NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorders Division
Washington, D.C. 20594

Special Study

DCA05MM008

by

Joseph A. Gregor

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GPS Receiver

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A. ACCIDENT

Location:	Dutch Harbor, AK
Date:	December 18, 2004
Time:	19:24 Atlantic Standard Time (AST)
Vehicle:	M/V Selendang Ayu
NTSB Number:	DCA05MM008

B. GROUP - No Group

C. SUMMARY

The 738-ft long, Malaysian bulk/freighter SELENDANG AYU experienced a propulsion failure sometime on Monday, December 6, 2004. The vessel, which was en route from Seattle to Japan with a load of soybeans, was proceeding through the Bering Sea northwest of Dutch Harbor, Unalaska Island, Alaska at the time. The vessel proceeded to drift and resisted all effort to secure her motion. The master requested the Coast Guard to evacuate the 26-man crew, which the Coast Guard accomplished in 3 stages. During the evacuation on Wednesday, December 8, 2004, a Coast Guard helicopter, with 3 Coast Guard and 7 crewmembers, crashed into the sea. Another Coast Guard helicopter rescued the 3 Coast Guard personnel and one crewmember, leaving a total of six crewmembers unaccounted for. A Coast Guard helicopter later removed the master and a Coast Guard swimmer, who had remained on board the doomed vessel. At 1924 AST, the SELENDANG AYU ran aground on Unalaska Island and broke in two parts. The vessel was carrying some 10,000 barrels of bunker fuel.

Two GPS navigation units were recovered from the vessel and sent to the NTSB Vehicle Recorder Laboratory for evaluation. Data relevant to the accident was photographically captured from the display.

D. DETAILS OF INVESTIGATION

A standard GPS receiver acquires low-level radio signals from a constellation of 28 Department of Defense (DoD) satellites in geo-synchronous orbit about the Earth. In order to fix position in on the earths surface, the GPS receiver must be synchronized to signals from at least 3 satellites. In order to fix position in all three dimensions, the receiver must be synchronized to signals from at least 4 satellites. Uncorrected horizontal accuracy of a civilian GPS receiver is approximately 30 meters. With DGPS,[1] horizontal accuracy in certain areas may be as good as 1 – 5 meters.

Two GPS Navigation units arrived at the NTSB Data Recovery Laboratory on January 4, 2005. Identifying information for these cameras is outlined in table 1.

GPS #	Make	Model	Condition	S/N
1	Japan Radio Co., Ltd	JLR-7700	Undamaged	KD43556
2	Japan Radio Co., Ltd	JLR-6800	Undamaged	KC51212

Table 1. Make, model, condition, and serial number for GPS units recovered from the M/V Selendang Ayu.

The JLR-6800 and JLR-7700 are bridge-mounted GPS acquisition and display units designed for the marine market. The JLR-7700 uses an external antenna to receive GPS satellite signals and DGPS correction information for precise position location. Vessel position is displayed on a B&W LCD[2] screen that is an integral part of the unit. The GPS navigation unit has a data output port designed to use NMEA0183[3] communication protocols for use in interfacing with an automated ship control system.

[1] Differential GPS is a system that employs an external GPS receiver at a known surveyed point on the earth. This receiver determines the difference between its surveyed location and that given by the GPS system, and transmits correction information to other GPS units in range and equipped to receive and integrate such information.
[2] Liquid Crystal Display.

The JLR-7700 is capable of storing up to 499 waypoints in memory, including 99 waypoints based on manually capturing the current position of the vessel using an 'event' key. The JLR-7700 is also capable of storing up to 300 points of tracked position. These are points of vessel present position that are acquired automatically and may be displayed on the LCD screen. Detailed information is not available for the older JLR-6800. Examination of the unit indicated a substantially reduced feature set compared with that of the JLR-7700. In particular, the LCD on the JLR-6800 is only capable of displaying digits using a '7-segment' arrangement – giving no access to tracked position data. Neither unit contained the hardware components and software protocols required to download data to an external device.

Upon activation, the JLR-7700 was found to contain 300 stored 'tracked position' points in internal memory and displayed on the LCD screen. The unit was found set to position interval 0.2, indicating that a tracked position point would be created and stored every time the unit moved 0.2 nm. Current position was displayed as N53º 38.097', W 167º 07.517'.

Since data could not be electronically accessed, the track log from the JLR-7700 was recovered by photographing the LCD screen. The results are displayed in figures 1 – 7. Data from the JLR-6800 was not recoverable using this technique, since the LCD screen on that model was not capable of displaying past position information.

Joseph A. Gregor
Data Recover Specialist

[3] A text-based serial communications protocol defined by the National Marine Electronics Association for standardized interfacing between external navigation devices and other microprocessor-based systems.

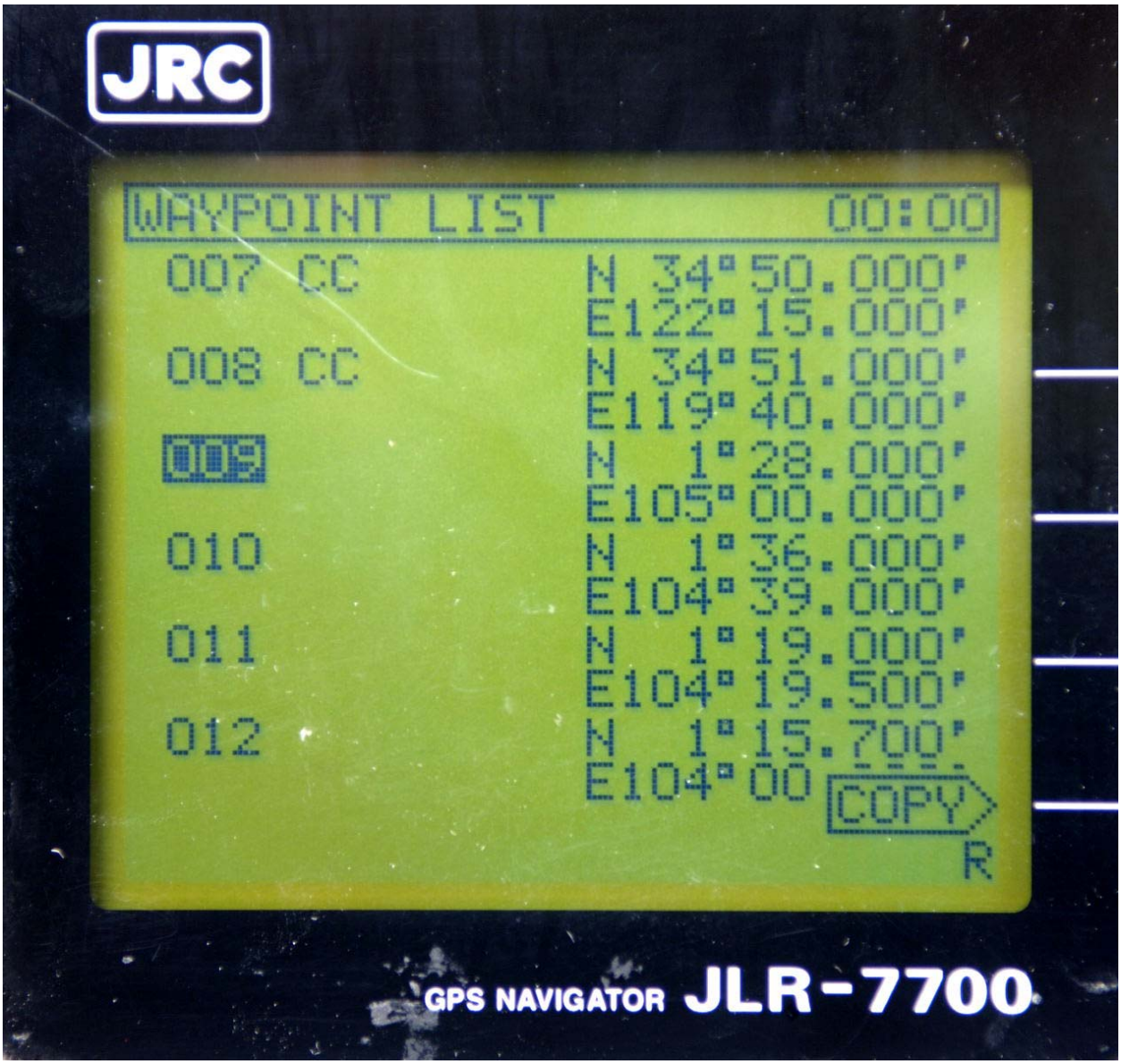

Figure 1. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing waypoints 7 through 12.

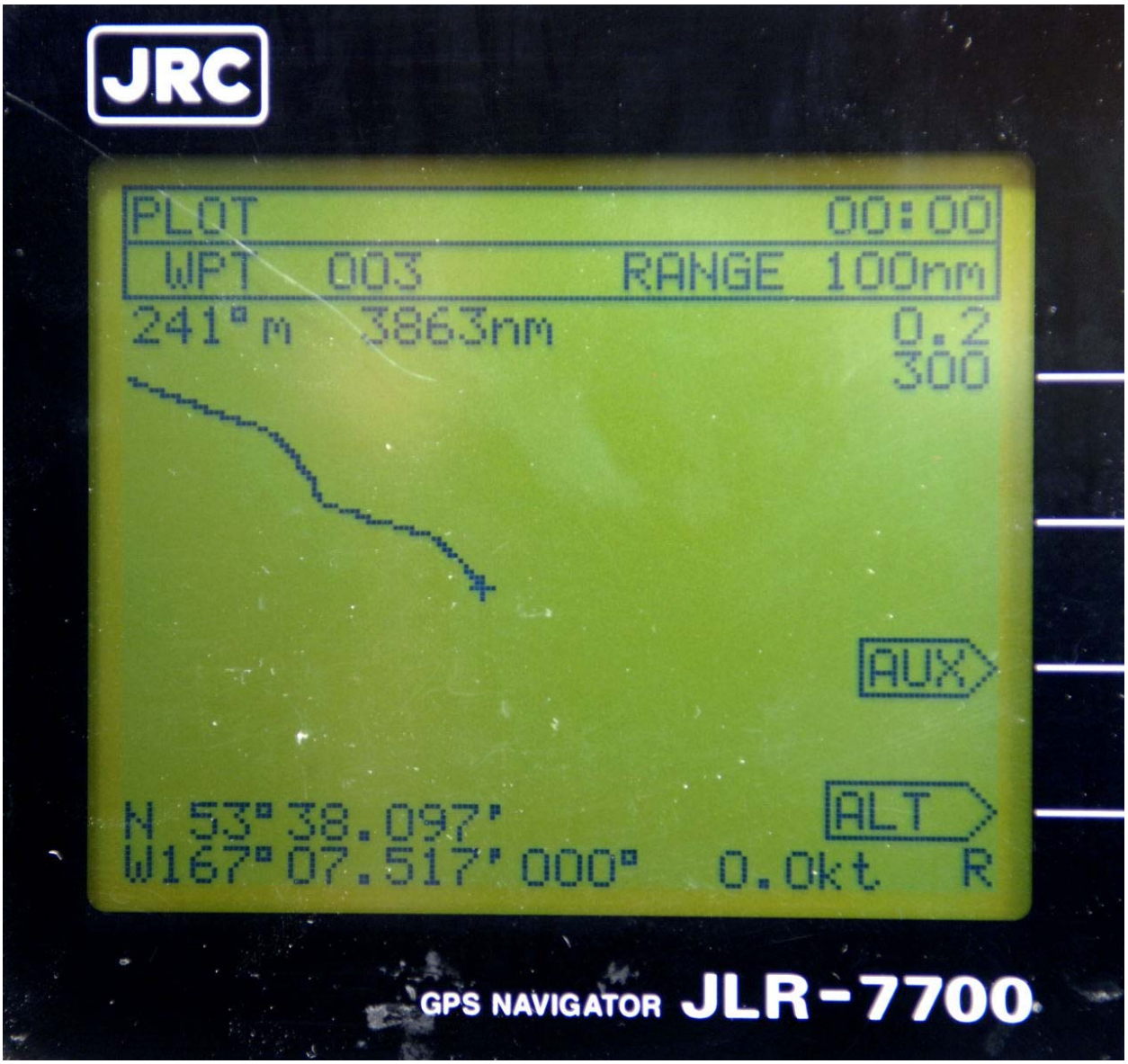

Figure 2. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 100 nm.

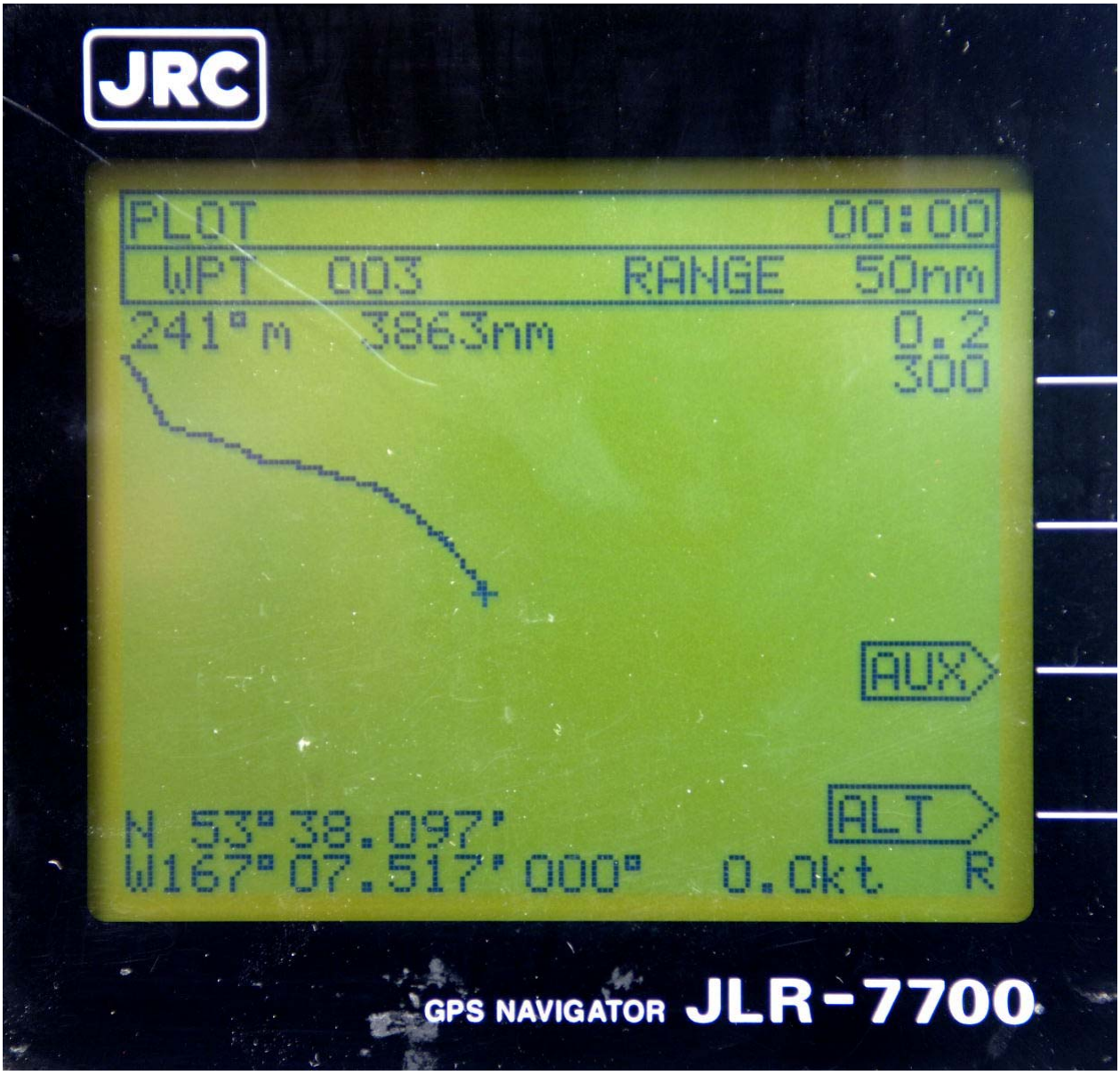

Figure 3. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 50 nm.

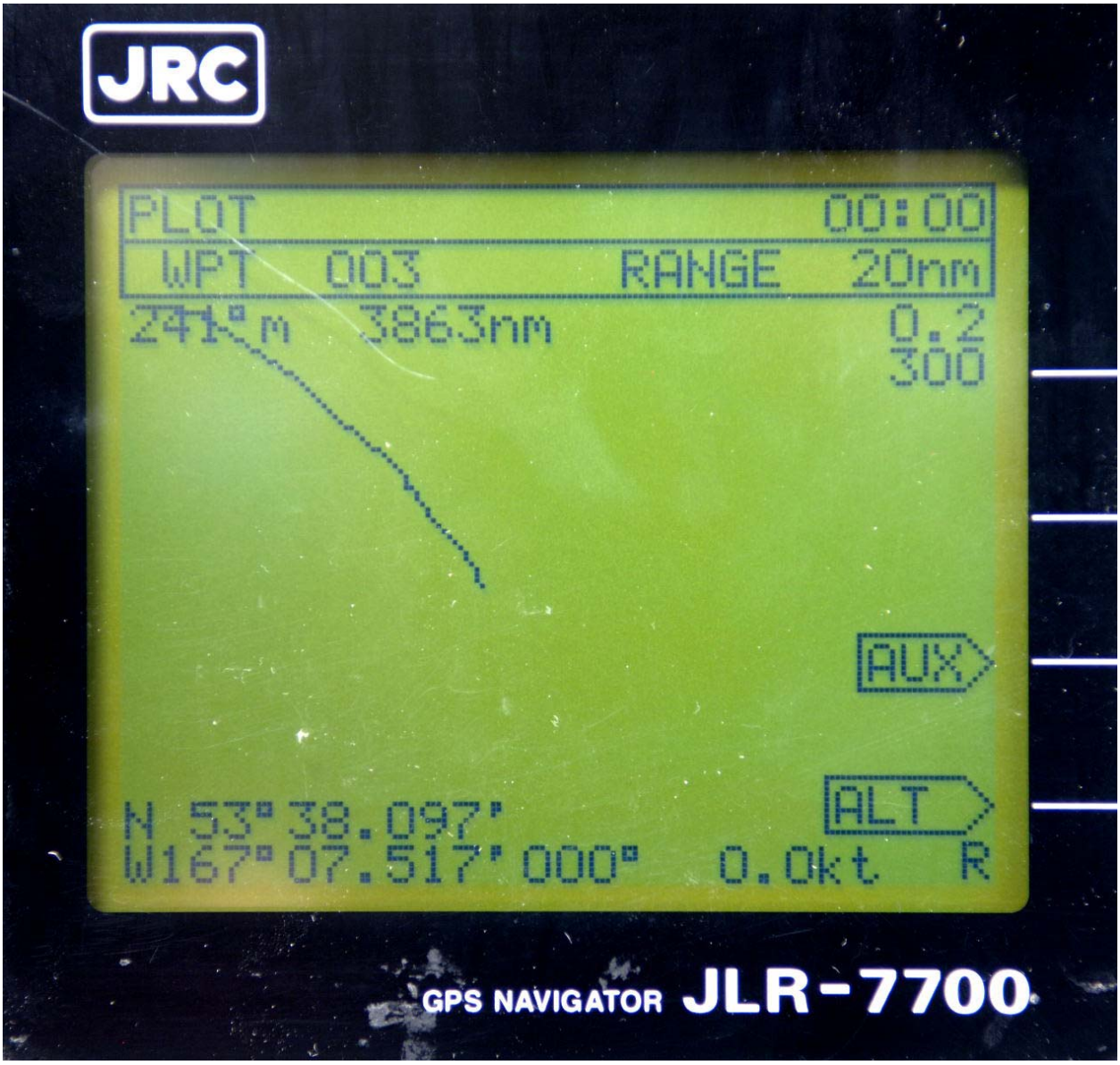

Figure 4. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 20 nm.

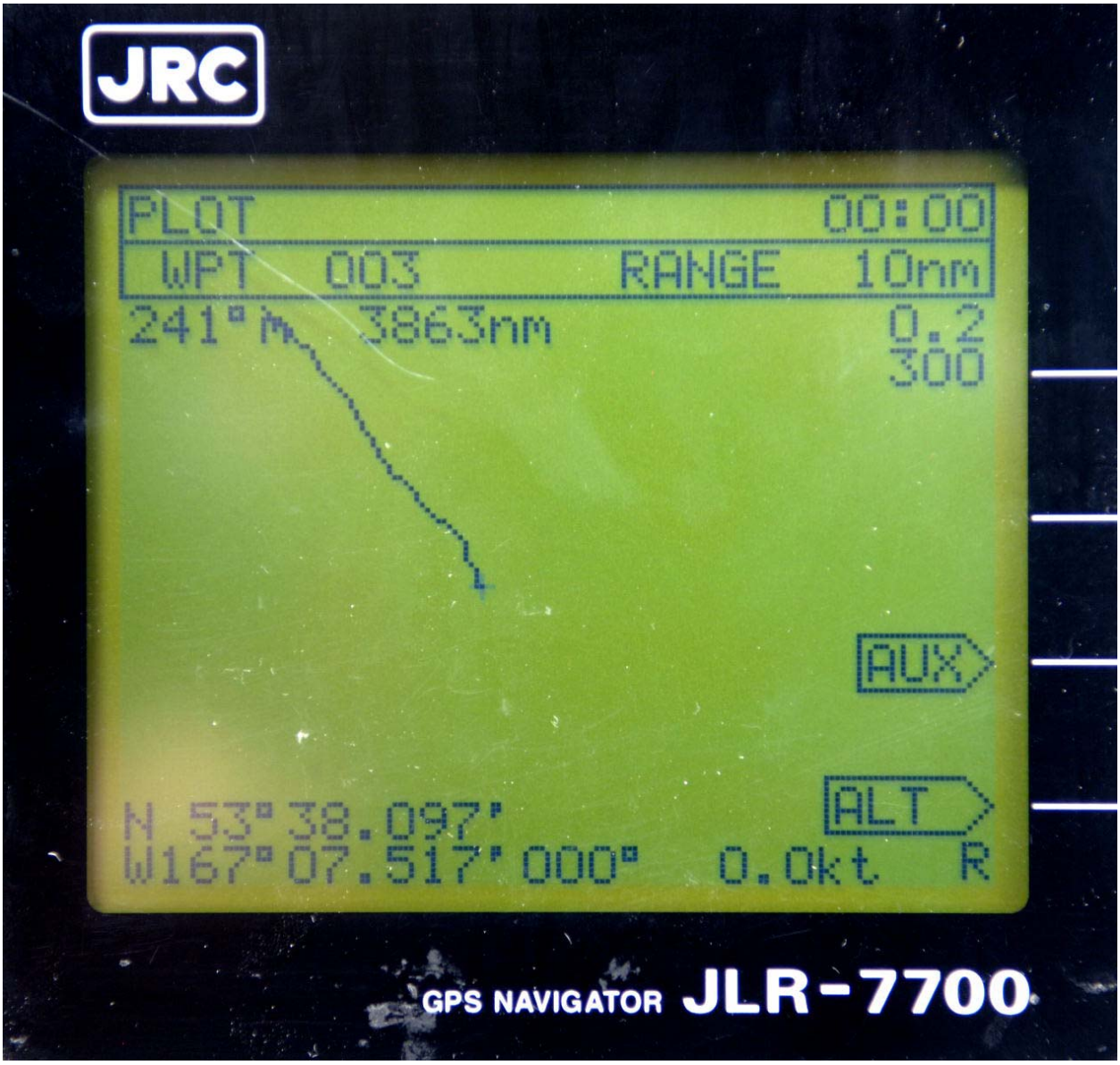

Figure 5. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 10 nm.

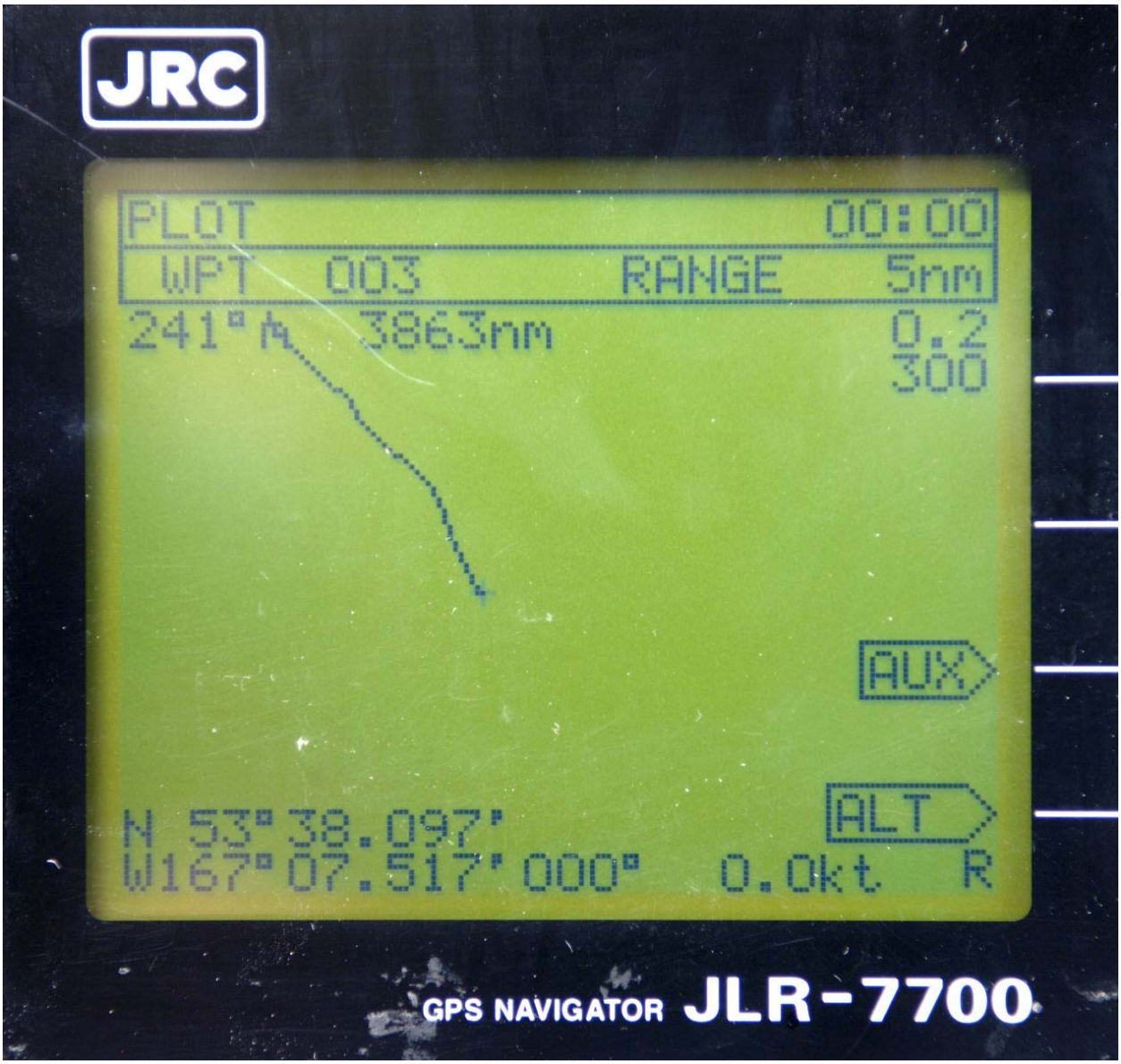

Figure 6. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 5 nm.

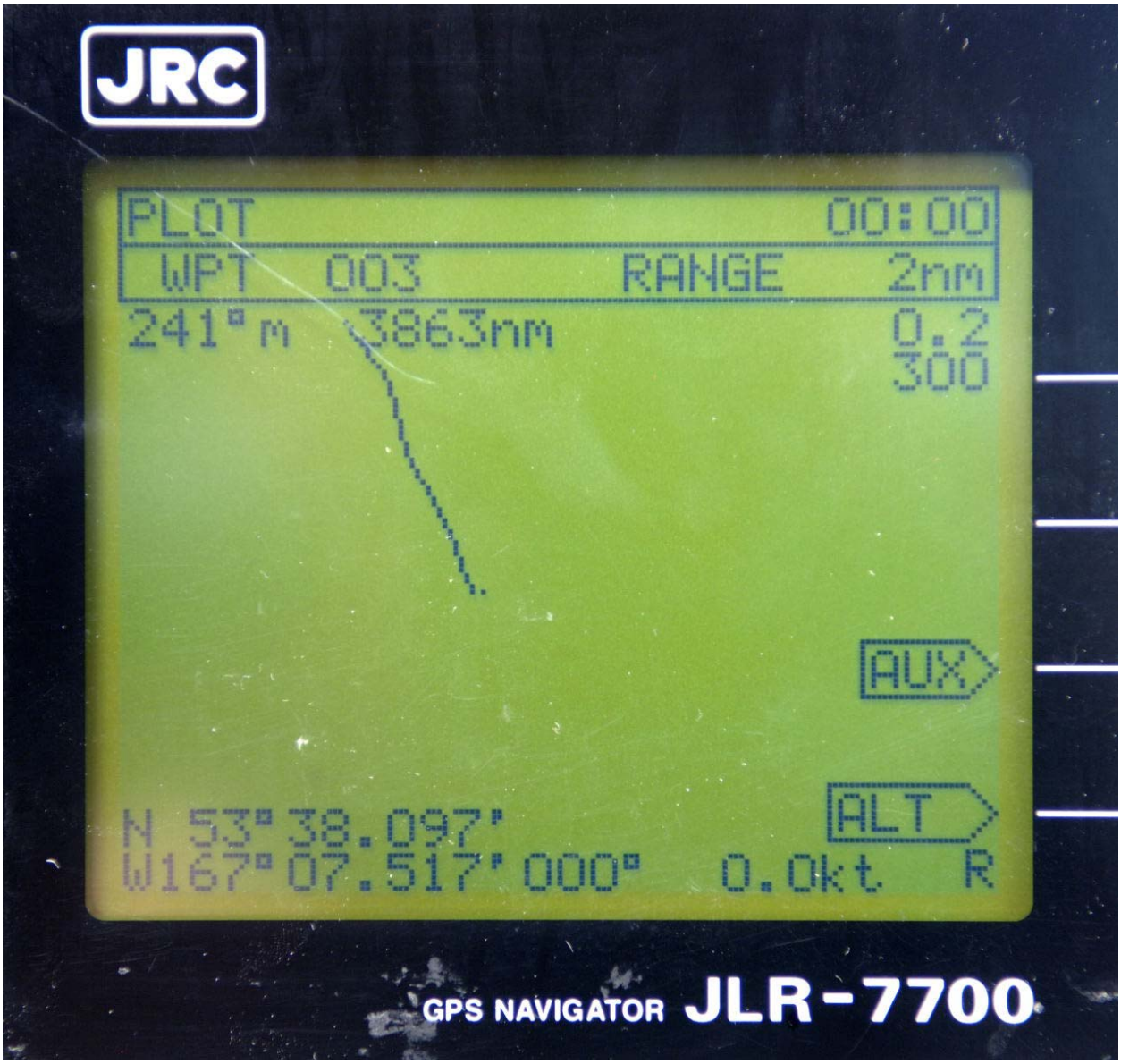

Figure 7. Photograph of the LCD screen for the JLR-7700 GPS navigation system showing the end of the saved position track information with range set to 2 nm.