White Paper

CHDD-2000
2nd generation Barco Avionics Cockpit Head Down Display

What's inside?

- ***What is a CHDD?***
- ***Why a 2nd generation CHDD?***
- ***The first offspring of the new family***

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Table of contents

1 WHAT IS A CHDD™?

CHDD™ stands for Cockpit Head Down Display, as opposed to CHUD, Cockpit Head Up Display[1].

A Head Down Display is any display for which a crew member has to change his line of sight (usually down) to be able to look at it.
Head Down Displays come in many sizes, have many uses and make extensive use of color and shapes to show information. They can be used to display simple video images (a TV camera or FLIR, for example), or they can display mission or flight critical information. In the latter case, an external computer generates the elements of the image, and the Head Down Display renders them.
Often, the Head Down Display is mounted with a bezel surrounding the display itself, and this bezel can be equipped with various types of buttons, in order to control the image, or to control an external computer or processor.

[1] The CHUD is a kind of display that can be looked at without changing the direction of sight. They are usually transparent, with a projecting device showing information on it. This way, a pilot can look outside and still get the required information. A good example of HUD is the well-known weapon sight.
A CHUD has a very limited range of conveyable information, as colored symbology cannot be used.

2 BARCO'S INVOLVEMENT IN HEAD DOWN DISPLAYS

Barco's company history goes back to the fifties, when it gradually became very well-known for making very durable and very high-quality television sets.
This early success drove Barco to broaden its range of products into monitors, video projectors, medical imaging solutions, Air Traffic Control and military grade displays, and many other solutions.
Until the eighties, all these products made use of Cathode Ray Tubes (CRT), and by the end of this period, Barco capitalizing on its extensive knowledge of display technology produced its first avionics product, a CRT-based 6" by 8" mission display.
It was back then when the first color LCD became available, quickly progressing in available colors and resolutions. Barco, understanding the potential advantages of this new technology for avionics displays, created the first Barco CHDD™ display, the VGA CHDD-5.4 display, in 1999.

Barco's first CHDD™: the CHDD-5.4/1-BM display

This first unit presents a 5" by 4 " display, and already harbors what would become the Barco Avionics trademark: the use of a Commercial Off The Shelf LCD glass, modified and ruggedized by Barco.
This unique way of making displays has given Barco the capability of having the most advanced LCD technology available in its new products at time of development.
The LCD ruggedization allows the CHDD™ display to withstand the hardships of flying, without having to use dedicated custom LCD glass, like many Barco competitors did, and still do, while keeping costs at a very reasonable level.
This first unit had only a simple bezel, and was used to display analog video outputs from camera or electronic map processors. Today's units have button-equipped bezels, and are extensively used for "mission computer"-type display and control.

3 THE EVOLUTION OF THE 1ST GENERATION CHDD™ DISPLAY

Since 1999, LCD technology has advanced very fast towards larger and larger glass sizes, with a simultaneous evolution in displayable resolution and optical performance.
On the operational side, Barco's existing and potential new customers were also developing cockpits that increasingly used LCDs. Also, there was a demand for more and more information to be displayed to the crew.
Very quickly, the demand for bigger displays led Barco to develop a 6"X8" VGA CHDD™ display which also introduced a digital video input instead of the analog inputs used by the CHDD-5.4 displays.
This drastic change was warranted by the superior quality of digital communication, the increased use of digital video outputs in airborne mission computers and symbol generators and the inherent capability of the LCD matrix to be digitally controlled.
Today, the VGA CHDD-6.8 display is mainstream of Barco's avionics LCD display production. It can be found in a large variety of aircraft, and it is the main type of display in the cockpit of some large aircraft, such as the Russian Beriev 200.

The Be-200 instrument panel made of CHDD-6.8 displays

However, not all video applications in a cockpit are digital; in particular the TV and FLIR video signals might stay analog for a long time.
In the mean time, the geometry and available display surface of the CHDD-6.8 display in "portrait mode" allows a separation of the display in two parts, the upper one displaying flight parameters (Primary Flying Display) coming from an external Symbol Generator (like the Barco PU-2000 processor unit), the lower one navigation parameters (Navigation Display) or Mission display, including video images.
The first CHDD-6.8 display did not have the capability to receive analog video, so Barco created a specific version, the CHDD-6.8/1-VP display, able to receive digital and analog video in the same time.

4 WHY A 2ND GENERATION CHDD™ ?

We can identify 7 reasons for developing a brand new family of CHDD™ displays:

1. As we have seen in the last paragraph, there is a definite need for a dual analog/digital display unit.

2. The wild variety of configurations in terms of format, bezel type, mission environment found in today's aircraft makes every type of CHDD-6.8 display slightly different from another, which induces non-recurring costs (NRC) due to engineering work. In order to reduce or avoid this type of NRC, the new standard unit must be able to fulfill as many types of use as possible.
   This means:

   - standardized bezels, usable in both portrait and landscape format
   - as many digital and analog types of video inputs as possible to cover the known range of uses.
   - Future input formats anticipated as options (ARINC 817/818, FiberChannel…).

3. The advance in electronics and FPGA technology might be used to achieve the lowest possible backcase size, weight and power consumption.

4. Of course, as a Barco display product, it must use state-of-the-art LCD technology, with an emphasis on optical performance characteristics, like contrast ratio and viewing angle. The use of LED backlight technology to enhance brightness and MTBF is also a must.

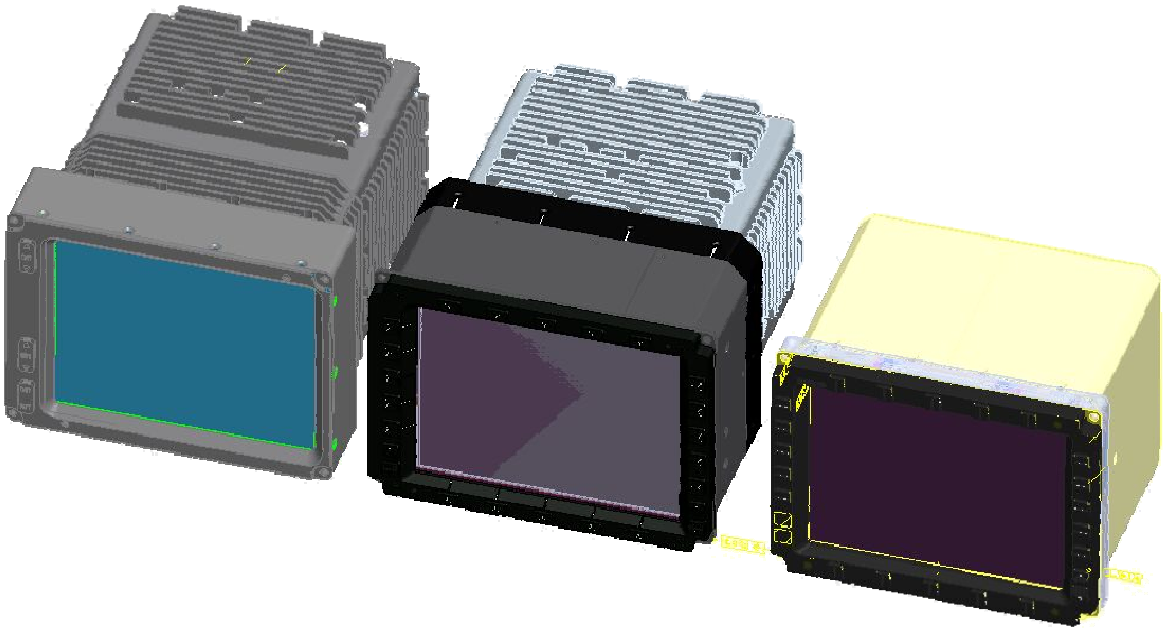
5. The LCD resolution should be XGA (1024X768, with at least 120 PGI -pixel groups/inch-) to anticipate the need for detailed background images and increased sharpness, especially with the appearance of synthetic vision solutions and better analog video.

6. The level A certification for software (DO-178B) and hardware (DO-254) must be included in the development, as this level is mandatory for Primary Flight Displays, and more generally in high-integrity applications.

7. The 2nd generation CHDD™ display's internal and, to a degree, external architecture must facilitate development of a family of formats: 5"X4", 6"X8", 8"X10", 9"X12",…

5 THE FIRST OFFSPRING OF THE CHDD-2000 FAMILY

Barco has decided to name its new family of products CHDD-2000, where the "2" stands for 2nd AMLCD generation, the two or three last digits will show the display width, and the display height, both values in inches.
The first representative of the family Barco is the CHDD-254 display, meant as a successor for the CHDD-5.4/1 family. The figures below show that the objectives of the new family development have indeed been met:



The first CHDD-5.4 display, the present one and the new CHDD-254 display

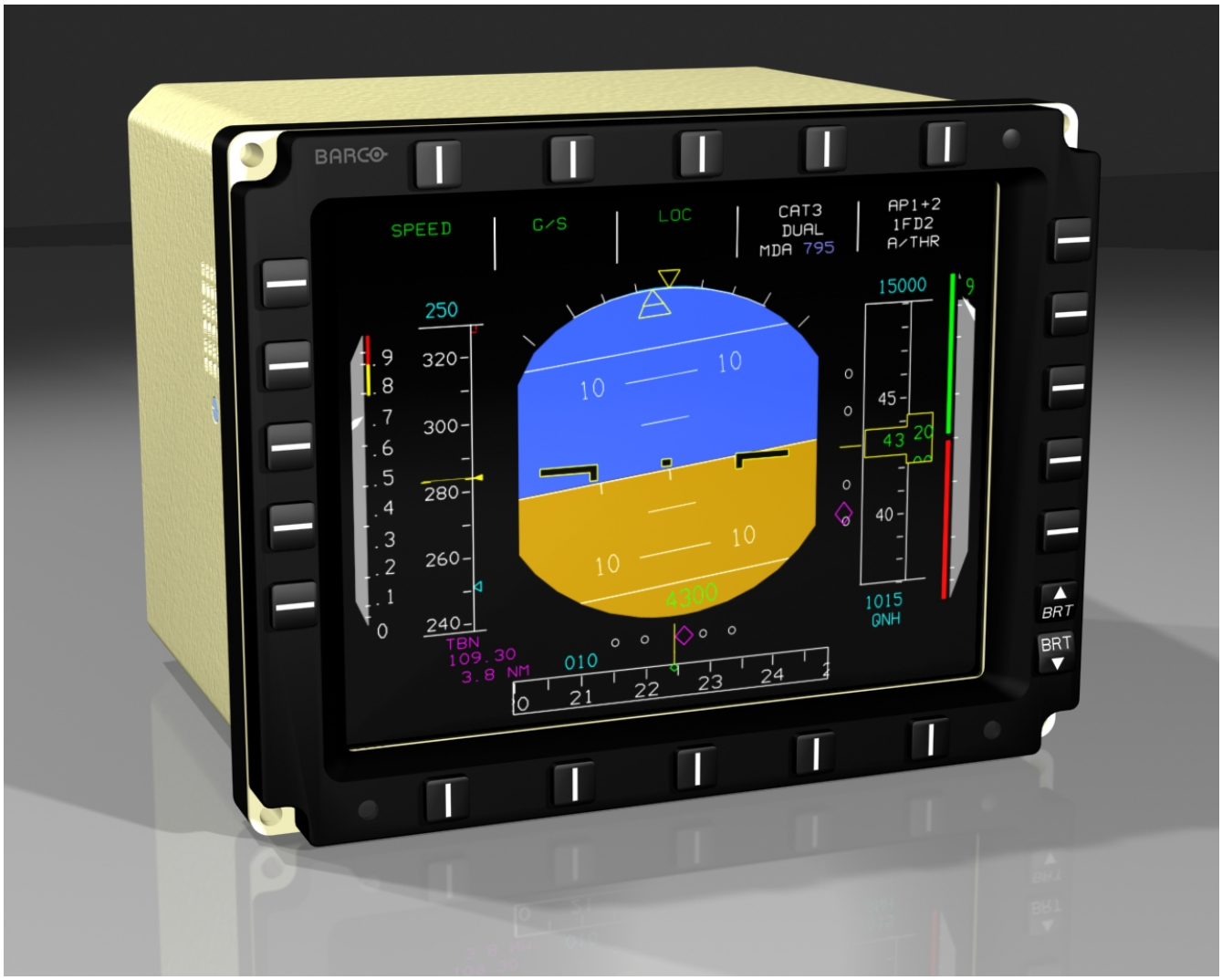
The net gain in installation space is indeed impressive.
This gain also translates in weight: the CHDD-5.4/1 display weight was 3.5 kg, the CHDD-254 display is only 2.3 kg.

This cockpit footprint allows the CHDD-254 display to be installed in a 6.25" standard radio/weather radar display rack using a dedicated bezel, which is a Barco exclusive advantage.

It must be noted that the CHDD-254 display is only available in landscape mode, due to its size.

Main features of the CHDD-254 display are:

- Reduced depth
- Reduced weight
- High reliability
- Low power consumption
- 20 button standard bezel, with rotary encoder(s) and mini-stick as options
- High video quality
- NVIS backlighting option
- More video interfaces
  - **4 analog video inputs**
  - **2 DVI digital video inputs (lightning protected inputs as option)**
  - **ARINC 817/818 as option (SD-SDI/HD-HDI)**
- RTCA-DO-178B and RTCA-DO-254 level A (only with digital input)



The new CHDD-254 display

The next member of the family being developed is the CHDD-268 display:

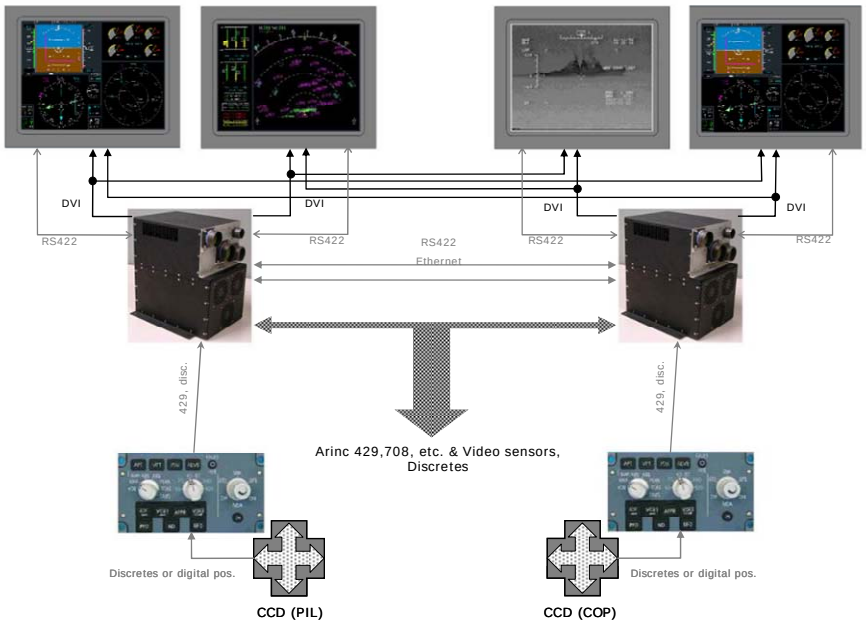
The new CHDD-268 display

The CHDD-268 display shows all the advanced features of the CHDD-254 display, but with an added flexibility and new features allowed by the larger size:

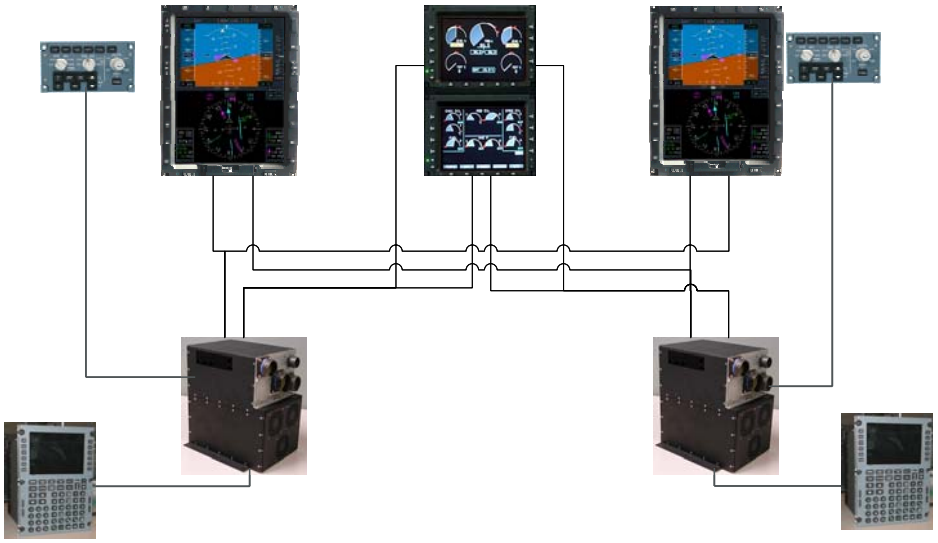
- High brightness white LED backlight
- Future touch screen control option
- XGA resolution
- Lightning protected DVI inputs as standard
- Very extensive basic and optional possibilities in terms of video inputs mixing, with advanced image processing:

The CHDD-268 display and the larger members of the family will feature a Picture-In-Picture (PIP) mode, combining analog and digital video inputs, while in the same time rotating, scaling or cropping the image… Later, it will even be possible to use PIP with two analog video inputs.
This is why the CHDD-2000 family is without doubt the most technologically advanced display offering on today's avionics market.

Below are some typical configurations using the CHDD-254, the CHDD-268 and the CHDD-2108 displays:



Configuration shows the use of 4 large CHDD-2108 displays in a new type of helicopter



Configuration shows the use of 2 CHDD-268 and 2 CHDD-254 displays, typical of a retrofit proposal for a regional aircraft electromechanical cockpit

6 CONCLUSION

The new CHDD-2000 family is the result of Barco's extensive experience in CHDD™ definition and production.

It shows a definite technological advance on several key points: extensive dual digital/analog video inputs and processing, level A certification for the digital inputs, very low depth, weight and power consumption, full compatibility with any existing installation,…

This makes Barco Avionics highly confident in the capability of its new displays to meet the most demanding requirements of civil air transport and military markets, for fixed-wing aircraft as well as helicopters.
Nowhere else the knowledgeable customer will find displays able of such flexibility in terms of video format, featuring in the same time state-of-the-art high-quality LCD matrix and an affordable price.
The same customer will also know that as soon as a new breakthrough display technology emerges, Barco will be ready to include in its next-generation displays.

7 GLOSSARY

AMLCD	Active Matrix Liquid Crystal Display
ARINC	Aeronautical Radio, Incorporated
CCFL	Cold Cathode Fluorescent Light
CHDD	Cockpit Head Down Display
CHUD	Cockpit Head Up Display
COTS	Commercial Off The Shelf
CRT	Cathode Ray Tube
DVI	Digital Video Interface
FLIR	Forward Looking Infra Red (camera)
FPGA	Field Programmable Gates Array
HD-SDI	High Definition-Serial Digital Interface
LED	Light-Emitting Diode
MTBF	Mean Time Before Failure
NRC	Non Recurring Costs
PIP	Picture-In-Picture
RTCA	Radio Technical Commission for Aeronautics
SD-SDI	Standard Definition-Serial Digital Interface
VGA	Video Graphics Array (640X480 pixel)
XGA	eXtended video Graphics Array (1024X768 pixel)