
CMS-400

Checklist Management System

User Manual

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INTRODUCTION

THE CHECKLIST PROBLEM

While the aircraft industry has seen tremendous improvement in airframe, engine, and instrumentation technology, the checklist has improved little in 40 years. While everyone appreciates the need for checklists, the magnitude of the checklist problem is not generally known. For example:

- NTSB statistics show that four major commercial airline accidents in a 15 month period can be attributed to the checklist misuse.
- NASA studies show that on average, a pilot will omit 3 checklist items per 1000 items performed. This means that the average corporate pilot misses about one item per flight.
- NSRS data reveals 200 + commercial aircraft incidents directly attributable to checklist error during the period 1983-1989.
- Boeing reports state that pilot error is responsible for 74% of all hull-loss accidents. In the United States, during the two year period Fall 1987 to Fall 1989, checklists contributed to nearly 50% of all commercial hull-loss and loss-of-life accidents.

These statistics indicate that checklist neglect or misuse is as large a problem as wind shear and collision avoidance combined.

COCKPIT RESOURCE MANAGEMENT

The industry response to this problem has been increased training, especially Cockpit Resource Management (CRM). CRM teaches that complacency, spontaneity, and ritual are the human frailties responsible for checklist errors. Further, it teaches that these frailties can be overcome by training.

HUMAN LIMITATIONS

Heads Up Technologies believes that checklist errors are mostly due to several inherent human limitations that cannot be overcome through training alone. These limitations are summarized as follows:

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- **Humans are not good at manipulating long lists of information.** Even in low pressure environments, humans have difficulty remembering sequences of items, recalling deferred items, etc.
 - **The act of diligently reading the checklist requires a large amount of concentration** that distracts the pilot from his primary job - flying the airplane. Even though this distraction may only last for 5-10 minutes per flight, it is during the busiest times during the flight.
 - **Humans prefer to deal with one thing at a time.** When executing a paper checklist, pilots view the task as the collection of items, rather than as individual items. The result is reduced effectiveness when checking individual items.

The CMS-400 solves these problems by using a computer to overcome the human limitations. Computers are excellent at manipulating lists, performing multiple tasks simultaneously, and even reducing complex data to simpler forms.

WHAT THE CMS-400 DOES

The CMS-400 reads aloud and manages the aircraft's checklist for the pilot. To this end, it acts like another crew member whose only job is to attend to the checklist. And it does this single function very well. It has all the flexibility of its human counterpart, but the human frailties have been eliminated by the use of the microcomputer.

The benefits of this state-of-the-art checklist management system include:

- **No Reading Required** so that the pilot can concentrate on other cockpit duties.
- **Standardization of the Checklist**, so that each crew member hears the checklist read correctly, the same way each time. No mumbling. No accidental omission of items. No mistakes after a long day.
- **Increased Efficiency** since the CMS-400 computer makes running the checklist so quick and easy. No more fumbling with paper lists. No more keeping place with your thumb.
- **Safety is Improved** for all the above reasons.

WHAT MAKES THE CMS-400 DIFFERENT

Clearly the CMS-400 is a unique system. Checklists that are presented either on a written piece of paper, scroll, or even a radar CRT screen still must be read by the pilot. What makes the CMS-400 work so well?

VOICE DELIVERY

Perhaps the most noticeable difference between the CMS-400 and any other approach to the checklist management is the voice. The CMS-400's "compact disk" quality voice is made possible by the latest advances in digital speech. This voice reads the checklist to the pilot, so he/she can focus attention on other cockpit duties.

NATURAL OPERATION

The easy operation wasn't an accident...it happened by design. Pilots worked with engineers to make the computer work for their aircraft needs. In fact, in most cases, the checklist can be run from start-to-finish with a single push button operation. The CMS-400 was designed after two years of simulator and flight testing of voice checklist systems by major carriers, government agencies, and corporate flight departments.

SEQUENTIAL CHECKLIST FLOW

The vast majority of the time, checklists are executed in the same order, beginning with a "Preflight Inspection" and ending with "Parking and Securing." Thus, checklists are presented in a sequential fashion. This provides the unique benefit: If the CMS-400 displays or speaks "BEFORE TAKEOFF- CHECKLIST COMPLETE" then the pilot has confidence that he/she has performed all previous checklists.

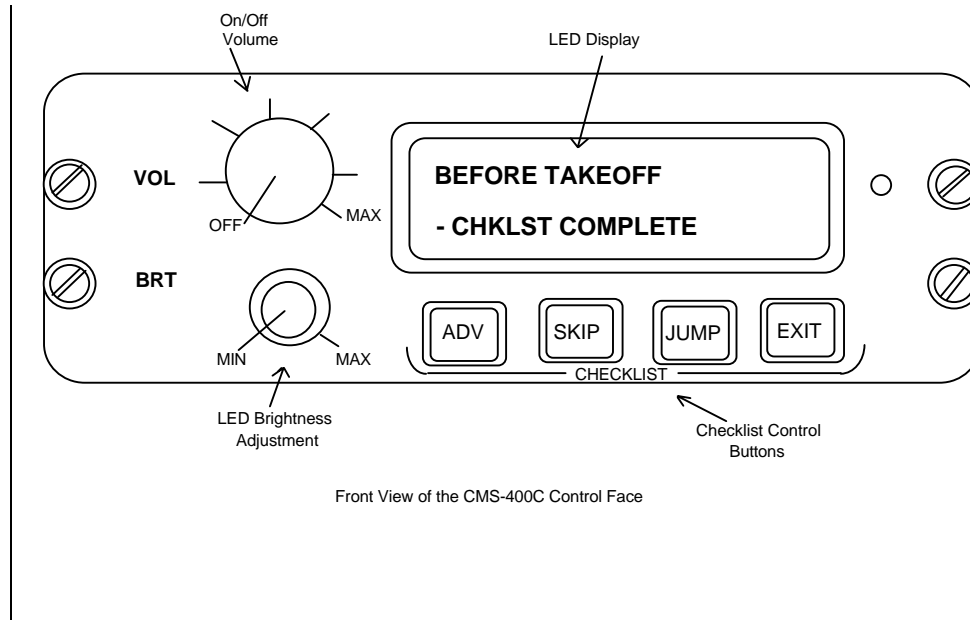
Note: This is not true if random selection methods are employed. Random selection techniques require the pilot to remember what checklists he/she has already performed or not performed.

FLEXIBILITY

Any checklist, any number of categories or items, challenge and challenge-and-response modes, do or done lists -- it is all possible with the CMS-400. Heads Up Technologies programs the computer for operation to meet your flight operation's requirements.

ILLUSTRATION OF CONTROL FACE

FIGURE 1



ON/OFF/VOLUME CONTROL

Rotating this switch from its extreme counter-clockwise position turns the unit on. Clockwise rotation increases the volume output, while rotating the knob counter-clockwise decreases the volume. The unit may be turned off by turning the knob to the extreme counter-clockwise position.

LED DISPLAY AND BRIGHTNESS ADJUSTMENT

The LED display shown in Figure-1 provides visual backup by displaying the current checklist item. Abbreviations are used when the spoken phrase is too long to fit on the 32-character display. The CMS-400 uses a manual adjustment (the BRT knob) and an automatic ambient light sensor to provide optimum LED brightness under all ambient lighting conditions.

“ADV”

The “ADV” button is a simple momentary action switch. It can be remotely mounted for convenient access. It has several functions that are all related. These functions are described below.

ENTER A CHECKLIST

When on a Category Title Page, pressing the “ADV” button enters the category and reads the first item on the list.

COMPLETE A CHECKLIST ITEM

After the CMS-400 reads an item, pressing the “ADV” button tells the computer to “mark” or “tag” that item as completed and read the next item.

REPEAT CURRENT ITEM

After the CMS-400 reads an item, the item may be repeated by holding the “ADV” button until the CMS-400 says “Repeat.” Releasing the button at this time signals the computer to read the current item again. Both checklist category titles and items can be repeated in this fashion. This feature may come in handy if, for any reason, an item was not heard clearly.

BACK UP ONE ITEM

The CMS-400 can back up one item only by the following method: Hold the “ADV” button down until the computer says “Repeat” then says “Back.” Releasing the button at this time signals the computer to repeat the previous item. It is really an Un-do function, since the item is also marked as not-done.

MOVE TO NEXT CATEGORY FROM CHECKLIST COMPLETE

When a checklist category has all the items completed, the CMS-400 announces “Complete” and waits silently for any button press to continue the checklist. Pressing any button, including the “ADV” button, causes the CMS-400 to read the title of the next category.

“SKIP”

The “SKIP” button is also a simple momentary action switch. Like the “ADV” button, it too can be remotely mounted. It can be used to skip checklist titles or defer checklist items.

SKIPPING OVER CHECKLIST CATEGORIES

If the current item is a title of a checklist category, pressing the “SKIP” button reads the title of the next category. In this fashion, it is possible to toggle through the entire list of categories. It can also be used to skip a category like “First Flight Items” when it is the second flight of the day.

DEFERRING CHECKLIST ITEMS

Once in a particular checklist category, pressing the “SKIP” button marks the current item as “not done” and places it at the end of the checklist category. The item will be read as the last item on the list. Any number of items can be deferred and will appear in the order in which they were skipped at the end of the list. The checklist cannot be completed without marking each item as complete by finally pressing “ADV.”

“JUMP”

Pressing the “JUMP” button allows immediate access to user definable checklists. It is often programmed to call up the Approach checklist to facilitate missed approaches or touch and go landings.

“EXIT”

A simple momentary action switch, the “EXIT” button is rarely used under normal flight conditions. It does, however, provide a large degree of flexibility of checklist performance.

QUITTING OR RESTARTING A CHECKLIST CATEGORY

Sometime, it might be necessary to quit and restart a checklist category before it is completed. For example, if a generator bus goes “off line,” it may be necessary to repeat the entire “After Start” checklist. This can be accomplished by pressing the “EXIT” button. The CMS-400 will return to the title page and read the title of the checklist category. At this time, pressing

“ADV” re-enters the checklist, while pressing “SKIP” reads the next checklist category.

MANUAL ACCESS TO EMERGENCY CHECKLISTS

The “EXIT” button can be used to call up the emergency checklists if they have been programmed. As mentioned above, pressing the “EXIT” button once, leaves a checklist category and reads the title of the checklist category. Pressing “EXIT” from the title page activates the emergency checklists. The CMS-400 reads the title of the first emergency category and a small symbol, E, appears in the upper left-hand corner of the display. Once in the emergency-checklist mode, the CMS-400 operates the same as in its normal-checklist mode: “ADV,” “SKIP,” and “EXIT” all behave as described above, but only operate on the emergency checklist.

RETURN TO NORMAL CHECKLISTS

After an emergency checklist has been completed, the CMS-400 speaks the word “Complete.” Pressing any button reads the title of the next emergency checklist category. Pressing the “EXIT” button at this time toggles the checklist mode to normal-checklist operation. The CMS-400 will now read the title of the normal checklist it was performing before the emergency lists were accessed.

CMS-400 OPERATION

In this section, the CMS-400 operation will be described in a sequential fashion. It provides an explanation of the events and responses and assumes that the reader is familiar with the previous section.

POWER UP

To Turn the CMS-400 on:

- Turn the ON/OFF/VOLUME knob clockwise.
- The CMS-400 performs a self test.

SELF TEST

The self-test mode is indicated by:

- The display produces the message “TESTING SYSTEM PLEASE WAIT...” At this time, the computer is checking various internal components.
- The software Version, Checklist Owner, Checklist Revision, and Date are then displayed.
- The CMS-400 computer performs a memory check and displays the message “Detailed Memory Testing.”
- A successful self-test is announced by a verbal “Ready” and displays the message “SYSTEM READY-PRESS ANY KEY.”

An unsuccessful test results in an error message appearing on the display. There are no user serviceable parts. Please call Heads Up Technologies and describe the error message.

RUNNING A NORMAL CHECKLIST

In most cases, the checklist can be run with only the “ADV” button. The following sections describe a typical checklist operation.

SELECTING A CHECKLIST CATEGORY

After a successful self test, the computer announces “READY.” Press any button (the “ADV” button will do fine) to read the first checklist CATEGORY.

SKIPPING CATEGORIES

To skip the current CATEGORY, press the “SKIP” button. The title of the next CATEGORY will be read.

ENTERING A CATEGORY

Press the “ADV” button to enter the current CATEGORY.

TO LEAVE A CATEGORY

Should the wrong CATEGORY be entered, press the “EXIT” button to quit that CATEGORY.

CHECKLIST MANAGEMENT

Using the “SKIP” and “ADV” buttons, the pilot can have the same flexibility as the written page provides.

MARKING ITEMS AS COMPLETE

Pressing the “ADV” button tells the computer to “mark” or “tag” the current item as completed and read the next item.

DEFERRING ITEMS

Pressing the “SKIP” button marks the current item as not done, and reads the next item. The skipped items are placed at the end of the list in the order in which they were skipped. Thus, these items will not be forgotten.

REPEATING AN ITEM

Holding any key down (the “ADV” button will do fine) will cause the CMS-400 to announce “Repeat.” Release the button at this time and the computer will say the current checklist item again. The item can be repeated as many times as necessary.

BACK UP ONE ITEM

Holding any key down (again, the “ADV” button is preferred) will cause the CMS-400 to announce “Repeat.” Continue to hold the button down and the computer will announce “Back,” thus forming the phrase “Repeat-Back.” Release the button at this time and the CMS-400 will read the previous checklist item. The item is marked as not-done. The CMS-400 was designed to back up only one item.

“READY” REMINDER

If the CMS-400 is in a particular checklist CATEGORY and no button has been pushed after sixty (60) seconds, the computer announces “Ready” to remind the pilot that unfinished items remain. Only one such announcement will be made. The checklist should either be completed by pressing “ADV,” or restarted from the beginning by pressing “EXIT.”

CHECKLIST COMPLETE

After all the checklist items have been marked as complete, the CMS-400 announces “Complete.”

CONTINUING TO NEXT CHECKLIST

The CMS-400 waits silently for the pilot to press any button (the “ADV” button will work) to begin the next phase of the flight. The title of the next CATEGORY is announced.

EMERGENCY CHECKLISTS

The CMS-400 treats the emergency checklists as independent from the normal checklists. In this fashion, efficiency is enhanced and consistency of operation is maintained.

NOTE: *Emergency checklists must be specifically requested by the customer and are available at an additional cost.*

EMERGENCY TITLE PAGE

To access the emergency checklists:

- Press “EXIT” once to quit the current checklist.
- Press “EXIT” again to toggle to the emergency mode.
- The CMS-400 will announce the title of the emergency checklist CATEGORY.

SELECTING THE CHECKLIST

The emergency checklist modes behaves exactly as the normal mode:

- To skip past a checklist CATEGORY, press “SKIP.”
- To enter a checklist CATEGORY, press “ADV.”

RETURNING TO NORMAL MODE

The “EXIT” button is used to return to the normal checklist mode.

- Press “EXIT” once to return to the emergency checklist page.
- Press “EXIT” again to toggle to the normal checklist mode.
- The CMS-400 will read the title of the normal checklist in use before the emergency checklist access.

OTHER FEATURES

The following features have been programmed into your CMS-400 to provide additional benefit and utility:

CHECKLIST NAME

To see the owner's name and airplane on the Display:

- Turn the CMS-400 off. Wait at least 10 seconds for the computer to reset.
- Depress the "ADV" button and simultaneously turn the unit on.
- Before self testing, the unit will display who it was programmed for.
- Release the "ADV" button to continue with the self test.

CHALLENGE & RESPONSE vs. CHALLENGE ONLY

The CMS-400 is programmed at the Factory to automatically power up in the Challenge-Only mode (i.e., the unit will read the Challenge but not the response to the pilot). To access the Challenge & Response form of the checklist delivery:

- Turn the CMS-400 off. Wait at least 10 seconds for the computer to reset.
- Depress the "EXIT" button while simultaneously turning the unit on.
- The computer displays the choice of checklist delivery selected.
- Release the "EXIT" button to continue with the self-test.

Note: Studies have shown that pilots participate in checklist performance to a higher degree if the Challenge-Only mode is used. Heads Up Technologies recommends that Challenge & Response mode be used only for training purposes.

AUTOBRIEF

If the CMS-400 is used in conjunction with a Heads Up Technologies cabin briefing system, the checklist can automatically trigger the passenger briefing

system. Takeoff and landing messages can be given automatically whenever the checklist encounters a passenger briefing item.

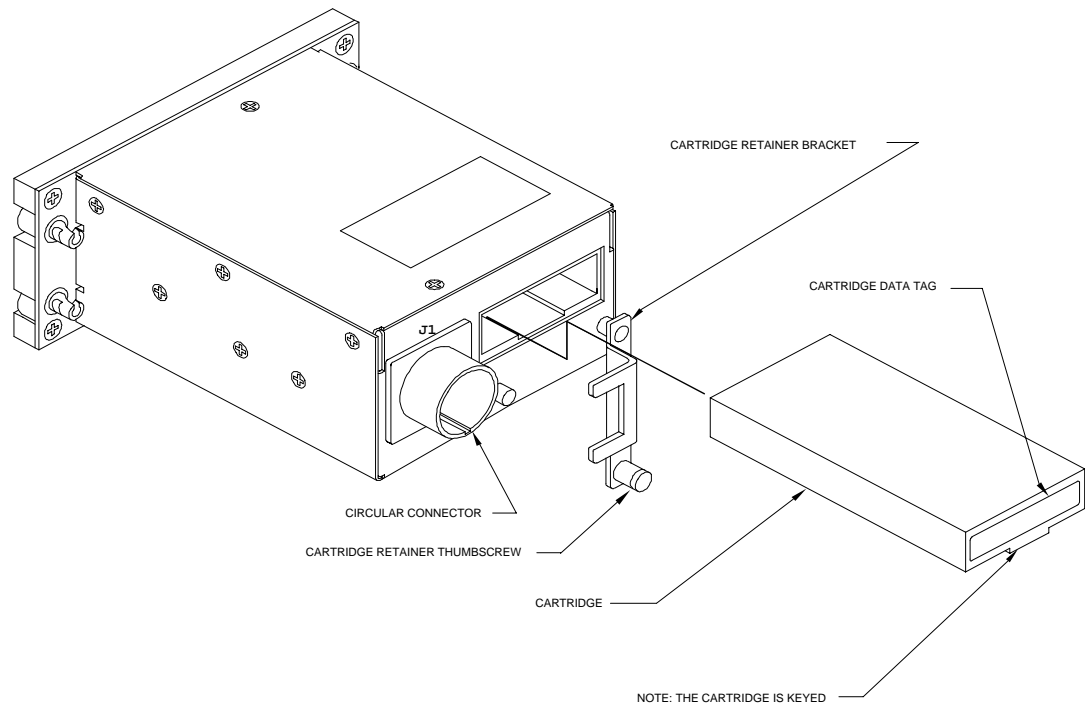
“JUMP” TO APPROACH/LANDING

At any time during the checklist operation, pressing the “JUMP” button and releasing it causes the CMS-400 to skip immediately to the approach or landing checklist (depending on customer specification). This user-suggested feature allows instant access to the approach/landing checklist for touch and go landings or missed approaches.

CHANGING THE CHECKLIST

Occasionally it will be necessary to change the checklist programmed in your CMS-400. These changes may be required because of new equipment, FAA notices, procedure changes, etc. The data cartridge DSC20 that is inserted in the rear of the unit allows for easy checklist updates.

Figure 2



Rear View of CMS-400 Illustrating
Data Cartridge Insertion and Removal

Make Changes to the Written Copy

Edit the written copy of your checklist and mail or FAX the changes to Heads Up Technologies, ATTN: Customer Service Department. Heads Up will call you to discuss any changes.

Heads Up will produce a replacement data cartridge that contains the new checklist revisions. It will be mailed to you.

Removing the Data Cartridge

The following steps describes the removal of the checklist data cartridge:

- After removing the CMS-400 from the aircraft, remove the old data cartridge by loosening the thumbscrew that holds the data cartridge retainer in place as shown in Figure 2. Rotate the retainer counter clockwise. Pull the old data cartridge out of the unit.
- Insert the new data cartridge. Note that it is keyed so that it may only be inserted in one direction. Return the cartridge retainer bracket to the closed position and tighten the thumb wheel screw.
- Install the CMS-400 in its original location in the aircraft.
- Verify that the new revision is correct by listening to the entire checklist.
- Return the old data cartridge to Heads Up Technologies.

Note: Failure to return the data cartridge within 30 days will result in a substantial replacement penalty. Please return the cartridge within this time frame.

Field Support

The CMS-400 has a one year warranty covering all parts and labor (see installation manual). In the event that your CMS-400 fails or if you have any questions regarding the operation of the unit, call Heads Up Technologies, Technical Support Department.

Note: There are no user serviceable parts inside the CMS-400. Opening the case invalidates your warranty.

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