

AVIONICS CRT DISPLAYS BEYOND 2020: THE RISING COST OF OBSOLESCENCE



The obsolescence of cathode ray tube (CRT) aircraft cockpit displays is fast becoming a reality for business and commercial aviation operators. As the world's last CRT display manufacturing facility prepares to close in 2020, we examine the impact of the CRT sunset for legacy aircraft operators.

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Toshiba, the world's last remaining manufacturer of cathode ray tube (CRT) technology, has confirmed it will close its last CRT manufacturing facility in 2020. This news comes after years of advisories of the impending CRT technology sunset by avionics display manufacturers, airframe OEMs, and others in the aviation displays supply chain.



Today, despite warnings of declining CRT availability over the past 15 years and vendor incentives to equip with liquid crystal displays (LCDs), thousands of aircraft with substantial remaining service life are still flying with CRT displays. Meanwhile, display manufacturers have moved on, leveraging LCD technology to provide higher functioning and more reliable displays capability to their respective customers at a lower lifecycle cost.

"A lot of the CRT displays are sun setting and not being supported by vendors anymore," said Dave Jensen, vice president of aircraft maintenance at ACI Jet, a business jet operator and repair station based in California. "Rockwell Collins, Honeywell, Universal and Garmin are offering significant incentives to upgrade to LCDs. The surplus of stock and trade-ins they're offering will not be there forever. As they sunset these old avionics, displays incentives will get smaller and smaller."

In addition to declining availability, CRT-equipped operators may need new options for sustainable CRT repair and support. In 2016, Lufthansa Technik began to embrace a new policy toward contracts and agreements it has with airlines to maintain and service their CRT displays. Norbert Sabogal, head of Avionics Engineering in Hamburg, Germany said the MRO is reserving CRT support for operators that have formulated future facing agreements for those services. "We continue to provide support for old CRTs, but only for those operators that have ordered in advance such repair programs," said Sabogal.

The incentives to adopt LCD technology are many and well-established. Sabogal estimates the average weight of an LCD display for an Airbus A320 or Boeing 737 to be close to a third of the weight of a CRT. Further, LCDs are more reliable, require less power to operate, and little to no cooling. The result is lower annual operating and maintenance costs, and weight savings that may be taken in range or added payload. Another key motivator for many operators is the LCD capacity for growth to support new capability, and to position the aircraft to operate in regulated, more efficient airspace.

Alexander Krause, product sales manager for avionics and flight deck solutions at Lufthansa Technik, sourced the following Mean Time Between Failures (MTBF) information from the MRO's avionics display manufacturers customers and business partners:

Display Type	Mean Time Between Failures (MTBF)
CRT 	18,000 hours
LCD 	32,000 hours

Despite the clear and acknowledged benefits of embracing LCD technology, and the risks of relying on a supply chain in decline, thousands of aircraft across multiple models continue to operate with CRTs.

CRT-equipped Model Types

Airbus A320 family early production models
Airbus A330/A340 early production models
ATR-42/72 & Dash 8 1/2/300
Boeing B737-3/4/500
Boeing B757-2/300
Boeing B767-2/300
Bombardier CRJ100,200,300,400,700,900,1000,CL-850
Fokker 70/100
MD-11
Saab 340B
Embraer EMB-120

Why the resistance to equip? Depending on the aircraft configuration and displays solution, upgrading may require extensive re-wiring and flight deck reconfiguration. The expense of a flight deck LCD retrofit, including regulatory certification, installation, aircraft down-time, and training can be prohibitive, particularly for lower market value airframes or those without a business case for a large-scale modification.

Finding the Right LCD Replacement

Two of the most common CRT equipped aircraft in commercial service today are the earlier production A320 and Boeing 737-3/4/500 fleets. Sabogal advises that when upgrading from CRTs to LCDs, operators will have to account for embedded components, including the aircraft display symbol generators and electronic flight instrument system controllers. The A320 and Boeing 737 Classic models are good examples of this consideration.

“Airbus displays have an embedded symbol generator included in the display LRU, which makes it difficult to find an LCD solution or to replace it. It’s a very complex system,” said Sabogal. “For Boeing, the symbol generator is not included, it’s just a discrete CRT display unit, and the technology can be more readily replaced by LCD.”

Despite several successful LCD flight deck upgrades industry-wide, operators of legacy Boeing aircraft remain challenged by the often heavy price tag associated with major flight deck overhauls that involve complex re-wiring, long down-times, and in some cases expensive software updates.

One major North American airline recently overcame that challenge by selecting the Thomas Global TFD-7000 Series LCD to modernize its Boeing 757 and 767 fleet. Installation is scheduled for 1st quarter 2019.

The TFD-7000 Series solution leverages Thomas Global's latest in-house innovation in analog-digital signal conversion, enabling a seamless integration of their LCD solution into the installed Boeing EFIS architecture.

Nelson Mino, Director of Advanced Programs and CTO for Thomas Global said "The TFD-7000 Series will give customers a common plug-and-play LCD solution for 757, 767 and 737 Classic flight decks utilizing the existing, reliable Boeing SFE symbol generators and aircraft wiring. These lightweight LCDs require no cooling, no downtime for installation and no crew retraining. Our family of drop-in LCD replacements also includes additional A429 ports for added functionality and growth to support new airspace requirements. Higher reliability based on the latest technology results in reduced maintenance costs and improved dispatch ability for operators."

Robert Dankers, director of avionics modifications for Boeing Global Services, said Boeing has offered "several CRT replacement programs in the past on multiple model types, including 737 Classics, although that has since changed." "We currently do not have any active programs for the 737 Classic. We are, however working with display OEMs on other platforms including the 757 and 767. We will be able to meet customer demand for the 737 Classic programs should it arise," said Dankers. Dankers said the complexity of LCD upgrades on Boeing aircraft depends on the existing avionics configuration within the aircraft. There are simple LRU replacement paths for LCDs, while other more complex upgrades can also introduce new navigation capability. "The more complex flight deck modifications can reduce maintenance costs while introducing new features that offer the latest in pilot guidance, such as lateral and vertical displays for required navigation performance (RNP), lateral navigation (LNAV) deviation scale pointers and consolidation of radio/navigation panels, which also decreases the aircraft's weight," said Dankers.

CRT Displays Beyond 2020

The inevitable decline of the CRT displays supply chain, and the resulting increase in repair cost and availability risk has been long anticipated throughout the industry.

CRT display assemblies featured in flight deck displays were for many years supplied by color television manufacturers. Those companies started closing their facilities in the mid- to late 2000s. Sony for example, closed its last CRT manufacturing facility in 2008. Now Toshiba, the last of the CRT manufacturers for television and aviation applications will exit the market in 2020, fulfilling only pre-arranged parts supply and support commitments beyond then.

"The CRT box will not be produced by Toshiba anymore. That is leading to rising prices for maintaining and repairing them," said Sabogal. "The cost will continue to increase into the future. Although there will be alternative LCD options available, trying to upgrade and maintain a CRT itself will become increasingly more expensive."

How will legacy operators continue to replace and repair aging CRTs?

One way is through companies like INAir Legacy Avionics Solutions, an Indiana-based Part 145 certified repair station that supplies assemblies and components for electronic displays and flight instrumentation systems. The majority of aftermarket repair stations and suppliers of CRT displays buy the full assemblies from Toshiba and provide them to

business, commercial and military aircraft operators. InAir, however, buys the tubes from Toshiba and manufactures the final assembly at its factory in Indiana.

Roger Messick, president of InAir commented, "Toshiba will manufacture their last CRTs, and then in 2020 they'll make the final deliveries of CRT assemblies. Their factory in Japan that makes CRTs — I've been through it — they used to have thousands of people working there, and now there are around 50, and they're all nearing retirement age."

Messick said outside of Toshiba there are some companies that provide and manufacture "specialty" final CRT display assemblies. He said the cost to repair CRTs will continue to increase as the supply becomes increasingly scarce. "There's a huge Airbus A320 fleet flying with Thales CRT displays, and we're in discussion with some of those operators," said Messick.

The most common CRT requests InAir receives are those for complete CRT display assembly failures, loss of focus or phosphorous burns on the screens. Discussions with operators about keeping their CRTs versus replacing them has shown Messick that operators are aware of the obsolescence issue, and continue to resist upgrading because of cost.

Messick estimates that the average cost of replacing a CRT display in an Embraer 145, to be close to \$20,000. On the A320, Thales currently has a flat rate of \$40,000 for its CRTs.

"They're getting quite expensive to repair, and they're fairly high-failure-rate items," said Messick.

Another company in the business of supporting CRT aircraft displays long term is Millennium International, a Part 145 repair station based in Missouri. Millennium provides CRT assembly replacements for 21 different CRT flight, multifunction, information and control displays manufactured by Bendix King, Honeywell and Rockwell Collins.

Messick and Millennium insiders agree that eventually CRT-equipped aircraft will become too expensive to repair versus either replacing with LCD displays or replacing the aircraft altogether.

As CRT equipment scarcity grows, commercial and business aviation operators will be left to determine how far to follow the path of rising CRT repair and replacement costs, and when if ever, to consider new LCD replacements, such as discrete solutions, or via upgrades from manufacturer service bulletins or third-party MROs.

Thomas Global CEO Angus Hutchinson, while acknowledging the industry challenges of this transition, is clear that they are prepared. Thomas Global has been in the business of building [from Toshiba tubes] and repairing CRTs for over 3 decades. Today, they repair and support a broad range of CRTs, and indicate they have secured strategic stocks of new CRTs ahead of Toshiba's shutdown to help customers ease the transition to LCD technology.

Further, Hutchinson believes the TFD-7000 plug-and-play LCD solution is the innovative advance that will enable legacy operators to move beyond aging CRT technology with confidence.

"Thomas Global is committed and prepared to support our CRT customers as they evaluate flight deck solutions for their legacy fleets," Hutchinson said. "That said, the future of LCD technology is here, and we very much look forward to helping those customers prepare to take that next step. The benefits and the path are there."