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DIGITAL TECHNIQUES
ELECTRONIC INSTRUMENT SYSTEMS

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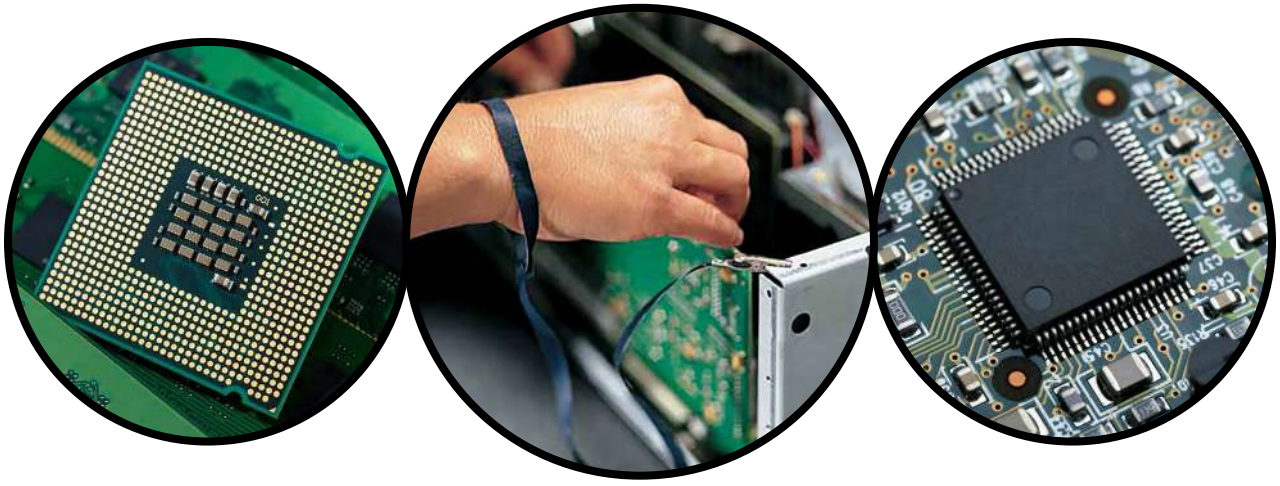

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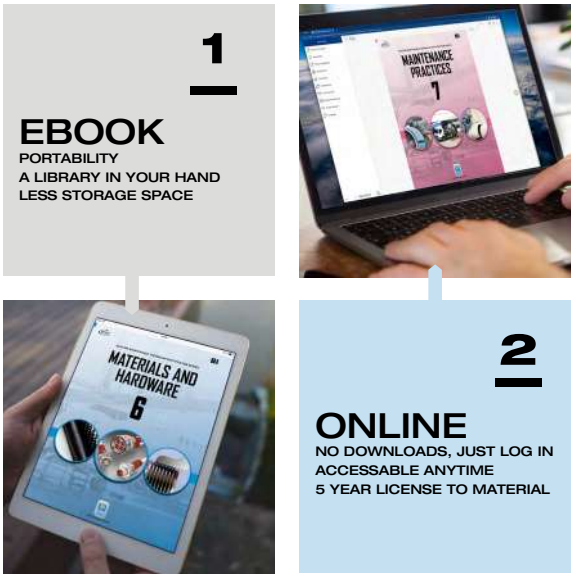

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REVISION LOG

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VERSION	EFFECTIVE DATE	DESCRIPTION OF REVISION(S)
001	2014.09	Module creation and release.
002	2019.05	Fine tuned Submodule content sequence based on Appendix-A. Updated layout and styling.
002.1	2021.09	Formatting Updates - no content changes.
002.2	2023.04	Minor appearance and format updates.
003	2024.06	Regulatory update for EASA 2023-989 compliance.

Module was reorganized based upon the EASA 2023-989 subject criteria.

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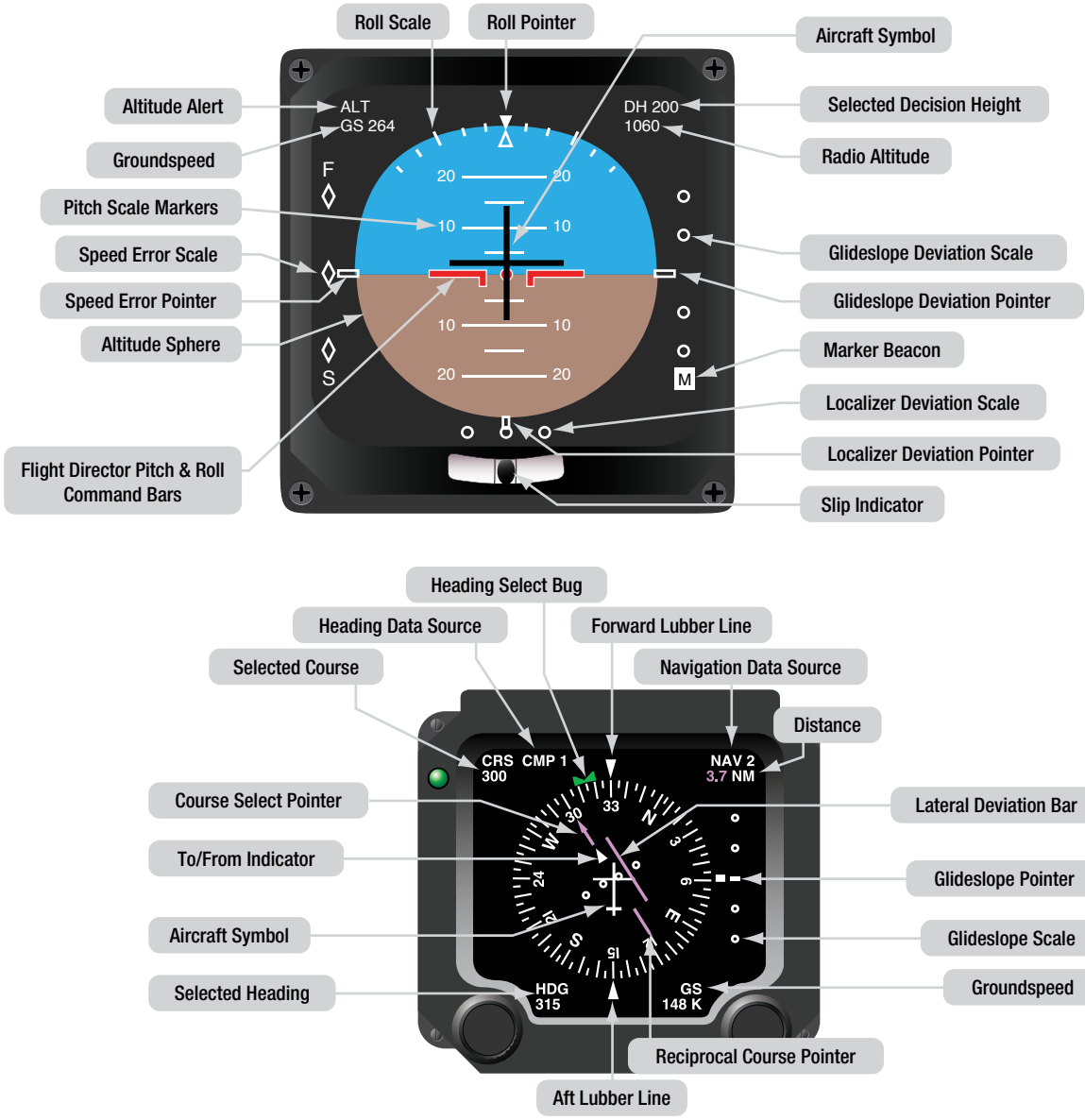

Figure 1-4. Typical EADI (top) and EHSI (bottom) Display Symbology.

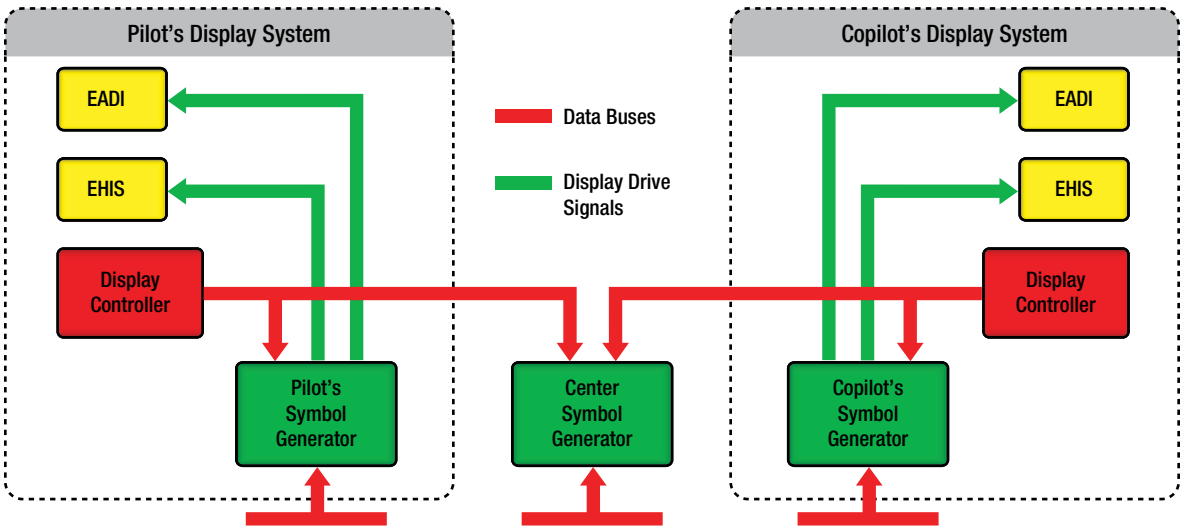

Figure 1-5. Electronic displays are driven by symbol generators.

Figure 1-6. Boeing 777 Electronic instrument system has 6 LCD Displays.

into a single composite display instead of the crew having to monitor several independent analog instruments. Also, the colors on the display change to alert the crew to potentially hazardous flight conditions, such as low airspeed, high rate of descent, etc.

Figure 1-7 is a typical primary flight display format showing the artificial horizon in the center of the display, airspeed on the left side, altitude on the right side, heading on the bottom, and flight modes on the top of the display. Notice how the moving ladder format used for altitude and airspeed provide both absolute and relative information so the crew knows not only the exact numeric value, but also the rate that the altitude and airspeed is changing.

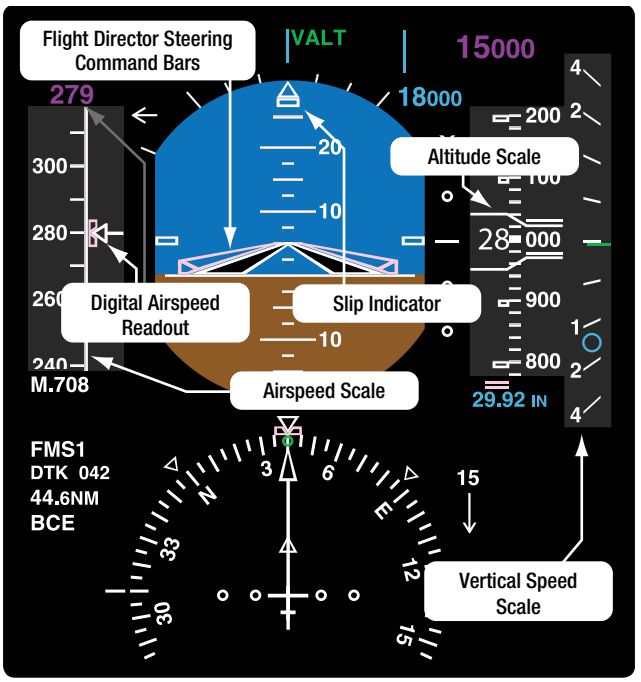

Figure 1-7. Primary flight display format.

The navigation display, shown in **Figure 1-8**, takes the place of the EHSI display to show the requisite information to navigate the aircraft, including heading, VOR, GPS, and ILS guidance. The ND has the ability to overlay additional information on the navigation page to eliminate the need for separate dedicated

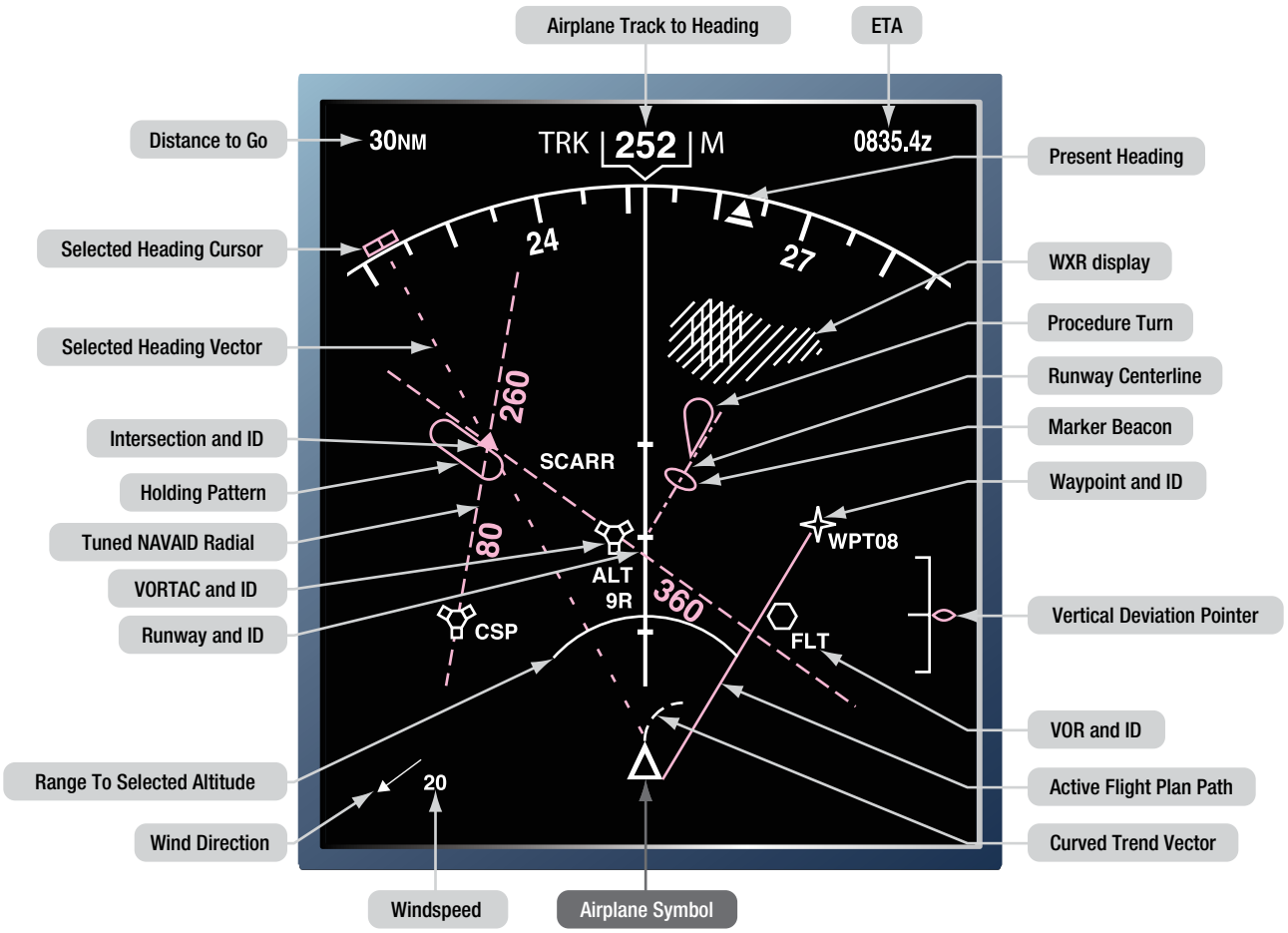

Figure 1-8. Navigation map display format.

Figure 1-9. EICAS engine display format.

displays. Some examples of information that is typically overlaid on the ND include weather information from either the onboard weather radar (WXR) or ground based sensors, and digital maps showing pre-programmed routes and waypoints from the Flight Management System.

ENGINE INDICATION AND CREW ALERTING SYSTEM

The Boeing Engine Indication and Crew Alerting System (EICAS), also called an Electronic Centralized Aircraft Monitor (ECAM) on Airbus aircraft, performs the monitoring of aircraft systems that was previously performed by the Flight Engineer in three crew member cockpits. As previously shown in **Figure 1-6**, the two EICAS displays on the B777 are located in the center instrument panel. The upper EICAS display shows engine performance data, such as pressure ratio, N1 rotor speed, exhaust gas temperature, total air temperature, thrust mode, etc., in addition to cabin pressure, flat/slat position, landing gear position, and crew status alerts. [**Figure 1-9**]

The EICAS engine display formats mimics the round analog instruments, while also providing digital readouts of the parameters. EICAS improves situational awareness by allowing

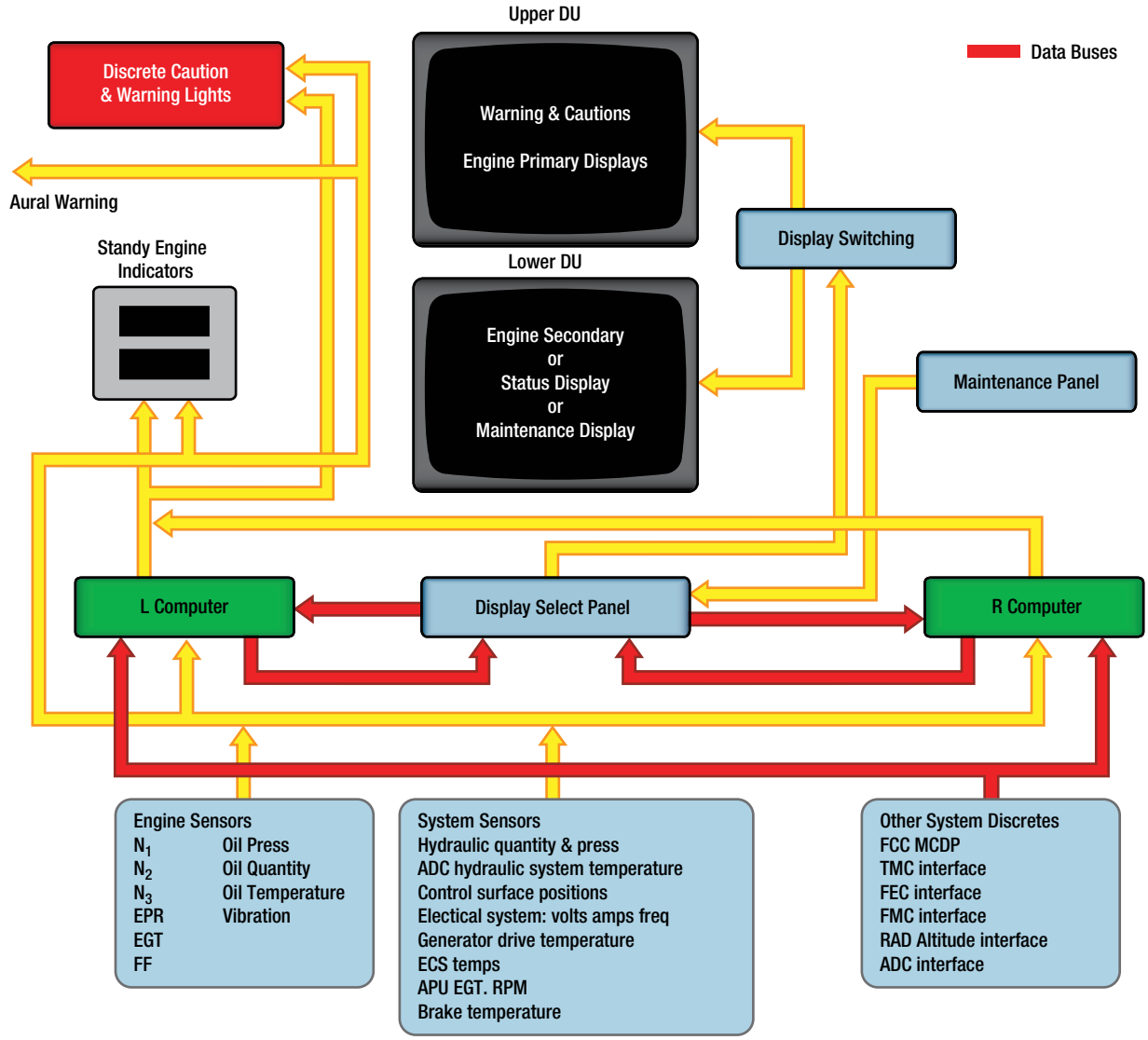

Figure 1-10. EICAS schematic diagram.

the crew to see systems operation in graphical format and alerting them to any failures or impending failures. For example, if low oil pressure is detected, the EICAS will provide an aural alert and show to the oil pressure page on a lower display with a red box outlining which engine has low oil pressure.

The Airbus ECAM system provides the crew with the following levels of warning along with detailed messages as to the nature of the problem and suggested courses of action.

- *Level 3*—An overspeed, fire, or stall condition will cause a repetitive chime aural warning with a bright red flashing light.
- *Level 2*—A system failure, but not a safety of flight issue, will result in a single chime aural warning and a steady amber light.
- *Level 1*—Failure leading to system degradation results only in an amber light.
- *Mode or System Status*—If everything is normal, a green light will illuminate.

The lower EICAS display is called a multi-function display because it provides auxiliary information to the flight crew and maintenance crew. The MFD can be used as a secondary engine display, status display, communications display, maintenance page, or electronic checklist. The MFD formats also include synoptic displays that provide system status diagrams for the fuel, electrical, hydraulic, flight control, and environmental control systems, in addition to showing door and landing gear positions. On some aircraft, the MFD is also used to display images from the ground maneuvering camera system.

Figure 1-10 is a schematic diagram of an engine indication and crew alerting system (EICAS) with all its associated components. The display select panel allows the crew to choose which computer is actively supplying information. It also controls the display of secondary engine information and system status displays on the lower monitor.

EICAS has a unique feature that automatically records the parameters of a failure event to be regarded afterwards by maintenance personnel. Pilots that suspect a problem may be occurring during flight can press the event record button on the display select panel. This also records the parameters for that flight period to be studied later by maintenance. Hydraulic, electrical, environmental, performance, and auxiliary power unit (APU) data are examples of what may be recorded. EICAS uses built-in-test equipment (BITE) for systems and components.

A maintenance control panel is included for technicians. When the aircraft is on the ground, push-button switches display information pertinent to various systems for analysis. [**Figure 1-11**]

This *Submodule* containes an overview of a state-of-the-art aircraft cockpit with its electronic instrument system. The following *Submodules* will discuss how digital data streams are formed and processed by aircraft computers and then sent over digital data buses to cockpit displays to provide essential information for the flight crew and maintenance crew.

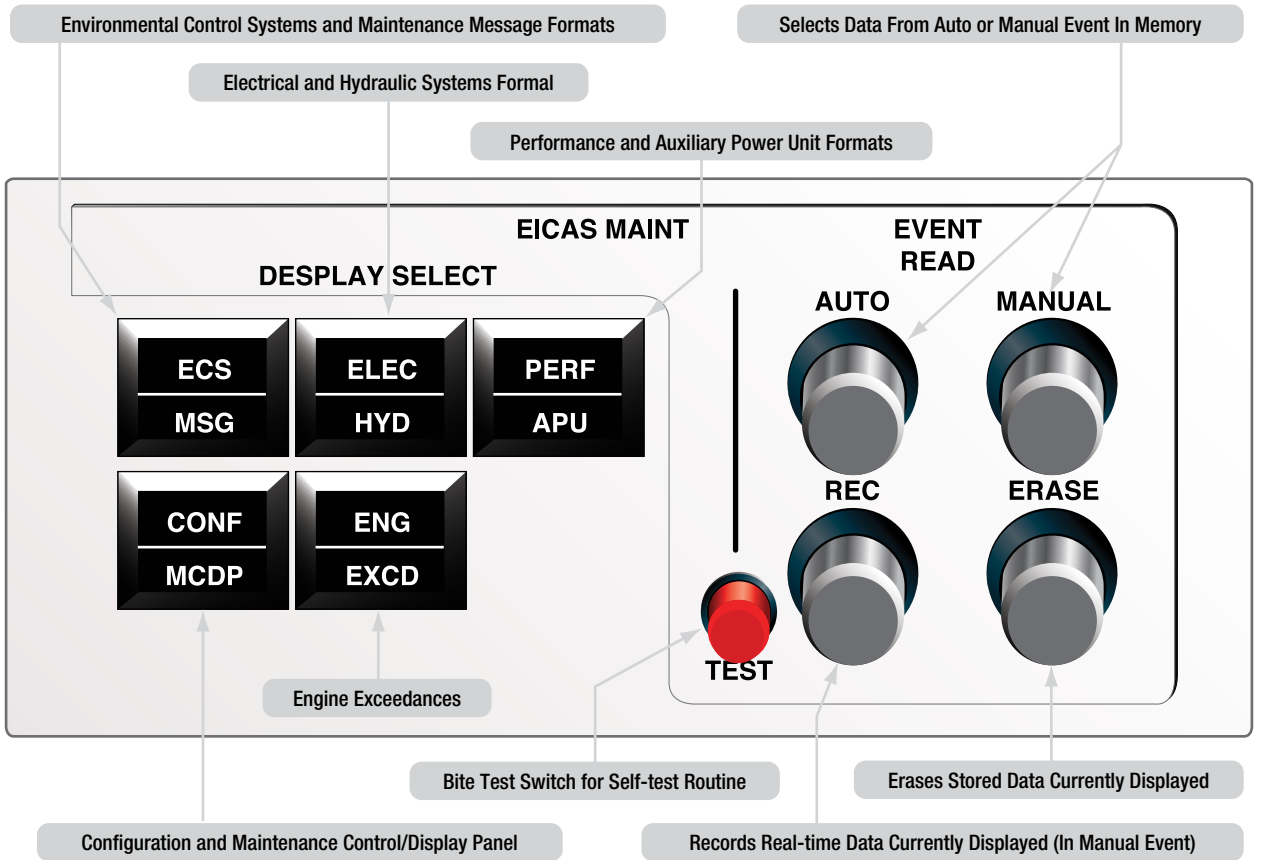

Figure 1-11. EICAS maintenance control panel.