclinometer).
2. Remove the laser/inclinometer device from the laser support plate by undoing the four Torx® bolts (T20 bit, 7 mm hex key).
3. Remove the **old** laser support plate from the KARA-MINIBU by undoing both hex screws (5 mm hex bit).
4. Mount the **new** laser support plate horizontally to the KARA-MINIBU (verify with the handheld inclinometer) by driving two hex screws (thread-locker, 5 mm hex bit, 5 N.m/45 in.lb<sub>f</sub>).
5. Mount the laser/inclinometer device to the new laser support plate (laser lens towards the M-BUMP slits) by driving the four Torx® bolts (T20 bit, 7 mm hex key, 3 N.m/27 in.lb<sub>f</sub>).

### **7.2.3     Rubber feet**

#### **Replacement kit and tools**

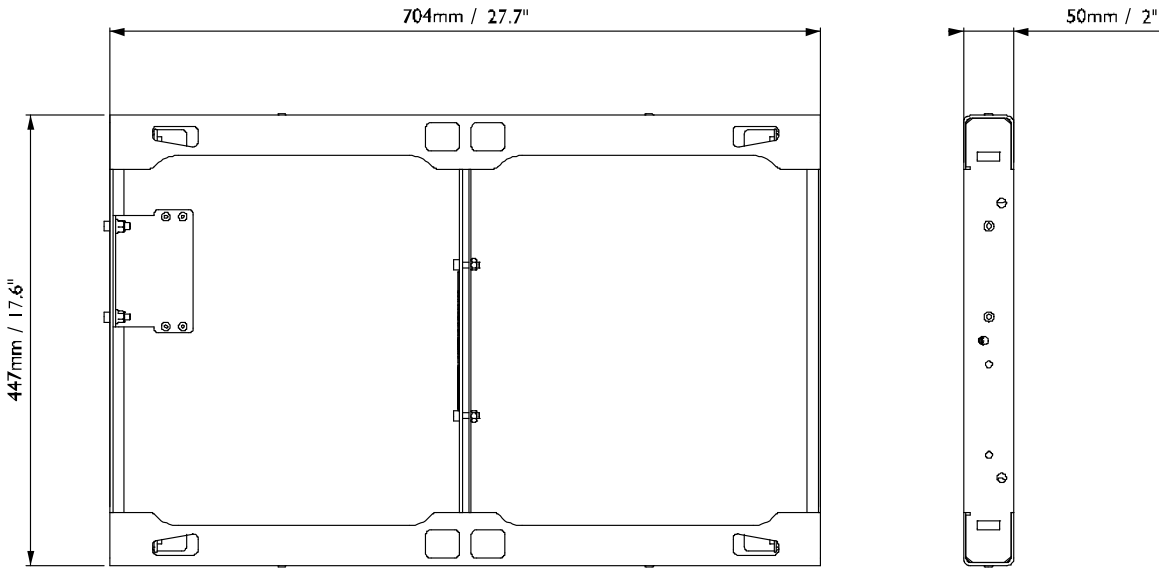
KR SB18iPAT, electric screwdriver with torque selector (N.m or in.lb<sub>f</sub>), T30 Torx® bit, 10 mm hex key.

#### **Rubber feet replacement procedure**

1. Remove the **old** foot from the KARA-MINIBUEX by undoing the Torx® bolt (T30 bit, 10 mm hex key).
2. Mount a **new** foot on the KARA-MINIBUEX by driving a 35 mm Torx® bolt (T30 bit, 10 mm hex key, 3 N.m/27 in.lb<sub>f</sub>).
3. Repeat the procedure for all feet to be replaced.

## 8 SPECIFICATIONS

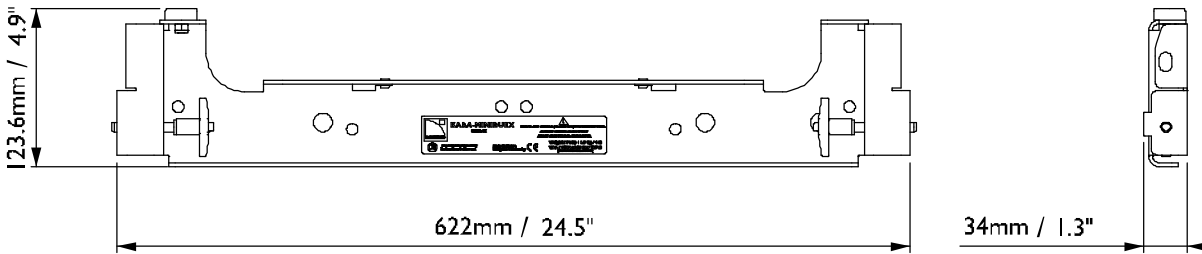
Reference	KARA-MINIBU
<b>Dimensions (L x H x D)</b>	704 x 50 x 447 mm / 27.7 x 2 x 17.6 inch

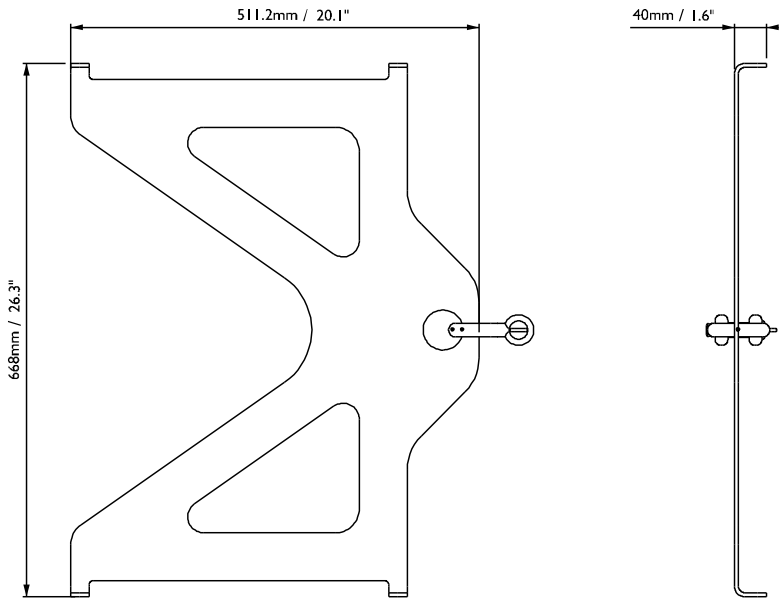
<b>Weight</b>	7.6 kg / 17 lbs
<b>Setup safety limits <sup>1</sup></b>	Maximum 6 KARA or 2 SB18/6 KARA or 4 SB18 per KARA-MINIBU in flown config. Maximum 6 KARA per KARA-MINIBU in stacked config.
<b>Material</b>	High-grade steel coated with polyester powder.
<b>Included accessories</b>	4 R-BLP, 1 laser support plate with 4 bolts, 2 shackles.

<sup>1</sup> Installation safety limits are specified in SOUNDVISION Software which is designed to help with L-ACOUSTICS® product implementation.

Reference	KARA-MINIBUEX
<b>Dimensions (L x H x D)</b>	34 x 123.6 x 662 mm / 1.3 x 4.9 x 24.5 inch

<b>Weight</b>	1.9 kg / 4 lbs (for two pieces)
<b>Material</b>	High-grade steel coated with polyester powder.
<b>Included accessories</b>	4 T-BLP, 4 feet (for two pieces).

<b>Reference</b>	<b>KARA-PULLBACK</b>
<b>Dimensions (L x H x D)</b>	668 x 40 x 511.2 mm / 26.3 x 1.6 x 20.1 inch
	
<b>Weight</b>	6 kg / 13 lbs
<b>Setup safety limits [9.2.3]</b>	Maximum of 6 KARA or 2 SB18/6 KARA enclosures per KARA-PULLBACK.
<b>Material</b>	High-grade steel coated with polyester powder.
<b>Included accessory</b>	1 shackle.

## 9 APPENDIX

### 9.1 LAP-TEQ inclinometer mounting

A **laser support plate** has been integrated inside the KARA-MINIBU for optional TEQSAS® LAP-TEQ inclinometer/laser device mounting. The LAP-TEQ is a remote control device which is part of the **L-ACOUSTICS® TECH TOOLCASE** (refer to the **TECH TOOLCASE Product spec sheet** [3.4]).

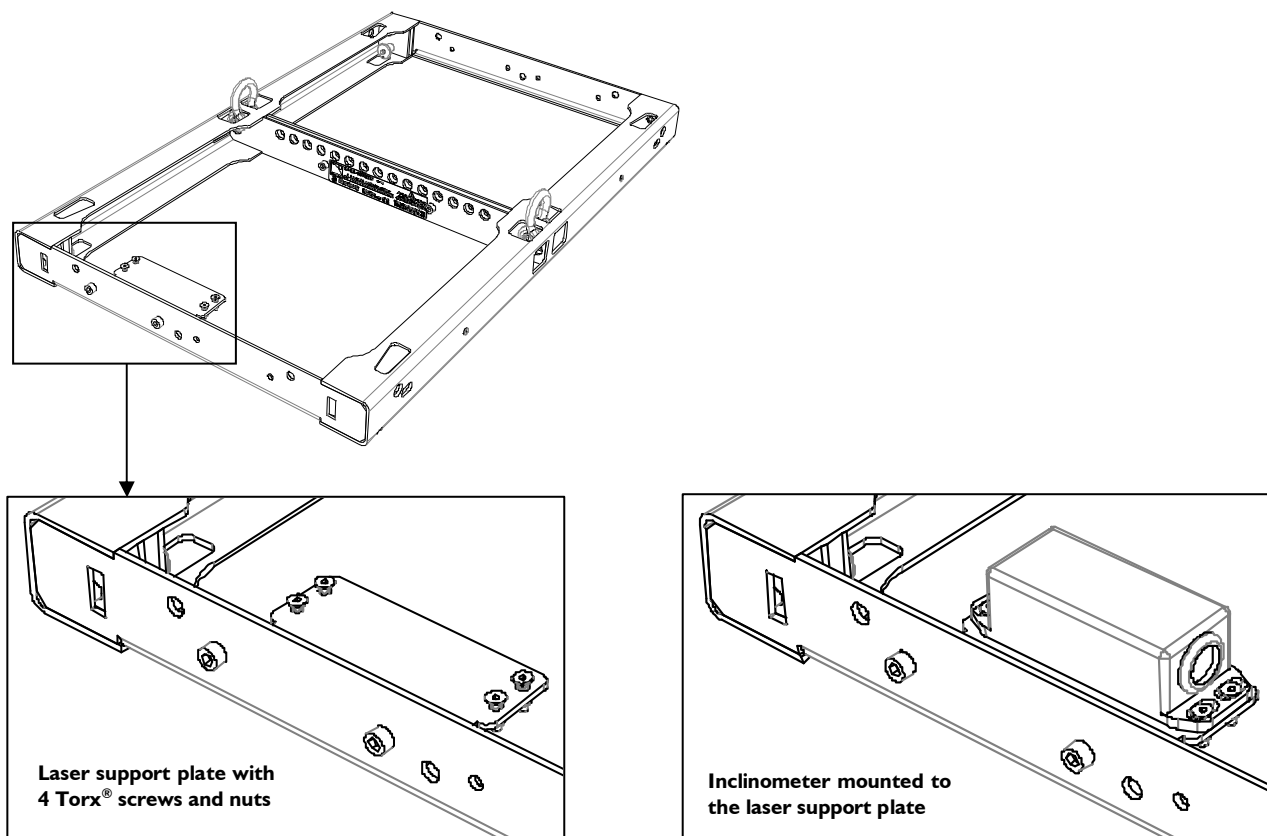


Figure 65: Laser support plate and LAP-TEQ inclinometer

#### LAP-TEQ mounting procedure

##### Required tools

Handheld inclinometer (available in the **TECH TOOLCASE**), electric screwdriver with torque selector (N.m or in.lb<sub>f</sub>), T20 Torx® bit, 7 mm hex key, XLR3 cable.

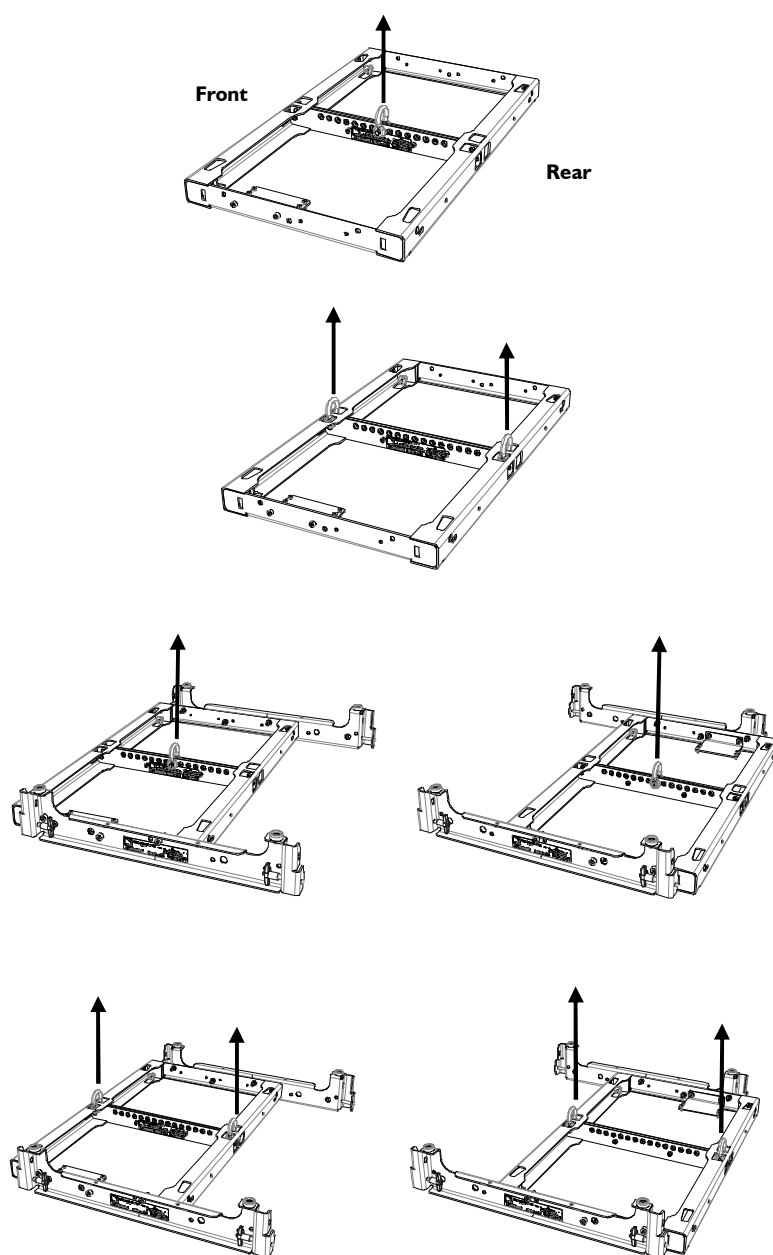
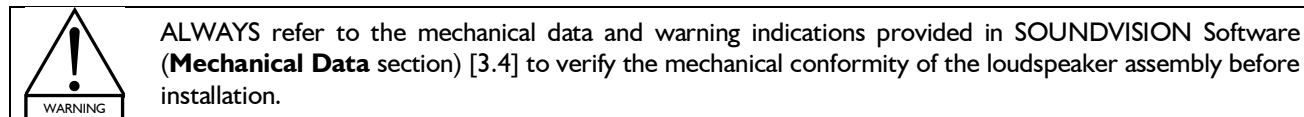
##### Procedure

1. Put the M-BUMP on a flat horizontal surface (verify with the handheld inclinometer).
2. Undo the four Torx® bolts on the laser support plate (T20 bit, 7 mm hex key).
3. Position the LAP-TEQ sensor on the laser support plate with laser lens towards the KARA-MINIBU slits.
4. Drive the four Torx® bolts into the sensor and plate holes (T20 bit, 7 mm hex key, 3 N.m/27 in.lb<sub>f</sub>).
5. Connect an XLR 3 cable to the sensor.
6. Calibrate the sensor by following the manufacturer's recommendations.

## 9.2 Flown array options and site angle setting

### 9.2.1 KARA-MINIBU rigging options

L-ACOUSTICS® recommends 4 different rigging options to fly the KARA-MINIBU for arrays containing KARA and/or SB18 enclosures. It is possible to use 1 or 2 hang points and to include the KARA-MINIBUEX accessories (see Figure 66).



#### **Option 1: KARA-MINIBU, 1 point**

- KARA standalone array
- 1 motor
- Variable position [9.2.2]

#### **Option 2: KARA-MINIBU, 2 points**

- KARA standalone array
- 2 motors
- Fixed front and rear positions [9.2.2]  
(spacing = 407 mm/16 inch)

#### **Option 3: KARA-MINIBU, KARA-MINIBUEX, 1 point**

- SB18/KARA mixed array or SB18 standalone array
- 1 motor
- Variable position [9.2.2]
- Left view = Rear extension config.  
Right view = Front extension config.

#### **Option 4: KARA-MINIBU, KARA-MINIBUEX, 2 points**

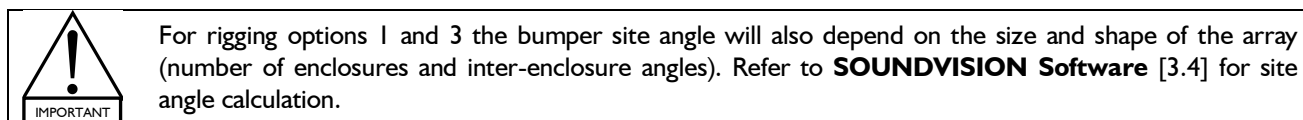
- SB18/KARA mixed array or SB18 standalone array
- 2 motors
- Fixed front and rear positions [9.2.2]  
(spacing = 407 mm/16 inch)
- Left view = Rear extension config.  
Right view = Front extension config.

**Figure 66: KARA-MINIBU rigging options**

## 9.2.2 KARA-MINIBU site angle setting

The KARA-MINIBU site angle setting will be discrete or continuous depending on the chosen rigging option.

**Rigging options 1 and 3** offer 17 discrete site angle values in each configuration by selecting the single shackle position (holes 1-17). The hole numbering convention is shown in Figure 67 for KARA-MINIBU and Figure 68 for KARA-MINIBU/KARA-MINIBUEX.



**Note:** Hole 15 provides 0° site angle for an SB18 standalone array.

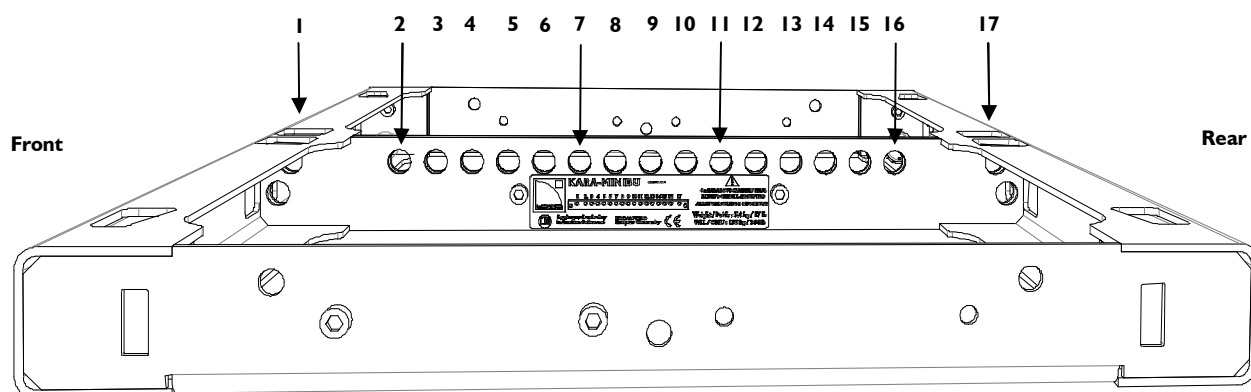


Figure 67: Rigging hole numbering convention for KARA-MINIBU

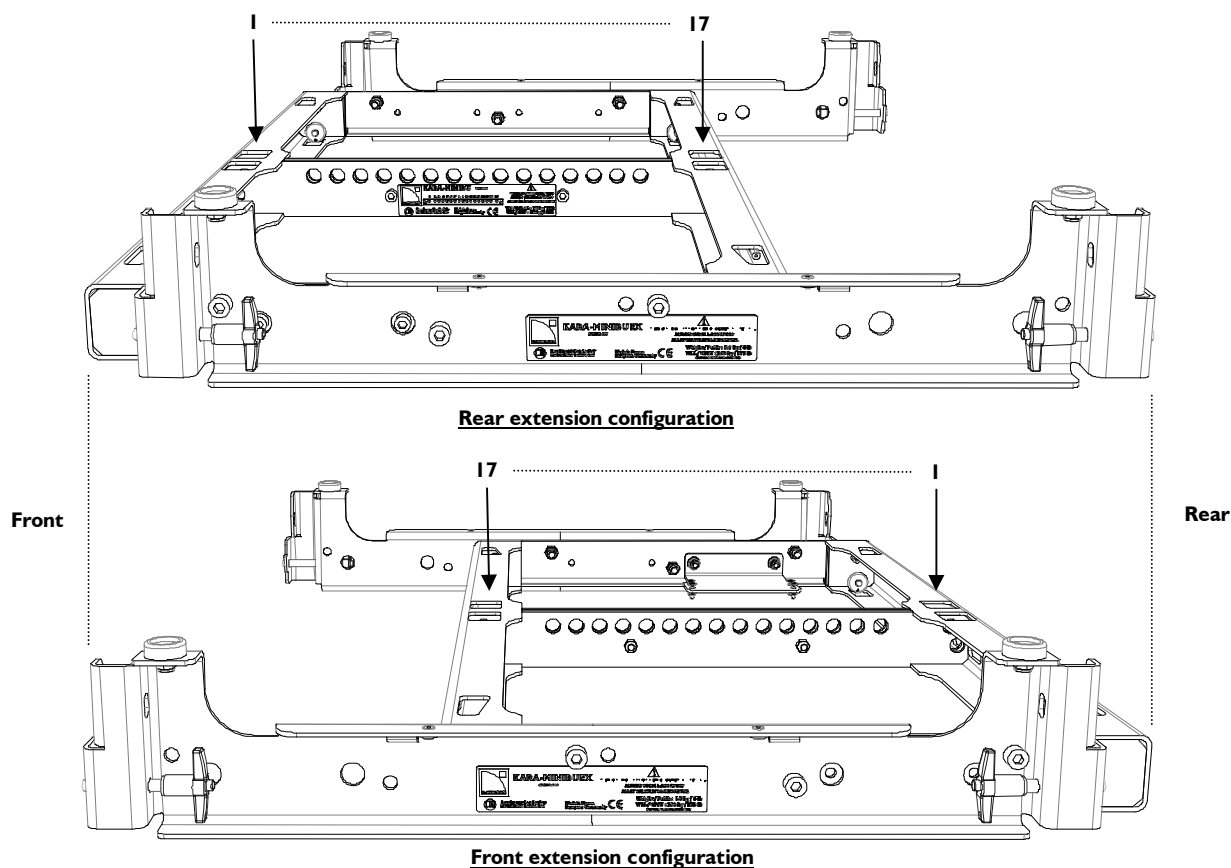

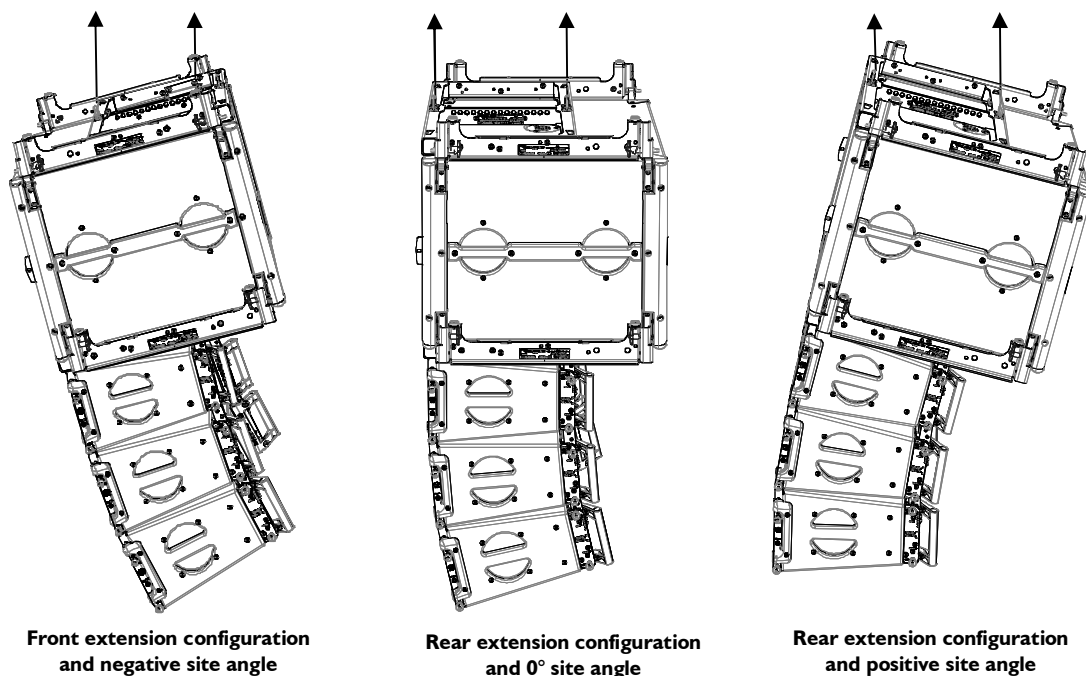


Figure 68: Rigging hole numbering convention for KARA-MINIBU/KARA-MINIBUEX

**Rigging options 2 and 4** allow continuous bumper site angle setting depending on the relative heights between the front and rear hang points (holes 1 and 17) as shown in Figure 69.




The configurations shown in Figure 69 are purely indicative.  
**ALWAYS** refer to the mechanical data and warning indications provided in SOUNDVISION Software (**Mechanical Data** section) [3.4] to verify the mechanical conformity of the loudspeaker assembly before installation.



**Figure 69: Continuous angle selection (option 4 examples)**

### 9.2.3 **KARA-PULLBACK setup safety limits**

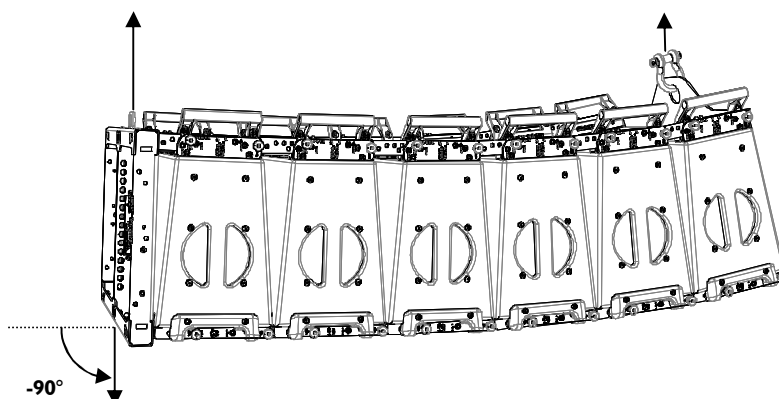
The KARA-PULLBACK accessory attaches to the bottom enclosure of a KARA array to allow setting the site angle down to -90°. However, this limit depends on the composition of the array as shown in Table 6.



**ALWAYS** refer to Table 6 before using the KARA-PULLBACK accessory.

**Table 6: Possible downwards site angles with KARA-PULLBACK**

Number of KARA enclosures in the array	6	6	3
Number of SB18 enclosures in the array	0	2	1
Maximum array site angle	-90°	-90°	-90°




**Figure 70: 90° downwards site angle with KARA-PULLBACK**



## 9.3 Stacked array options and site angle setting

### 9.3.1 Stacking platform configuration

The KARA-MINIBU can be used as a horizontal stacking platform along with both KARA-MINIBUEX extension bars. The platform can be set in **front or rear extension configuration** as show in Figure 71 and Figure 72 (refer to [9.3.2] for bottom KARA angle settings).



The configurations shown in Figure 71 and Figure 72 are purely indicative.  
Refer to [6.3.1] for setup safety limits.

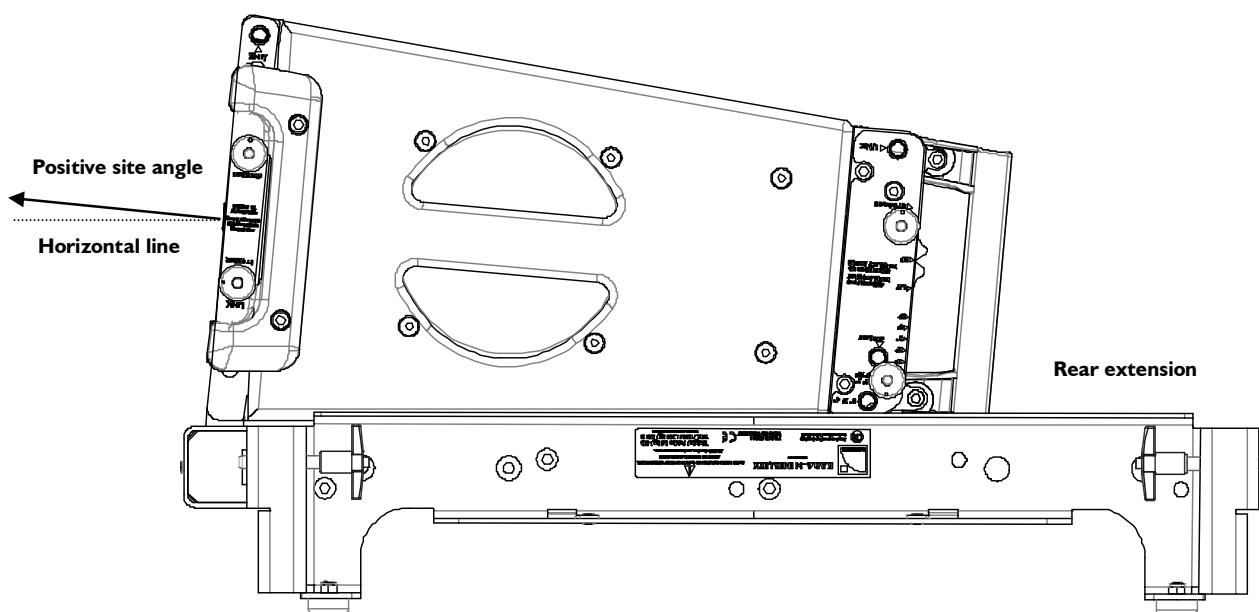


Figure 71: Rear extension configuration

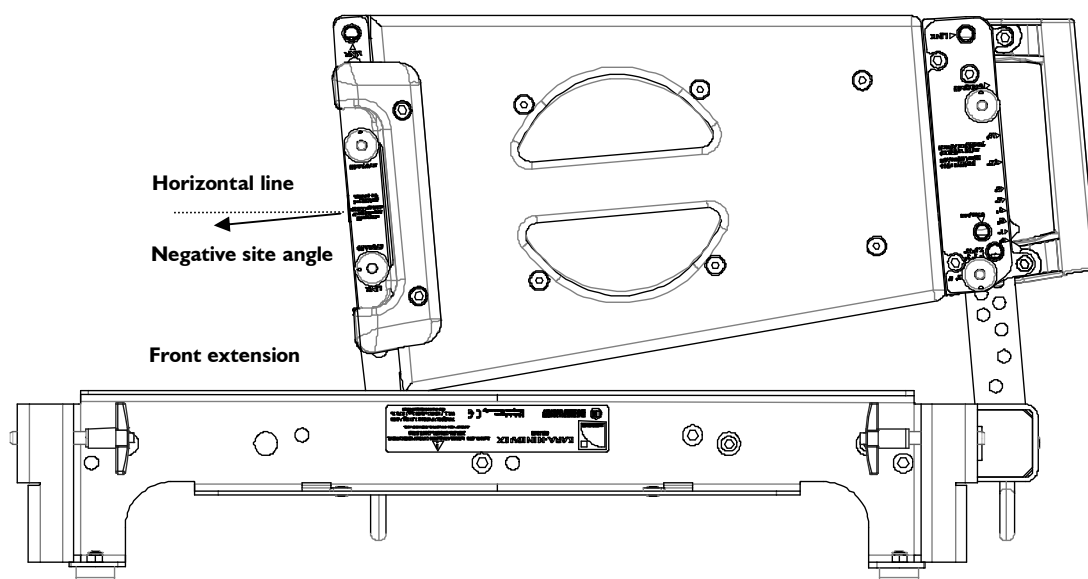


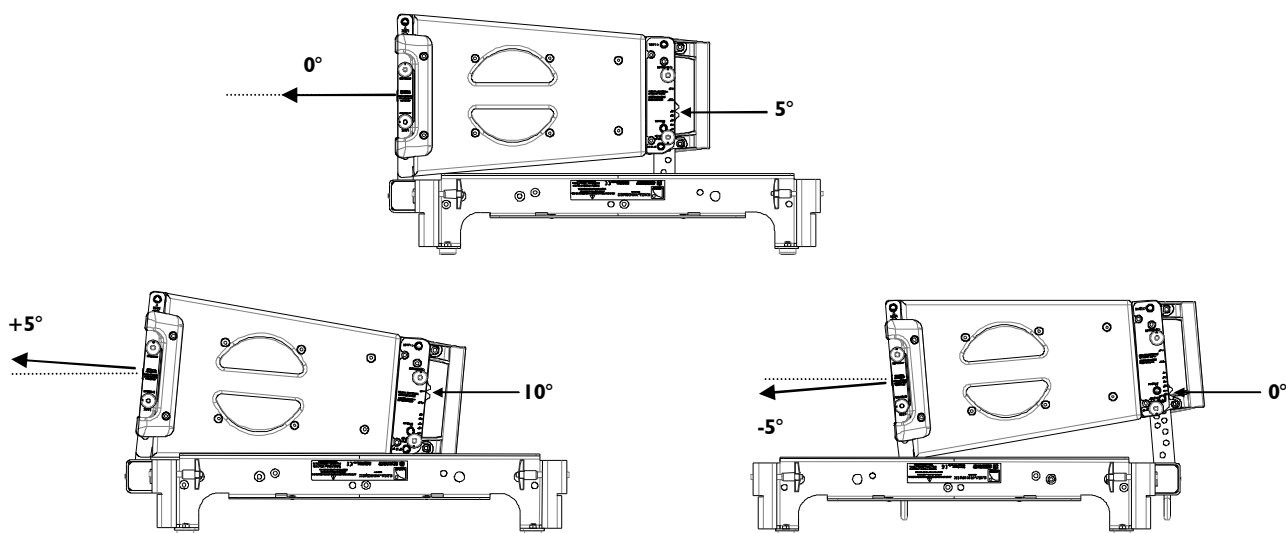
Figure 72: Front extension configuration

### 9.3.2 Array site angle setting

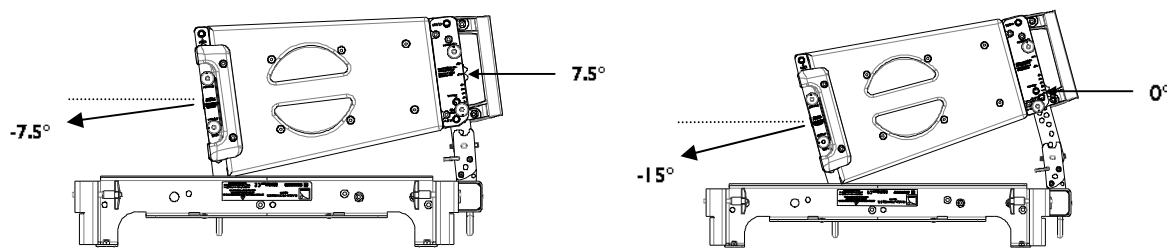
The site angle of the stacked KARA array will be determined by the angle of the bottom enclosure in the range from  $-15^{\circ}$  to  $+5^{\circ}$ . Install both KARA-ANGARMEX angle arm extensions to obtain angles from  $-7.5^{\circ}$  to  $-15^{\circ}$ . Table 7 indicates all possible site angles settings:

**Table 7: Possible site angles for stacked array**

Angle selection on KARA (angle label facing the cursor)	Resulting site angle <u>without</u> KARA- ANGARMEX (Figure 73)	Resulting site angle <u>with</u> KARA- ANGARMEX (Figure 74)
$0^{\circ}$	$-5^{\circ}$	$-15^{\circ}$
$1^{\circ}$	$-4^{\circ}$	$-14^{\circ}$
$2^{\circ}$	$-3^{\circ}$	$-13^{\circ}$
$3^{\circ}$	$-2^{\circ}$	$-12^{\circ}$
$4^{\circ}$	$-1^{\circ}$	$-11^{\circ}$
$5^{\circ}$	$0^{\circ}$	$-10^{\circ}$
$7.5^{\circ}$	$+2.5^{\circ}$	$-7.5^{\circ}$
$10^{\circ}$	$+5^{\circ}$	—



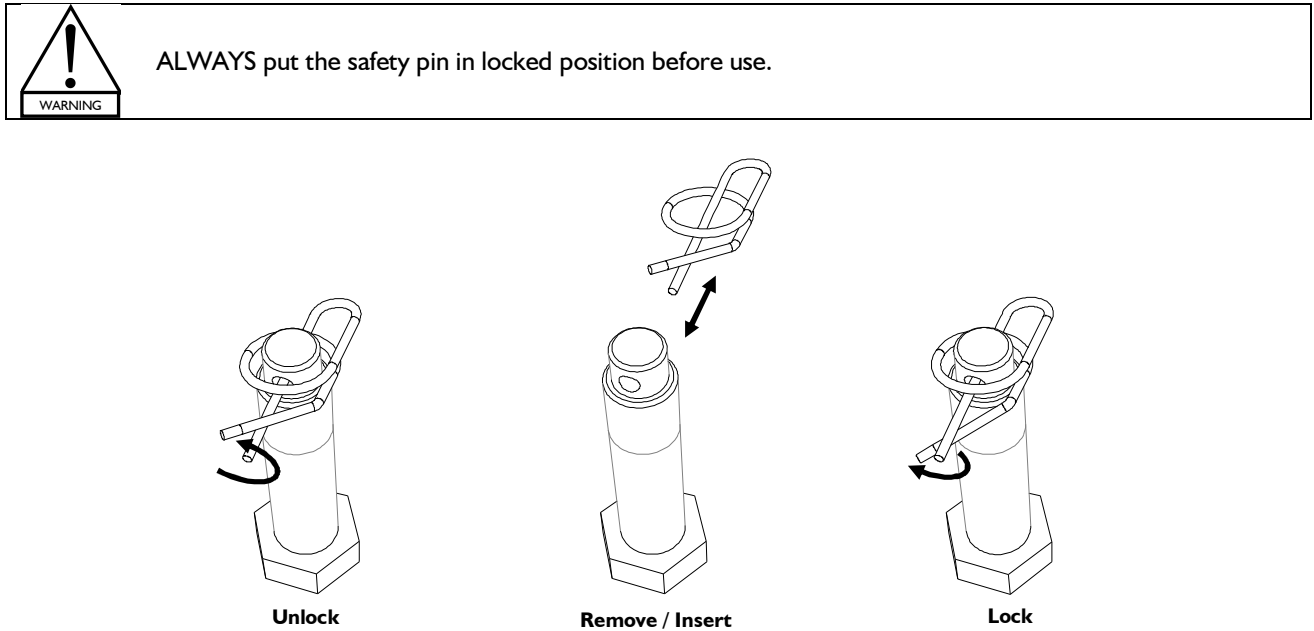
**Figure 73: Bottom KARA angle selection without KARA-ANGARMEX**



**Figure 74: Bottom KARA angle selection with KARA-ANGARMEX**

## 9.4 Safety pin removal and insertion

The safety pins provided with the shackles have an integrated locking system. Figure 75 presents the removal and insertion procedures.



**Figure 75: Safety pin removal and insertion procedures**









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