



CLART® CMA
NRAS-i KRAS

**DETECTION AND GENETIC IDENTIFICATION OF
POINT MUTATIONS IN 2 OF THE GENES BELONGING TO THE EGFR PATHWAY
ASSOCIATED TO COLORECTAL CANCER -KRAS, NRAS
FOR *IN VITRO* DIAGNOSIS**

CLART[®] CMA NRAS-i KRAS

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For more information, please refer to the web site: www.genomica.com

CE Mark



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1. GLOSSARY



Attention, see instructions for use



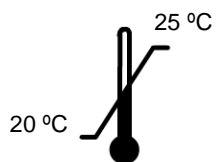
Expiration date



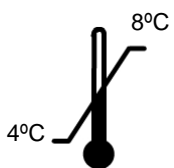
In vitro diagnostic medical device



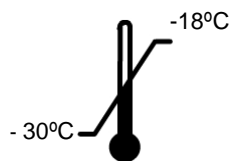
Lot



Store at room temperature



Store at 4°C to 8°C



Store at -30°C to -18°C

2.PROTOCOL DESCRIPTION

CLART® CMA NRAS-iKRAS detects the presence of the most prevalent point mutations in the NRAS gene and infrequent mutations in KRAS gene belonging to Epidermal Growth Factor Receptor (EGFR) pathway associated to colorectal cancer. The point mutations detected by the kit are the following:

- Mutations in NRAS: G12D, Q61H (183 A>T), Q61R, Q61K, Q61L
- Mutations in KRAS (infrequent): Q61H (183 A>C), K117N (351 A>C), K117N (351 A>T), A146V, A146T.

SAMPLE: formalin-fixed, paraffin-embedded colorectal biopsies.

Detection is carried out by the specific amplification of the mutation in the sample, originating a variable fragment for each mutation of between 100-200 base pairs.

The amplification is performed in a variable number of PCR tubes, depending on the gene of interest:

- The detection of point mutations for **NRAS-iKRAS** requires 4 amplification tubes that are differentiated by colour: mix 1 white, mix 2 green, mix 3 red, and mix 4 yellow.

The detection of the product amplified by PCR is carried out by means of a low-density microarray platform: CLART® (Clinical Arrays Technology). The platform is based on a principle that is very simple, but at the same time economical and effective. It consists of a microarray printed at the bottom of a microtiter plate well), which simplifies the entire hybridization and visualization process when compared to classic microarray systems. Figure 1 displays a CLART-Strip® or CS of 8 wells.

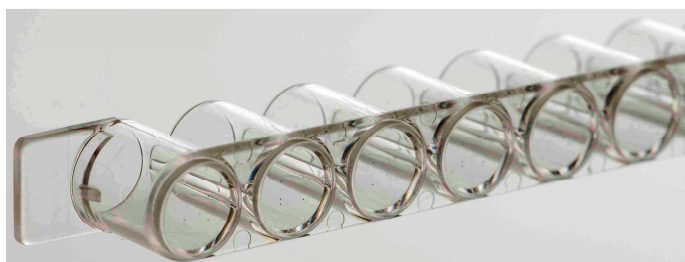


Figure 1. CLART-Strip® (CS) platform in the form of an 8-well strip.

The **CLART®CMA NRAS-iKRAS** detection system is based on the precipitation of an insoluble product in those microarray areas in which hybridization of amplification products with specific probes takes place. During PCR, amplified products are labelled with biotin. After amplification, these products are hybridized with their respective specific complementary probes that are immobilised in specific and well-known microarray areas. Afterwards they are then incubated with

a streptavidine-peroxidase conjugate. The conjugate is bound through streptavidine with the biotin present in the amplified products (which are bound to their specific probes) and the peroxidase activity prompts the appearance of a non-soluble product in the presence of the o-dianisidine substrate, which precipitates on the microarray areas where hybridization occurs (Figure 2).

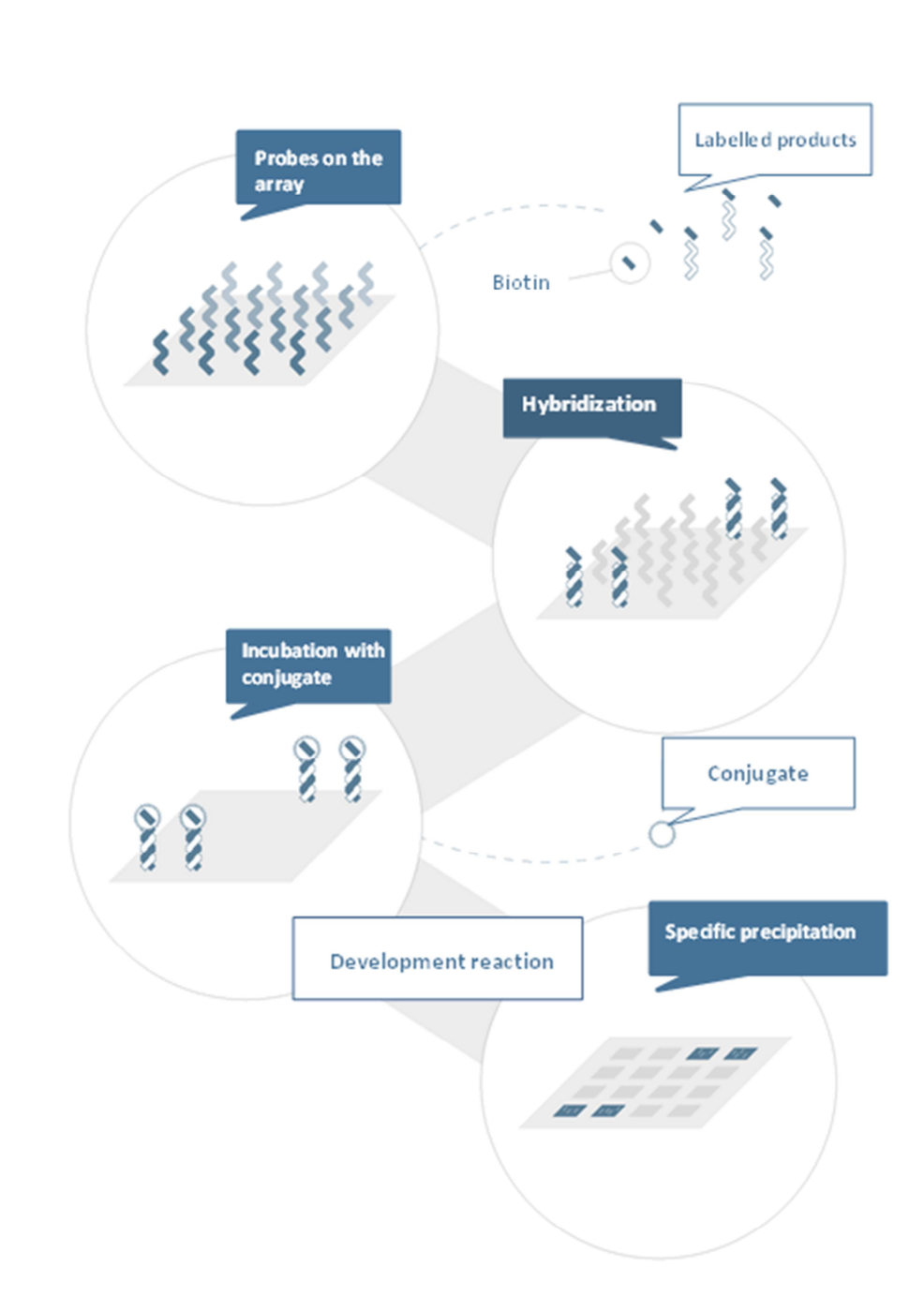


Figure 2: Diagram of the visualization method. Probes, immobilized on the surface, capture their complementary biotin-labelled amplified products. With the help of biotin, they bind to the conjugate, in this case streptavidine-HRP (*HorseRadish Peroxidase*). The o-dianisidine substrate, by the action of the HRP, produces a precipitate on the area where hybridization occurs.

3.- KIT COMPONENTS AND STORAGE

The **CLART® CMA NRAS-iKRAS** kit contains enough reagents for the analysis of 8 or 24 clinical samples. The reagents included in the kit have been grouped into various packages, depending on the temperature at which they should be stored. When storage recommendations are observed, all reagents should remain stable until kit's expiration date.

3.1. Amplification reagents

They are shipped and should be stored at -20°C.

- Ready-to-use **amplification tubes**. They contain 45 µL of reaction mixture. Only thaw on ice the exact number of amplification tubes that will be used and keep the rest at -20°C.

For the analysis of the **NRAS-iKRAS GENES**, 4 amplification tubes are provided:

Mix 1: White tube; Mix 2: green tube; Mix 3: Red tube; Mix 4 yellow tube.

Note: **The kit package includes a self-adhesive and irreversible temperature indicator; the appearance of a reddish colour on the visualization window indicates that, at a certain moment, products have exceeded the storage temperature of -20°C and they should not be used.**

3.2. Visualization reagents

The visualization kit is shipped at 4°C and at room temperature. This visualization kit should be stored at 4°C except Strips and hybridization solution which should be stored at room temperature.

WARNING! Upon arrival, the CLART-Strip® (CS), as well as the hybridization solution (SH) must be kept at room temperature.

- **CS strips** (including all specific probes). They are provided in a sealed thermal envelope. **Store it closed, at room temperature, protected from direct light and high temperatures.**
- **SH** (Hybridization Solution). **Store at room temperature.**
- **DC** (Conjugate Diluent). **Store at 4°C.**
- **CJ** (Conjugate). **Store at 4°C.** Centrifuge once before use.
- **RE** (Development Solution). **Store at 4°C and protected from light.**
- **TL** (Wash Buffer). **Store at 4°C.**
- **Adaptor and lid for 8-well strips (microtiter plate).**

3.3 Other components

The following components are required for the capture and subsequent image processing:

- **CAR® (CLINICAL ARRAY READER):** which allows the reading and automatic interpretation up to 12 CS, that means, a total amount of 96 samples. This platform is manufactured exclusively for GENOMICA kits use only.
- **SAICLART®:** software developed by GENOMICA for image processing.
- **CLART® CMA NRAS-iKRAS Software:** It is specific for *CLART® CMA NRAS-iKRAS* designed and validated by GENOMICA. Installed and ready to use.



Figure 3. CAR® (CLINICAL ARRAY READER)

4.-MATERIALS REQUIRED BUT NOT PROVIDED

Below you can find a list of all materials required but not provided.

4.1. Reagents and materials

- Distilled water.
- Disposable gloves.
- Filter tips or positive displacement pipettes.
- Crushed ice container.
- 1.5 mL autoclaved Eppendorf tubes.
- 1.5 mL tube grids.
- 0.2 mL tube holder.

4.2. Equipment

- autoclart® (Figure 3) which enables the automatic visualization of up to 12 CS, that means, a total amount of 96 samples.

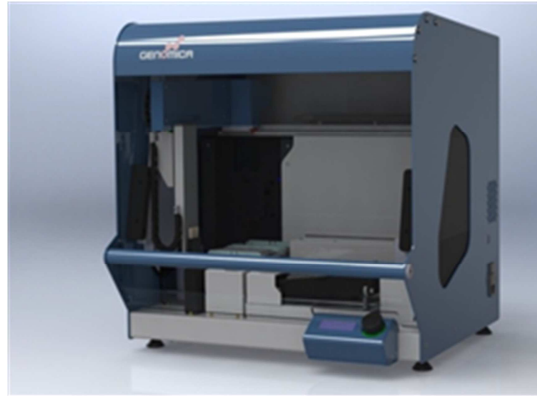


Figure 4. autoclart®

- Microcentrifuge.
- UV-visible spectrophotometer
- Thermal cycler.
- Laminar flow chamber for the extraction laboratory.
- Three adjustable micropipettes ranging from 1-20 μL , 20-200 μL , and 200-1000 μL for the extraction laboratory.
- One adjustable micropipette ranging from 1-20 μL , to add the genetic material to the amplification tubes.
- Three adjustable micropipettes ranging from 1-20 μL , 20-200 μL , and 200-1000 μL for the visualization laboratory.
- Thermoblock (Thermomixer) compatible with 96-well plates and adjustable shaking at 20°C, 25°C and 50°C.
- Vortex.
- Vacuum system (desiderable).

5.-RECOMMENDATIONS AND HANDLING PROCEDURES

Read carefully before starting the assay in order to avoid contamination!

5.1. General recommendations

1. This assay should be performed in two physically separated areas, in order to avoid sample contamination with the previously amplified product. Separate working materials should be available in each area (pipettes, tips, tubes, grids, gloves, etc.) which should never be used outside these areas.

1. Pre-PCR area: DNA extraction and sample preparation are performed in this area. Sample manipulation must be carried out within a biosafety cabinet (BSC).

2. Post-PCR area: Amplification and visualization of the amplified product are carried out in this area. The material of this area should never come into contact with the material of the extraction area. Avoid entering the pre-PCR area after having worked in the visualization area.

2. Always use gloves. It is recommended to change gloves quite frequently, and it is mandatory to change gloves before start working in each of the aforementioned areas. New gloves must always be used when DNA is added to the amplification tubes.

3. Clean working areas (laboratory cabinets, hoods, grids, pipettes) thoroughly with a 10% diluted bleach solution **after every sample batch processing**; it is mandatory to disinfect all working areas in case of contamination. For thermocyclers and thermomixers, it is advised to clean them before and after used, in these same conditions.

4. Always use filter tips and positive displacement pipettes to avoid contamination due to micropipettes. Different sets of pipettes should be used in each area.

5. Use disposable and autoclaved laboratory material.

6. Never mix reagents from two different vials, even if they belong to the same lot.

7. Close reagent tubes immediately after use in order to avoid contamination.

8. Discard the micropipette tip after pipetting.

9. GENOMICA is not responsible for the results obtained with the kit if other samples different to the ones indicated are used.

5.2. Precautions for the extraction and addition of extracted material to the amplification tube

1. Always wear gloves
2. Clean working surfaces of cabinets with a 10% diluted bleach solution.
3. Turn on the laminar flow and UV light at least 20 minutes before extraction. Turn off the UV light when it is working inside the cabinet.
4. The preparation of the samples before extraction must be made inside the cabinet.

5.3 Precautions for amplification

- Place the amplification tubes in the thermocycler when the block is above 90 ° C. Thereby minimizing possible nonspecific amplifications due to incubation below the annealing temperature

5.4 Precautions for visualization

1. Before starting the assay is recommended to verify the THERMOMIXER measuring the temperatures which will be used during the assay: 20°C, 25°C and 50°C. For it using a thermocouple in direct contact to themomixer plate.
2. The amplification product must be denatured only one time. Don't use for visualization a PCR product which has been denatured more than one time. If you have this necessity you must do aliquots previously to denaturalized step.
3. Avoid the pipette tip or the vacuum system touching the bottom of the well, since this could damage the probes printed at the well's bottom.
4. It is recommended to add all solutions to the wall of the CS well; never directly at the bottom.
5. At room temperature the SH solution (hybridization solution) forms crystals, so is need before using pre-warm up at 50°C until becomes homogeneous. Not to add the SH solution until the denatured products of PCR are ready, therefore SH solution must be maintained at 50°C until it is going to be added.
6. The array must not remain dry.
7. Following incubation with the CJ solution, it is very important to wash the microarray thoroughly in order to avoid any residues that could react with the RE solution, resulting in a non-specific precipitation that could lead to false interpretations of the result.
8. Avoid foaming when adding any reagent.
9. When visualizing the image in the reader, ensure that position markers appear and that there are no bubbles, fibers or spots interfering with the reading. Otherwise, clean the outer face of the well with cellulose paper.

6.-SAMPLES

The **CLART® CMA NRAS-iKRAS** kit has been designed to be used with DNA extracted from colorectal cancer biopsies. GENOMICA is not responsible for the results obtained if other types of samples are used.

7.-WORKING PROTOCOL

CLART® CMA NRAS-iKRAS has been development using two different protocols for sample pre-treatment.

7.1. Sample pre-treatment:

Preprocessing

FFPE sections (formalin fixed paraffin embedded tissue) should be placed on a glass slide for the examination by the pathologist.

Each sample must be processed using a new sterile scalpel.

The pathologist will perform a study of each cut by staining it with hematoxylin and eosin (H&E). The staining will help to define and verify the tumor area, being indicated as a percentage (%) of tumor cells.

Afterwards, follow the instructions below:

- By a percentage of tumoral cells <50% and a small area: take 6 cuts of 10 µm each.
- By a percentage of tumoral cells >50% and greater area: take 2-4 cuts of 10 µm each.
- In case of larger tissue amount, regardless of the percentage: take 1 cut of 10 µm.
- In the event of endoscopic biopsies (very small): take 10 cuts of 10 µm each.

Place all the obtained cuts in a 1,5 mL tube.

Select between these two protocols the one that best suits:

PROTOCOL 1.

1. Add 1 ml Xilen to the tube containing the sample and vortex it during 5 sec.
2. Incubate at RT during 10 min.
3. Centrifuge the tube at 13.200 rpm during 5 min.
4. Discard supernatant.
5. Add 1ml 96-99%Ethanol and vortex it for 5 sec.
6. Centrifuge the tube at 13.200rpm for 2 min.
7. Discard supernatant.
8. Incubate aprox. 15 min at 56°C in order to allow the remaining supernatant evaporates (dried pellet).
9. From this step in advance, please follow the protocol outlined in the QIAamp DNA FFPE Tissue Kit user's manual (Qiagen). The elution volume must be set at 50 µl.

PROTOCOL 2.

Day 1.

1. Centrifuge the tube containing the sample for 1 minute at 13.200 rpm, in order to get all FFPE cuts at the bottom of the tube.
2. Heat the tube (containing the sample) in the thermomixer for 5 min at 75°C without shaking.
3. Add 190µl of G2 lysis buffer (EZ1 DNA Tissue Kit, Qiagen) to each sample.
4. Incubate 5 minutes at 75°C, shaking at 1400 rpm.
5. Set the thermomixer temperature at 56°C.

6. Add 25 μl Proteinase K, previously prepared according user's manual of the above mentioned kit (20 mg/ml).
7. Incubate overnight at 56°C and shaking at 1.400 rpm.

Day 2.

1. Add 10 μl Proteinase K and vortex briefly.
2. Incubate overnight at 56°C shaking at 1.400 rpm.

Day 3.

1. Centrifuge 1 minute at 13.200 rpm.
2. Add 2 μl glycogen at 20 mg/ml (Optional! It's indicated for samples with very little prior extracted material).
3. Collect supernatant.
4. Homogenize the sample with the pipette tip in case of remaining tissue.
5. Move the supernatant to a tube provided by the extraction kit (Qiagen) specifically for extracting FFPE samples.
6. Place the specific tube at the BIO-ROBOT EZ1, in order to proceed with the extraction. Card must be "paraffin DNA", and the elution volume must be set at 50 μl .

7.2. Extracted Material

The extraction method chosen should be one that ensures the following concentration and purity parameters:

1. Total amount of extracted DNA add in each PCR amplification tube must be 150ng. An excess or a default of DNA can lead to misdiagnosis.
Not exceed 150 ng of amount of DNA and it must be added 5-10 μl of volume to each PCR amplification tube.

The following table shows all the possibilities:

Extracted DNA (ng/ μl)	Volume (μl) of extracted DNA add to each PCR tube	Total amount (ng) of DNA add to each PCR tube
30	5 μl	150 ng
25 ng/ μl	6 μl	150 ng
21.5 ng/ μl	7 μl	150 ng
19 ng/ μl	8 μl	150 ng
17 ng/ μl	9 μl	150 ng
15 ng/ μl	10 μl	150 ng

If the concentration is below 15ng/ μl , the sample should be re-extracted.

2. The extracted DNA should have the following purity enough to avoid misdiagnosis. The ratio between the absorbance at 260nm and the absorbance at 280 nm should be as close to 2 as possible.

If the purity is not adequate, sample should be re-extracted.

3. The extracted material should be stored at 4 °C when processing it immediately after extraction, otherwise keep it at -20 °C until its analysis.

It is important to include a negative control in every run, to verify that the samples have not been contaminated during the extraction, amplification and visualization processes, which might lead to a false positive result.

7.3. Amplification reaction

Amplification-specific recommendations:

- Work in the **pre-PCR area**, always using a cabinet and following the recommendations mentioned in section 5.1.
- During the process, keep tubes separate and refrigerated.
- Exclusive use of standard thermal cyclers only, with speed ramp of cooling / heating up to 3°C per second. (The maximum cooling/heating block ramp rate is 3 °C). Do not use fast thermal cyclers. In some of those the ramp rate can be adequate according these needs.

1. Thaw the necessary number of amplification tubes according to the number of samples and gene/s to analyse. Thawing the tubes at 4 25°C.
2. Centrifuge the amplification tubes for a few seconds, so that all liquid can get to the bottom of the tubes (in case you don't have microcentrifuge adaptors available for the tubes, you can use larger tubes after having cut their cap off).
3. Add 5-10 µL (see point 7.2) of the extracted DNA to each amplification tube, just after having check for DNA concentration and purity and mix several times with the micropipette. Keep the tubes refrigerated at any time.
4. Program the following temperature cycles on the thermocycler:

1 cycle	95°C 15 min
40 cycles	94°C 15 sec 62°C 60 sec
1 cycle	72°C 10 min
4°C continuously until tube collection (optional)	

5. Start the program and place the tubes in the thermocycler when the block has exceeded 90°C.

The amplified product must be visualized **within a maximum of 5 days** to avoid its degradation, and kept at 4°C.

7.4. Visualization of the product amplified in CLART-Strip® (CS)

Specific recommendations before starting visualization:

THE PROTOCOL DESCRIBED BELOW SHOULD ALWAYS BE USED IN THE **POST-PCR AREA**. DO NOT TAKE THE AMPLIFIED PRODUCT IN THE PRE-PCR AREA.

1. Turn on the CAR® (CLINICAL ARRAY READER) before starting the whole procedure. The self-calibration of the equipment takes a few minutes, and it is also necessary to introduce the name of the sample in the program before the reading. The device must be ready at the moment of reading to avoid unnecessary waiting that would produce an excessive exposure to developer.
2. Make sure that, before the hybridization begins, the thermomixer temperature has been 50°C for at least 60 minutes.
3. At room temperature the SH solution (hybridization solution) forms crystals, so is need before using pre-warm up at 50°C until becomes homogeneous and it must be maintained at 50°C until it is going to be added.
4. PREPARE THE WASH SOLUTION BEFORE EACH ASSAY; DO NOT REUSE PREVIOUSLY PREPARED SOLUTIONS OR RESIDUES.
5. Clean the thermocycler with a 10% diluted bleach solution before starting the denaturation programme. Place the amplification tubes in the thermocycler during the process, that should never exceed 10 min.
6. During the visualization, it is not necessary to use filtered tips, but it is necessary to use a different tip for each well and change it every time a reagent is added, even if it is TL. It is necessary, though, to use filtered tips during the addition of amplified products to the CS well.
7. In case of using vacuum pumps equipped with 8-tip comb for aspirating solutions, discard the combs after each use or decontaminate them with a 10% diluted bleach solution after every assay. Make sure the pump aspirates properly and does not leave traces at the bottom of the well.
8. Aspirate the different solutions completely without touching the array.

7.4.1 Manual visualization

1. Denaturation:

Use the thermocycler to denature the PCR products. For this step, place the amplification tubes in the thermocycler and incubate at 95°C for 8 min. Remove the tubes from the 95°C incubation and place them immediately in a container at 4°C. **It is advised not to exceed 10 min time of denaturation.**

2. Diluted TL solution preparation:

For each CS strip (a total of 8 wells), prepare 10 mL of diluted wash solution by adding 1 mL of TL solution to 9 mL of distilled water.

3. Prewash of the CS:

Before beginning the assay, it is necessary to wash the strips by adding 200 μ L of diluted TL solution to each well. Mix it with the multichannel pipette 10 to 15 times, taking into account that the surface of the array must not be touched. **It is advised to carry out this wash while the amplified samples are being denatured and maintain the wash solution in the well until samples are going to be added.** Discard the diluted TL solution with a pipette, or preferably with a vacuum pump.

The array must be free from solution residues, although it must never remain dry. Add the next solution immediately.

4. Hybridization:

Before using the SH solution, it must be heated at 50°C until the complete dilution of the salts. Once the PCR products have been denatured, add 100 μ L of SH solution (prevent foaming) to each CS well. Next, add the denatured PCR product from each mix to **the same array well according to the following volumes:**

Mix 1 NRAS-iKRAS: 5 μ L

Mix 2 NRAS-iKRAS: 5 μ L

Mix 3 NRAS-iKRAS: 5 μ L

Mix 4 NRAS-iKRAS: 5 μ L

Use one array per sample/patient. Mix it several times, being careful not to touch the bottom of the well. It is recommended to load each strip independently and separately from the rest to avoid contaminations. Cover the microtiter plate with the plastic lid provided and incubate in the thermomixer for **1 hour at 50° C shaking at 550 rpm** (previously this thermomixer has to be prewarm at 50°C at least for 60 minutes and make sure that the thermomixer reaches 50°C correctly previously to start the assay, see point 5.3). **For the correct interpretation of the results, it is mandatory to visualise all the tubes of the same sample in the same well, even if they are different genes.**

After this incubation, remove the plate from thermomixer and aspirate the SH solution of the CS with a pipette or, preferably, with a vacuum pump: The array must be free from solution residues, although it must never remain dry. Add the next solution immediately. After incubation set the thermomixer at 20°C, and in motion, so it may be used later in step 6.

5. Double Wash:

Add 200 µL of diluted TL solution to each CS well, resuspend 10 to 15 times with the multichannel pipette. Discard the diluted TL solution with a pipette, or preferably with a multichannel vacuum pump without leaving any residues. **Repeat the procedure. This step must be carried out with different tips for each well in both washes.** If having arrived at this step, the thermomixer has not reached 20°C, the wells are left with TL solution until the thermomixer reaches the temperature.

6. Blocking and conjugate:

It is recommended to centrifuge the high-affinity CJ solution for 10 seconds before use. Then, prepare the diluted CJ solution as follows: for each CS strip, mix **1 mL of DC solution** and **15 µL of high-affinity CJ solution**. Prepare this solution at least 5 minutes before ending the hybridization step.

Discard the diluted TL Solution without leaving any residues of the solution and add 100 µL of diluted CJ solution to each CS well. Incubate for **30 exact minutes in the** thermomixer at **20°C, shaking at 550 rpm**. After this incubation, remove the plate and discard the solution rapidly with a pipette or a multichannel vacuum pump. Once finished the incubation, set the thermomixer at 25°C, and in motion, so it may be used later in step 8.

7. Triple Wash:

Add immediately 200 µL of diluted TL solution to each CS well, mixing it 10 to 15 times with the multichannel pipette and discard the solution completely with the pipette or vacuum pump. **Repeat the procedure two more times.**

It is **very important** to avoid any residues of the CJ solution, since they could react with the RE Solution generating an unspecified signal.

8. Development with RE solution: Remove the diluted TL solution completely and add 100 µL of RE solution to each CS well and incubate for **10 minutes at 25 ° C** in the thermomixer **without shaking** (previously make sure that the thermomixer reaches 25°C).

Warning! It is very important to use the thermomixer without shaking.

9. Discard the complete RE solution using a pipette or a vacuum system. The array must remain dry for the reading.

10. CAR® (CLINICAL ARRAY READER): Carry out the steps described in point 7.3. Place the plate normally on the tray and the CAR® will take and analyze the arrays automatically.

7.4.2 autoclart® visualization

- 1 Switch on the autoclart® unit and follow the instructions described on the screen :
- 2 Close the door and press the knob.

- 3 Select Run Program at the main menu.
- 4 Select the assay **CMA KRAS test** among those listed
- 5 Select the well of the strip where the run should start: A1 or E1 in case the first 4 wells have already been processed.
- 6 Select the number of samples to be processed. With the autoclart[®], the user can process from 4 up to 96 samples per run. In any case, samples must be multiples of four.
- 7 Confirm that the number of samples and the start up-well (A1 or E1) are correct.
- 8 Place the tips rack (full) on its position.
- 9 Load the array microplate in the holder. Make sure that the catch is fastened in order to clamp the plate down.
- 10 Check that both, the tip waste and the liquid waste containers are empty and on its proper position.
- 11 Fill the DI bottle with 250 ml distilled water.
- 12 Add each of the reagents to its specific container. The autoclart[®] calculates the specific volumes required according to the amount of samples indicated:
 - **TL** (Washing buffer). The volume showed in the display indicates the diluted washing buffer required. In order to prepare the diluted washing buffer please dilute the TL reagent provided 1:10 into distilled water.
 - **CJ** (Conjugate). It's recommended to shortly spin the CJ before use. The display shows the final volume of diluted CJ to add, meaning that each mL indicated on the display should be prepared as follows: 1 ml of DC (Conjugate Diluent) and 5 µl CJ reagent. Vortex the diluted solution in order to mix it properly up.
 - **RE** (Developer). Add the RE volume indicated on the display.
- 13 Denaturation: Use the thermocycler to denature the amplification tubes. Place the amplification tubes in the thermocycler when this has reached 95°C and incubate the tubes for 8 min. Remove the tubes from the 95°C incubation and place them immediately on ice. Denature the amplification product before setting the visualization reagents in the autoclart[®]:
- 14 **SH** (Hybridization solution). Ready-to-use. Add the specified volume in the container once it has been tempered.

WARNING : It is important to add the SH at this point, If the SH is added in a previous steps , Its temperature might decrease affecting to the intensity of the probes and it could lead to false negative results.

15 Close the door and press the knob to start the program.

The device will start priming the system. Then it will perform the pre-washes of the CS and add the Hybridization Solution. Once finished these steps, the device will beep as a signal for the user to add the samples on the CS.

The autoclart® will keep beeping until the user opens the door.

16 For the addition of the samples on the CSs, please carefully remove the plate from autoclart® unit and add 5 µl of the denatured products from the same sample to each well.

Mix it up carefully in order to not touch the array and place the microplate again on the autoclart®. Press the knob to continue the visualization process.

17 Once the visualization process is finished, the autoclart® will beep indicating the end of the run. Please carefully remove the microplate and proceed with the reading step on the CAR®.

WARNING : Once the visualization phase is finished on the autoclart®, the arrays should immediately be read on the CAR®, otherwise false negatives caused by intensity loss might appear .

18 CAR® (CLINICAL ARRAY READER): place the plate normally on the tray and the CAR® will take and analyse the arrays automatically.

8. READING OF THE RESULTS

The processing of data obtained from each analysis is carried out automatically. The reading and analysis system (CAR®) will provide a report indicating the results.

9. INTERPRETATION OF THE RESULTS

For the correct interpretation of the results, the sample must be processed with all the amplification tubes and visualised placed in the same array.

A negative control of extraction must be included to verify that the samples have not suffered contaminations during the processes of extraction, amplification and visualization, which would give rise to a false positive result.

Each PCR tube has its own amplification and extraction control to make sure that there is enough genomic material to carry out the test.

The control of extraction of genomic DNA is necessary for the confirmation of a true negative result, as it informs us of the presence of the patient's DNA in the sample, although there has been no amplification of any mutation.

The internal control of amplification will allow us to distinguish between cases of PCR reaction inhibition and those in which no DNA was found in the sample.

There are three possibilities that give rise to a **“NOT ANALYSED”** results :

- **Non-valid extraction:** The presence of inhibitors or a mechanic failure in the extraction of the sample does not allow the amplification of mutations and/or of the controls of amplification and extraction; to solve this problem the entire process must be repeated.
- **Non-valid amplification:** The absence of amplification in one of the tubes, and the presence of amplification in other tubes will indicate that a correct extraction has been carried out, but that there has been a failure in the amplification of one of the tubes; to solve this, the corresponding tubes must be amplified again, before continuing with the process.

There is a possibility that gives rise to an **“UNCERTAIN”** result:

- Marked absorbance readings among replicates on the array

10. TECHNICAL AND OPERATIONAL SPECIFICATIONS

10.1 Control of known interferences:

False negatives are one of the drawbacks in the detection by genomic amplification due to either, an inadequate quality of the extracted DNA (due to insufficient sample quantity, DNA degradation, inadequate storage or DNA loss during extraction) or to the presence of DNA polymerase inhibitors in the samples that are to be processed (alcohol, salts, etc.).

To avoid these interferences, the indications appearing in the sections 5, 6 and 7 of this manual must be followed.

10.2 Technical specifications:

Processing parameters:

Analytical sensitivity. Analytical sensitivity has been determined by the amplification of serial dilutions of recombinant plasmids for each one of the mutations detected by the kit. Each one of them has the amplified product inserted (including the part that is complementary to the specific detection probes). This sensitivity has also been determined by means of the amplification of serial dilutions of commercial cell lines that contain the mutation to be determined. The visualisation was done in CS, giving rise to the following results (Table 1):

NRAS Point mutation	No. of copies of recombinant plasmid per PCR	Amount of DNA from cell lines
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	reaction	
NRAS		
G12D	1000	Nd
Q61H	1000	5ng
Q61R	1000	5ng
Q61K	1000	1ng*
Q61L	10000	5ng
KRAS		
Q61H (A>C)	10000	Nd
k117N (A>C)	100	Nd
K117N (A>T)	10000	Nd
A146V	1000	Nd
A146T	1000	10ng

Table 1. Relationship of the number of copies of recombinant plasmid/cell line nanograms necessary to obtain a sensitivity of 100% in the detection of each mutation. * Q61K cell line nanograms necessary to obtain a sensitivity of 78%.

Analytical specificity. Specificity experiments were carried out with 15 recombinant plasmids and cell lines, observing that an unspecific detection of other mutations different to what is sought to be determined is not produced. Therefore, it is considered that the technique reaches an analytical specificity of 100%.

Diagnostic utility parameters

In order to determine the diagnostic parameters of the kit, a comparative assessment of the **CLART® CMA NRAS-iKRAS** kit was carried on against the reference technique (Pyrosequencing). For this evaluation, we collaborated with the following laboratories:

- Pathological Anatomy Service, Vall de Hebrón University Hospital, Barcelona, Spain.
- Department of Pathology, Clinical Research Department, Copenhagen University Hospital, Hvidovre, Denmark.
- Pathological Anatomy Service, “12 de Octubre” University Hospital, Madrid, Spain.
- University Hospital Marqués de Valdecilla, in Santander.
- Comprehensive Cancer Center Clara Campal, in Madrid.
- Salamanca’s Hospital.

Results (N= 141) Clínical samples (S= 81)	Sensibility (%)	specificity (%)	PPV(%)	PNV(%)
KRAS K117N (351 A>C) (N= 6; S = 2)	100	100	100	100
NRAS Q61R (N= 19; S = 8)	100	100	100	100

KRAS Q61H (183 A>C) (N= 2; S = 2)	100	99,28	50	100
NRAS G12D (N= 15; S = 7)	100	100	100	100
NRAS Q61H (183 A>T) (N= 1; S= 1)	100	100	100	100
KRAS K117N (351 A>T) (N= 3; S = 2)	100	100	100	100
KRAS A146T (N= 14; S = 9)	100	99,22	100	100
NRAS Q61L (N= 0; S = 0)	ND	100	ND	100
NRAS Q61K (N= 7; S = 5)	100	100	100	100
KRAS A146V (N= 4; S = 4)	100	98,56	33,3	100

Table 2. Diagnostic sensitivity and specificity of the *CLART*[®] *CMA- NRAS-iKRAS* technique for each mutation. PPV: Positive predictive value. NPV: Negative predictive value.

100% of sensitivity has been obtained in all mutations which have been validated with 81 clinical samples. Number of results tested reached 141 data.

For each sample, the result was considered true if it there was concordance between the reference technique and the *CLART*[®] *CMA NRAS-iKRAS*. In case of discordances between both techniques, the result offered by sequencing was considered as valid.

-Diagnostic specificity:

The technique has been validated with a number of 44 negative samples, giving more than 100% of for all point mutations.

- Reproducibility diagnostic parameter.

The data obtained in Reproducibility test was: 97.2% (n=12 samples).

	% homology
Reproducibility (n=12)	97.22

Table 3. diagnostic reproducibility

The reproducibility series have been set starting with the extraction of the biopsy up to visualization in the array of the amplified material.

11. REFERENCES

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