Title: **Operating and Test Manual For The Model LC-90 Digital Electronic Aircraft Clock for ADS Part Number AT945040**

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Author: **John Doyle et al**

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MFG Engineer	Date
QA	Date
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1. SCOPE

1.1 Scope:

This manual defines the features and operation of the Model LC-90 Digital Electronic Aircraft Clock for ADS part number AT945040. Testing is defined to meet the requirements of ARINC 731-2, Electronic Chronometer.

1.2 Definitions, Acronyms, and Abbreviations

ADS	Aerospace Display Systems
ARINC	Aeronautical Radio Inc.
FMTN	First Minima Twisted Nematic
LCD	Liquid Crystal Display
LED	Light Emitting Diode
PMW	Pulse Width Modulation
CHR	Chronograph
ET	Elapsed Time
PTS	Push To Test
RTCA	Radio Technical Commission for Aeronautics
UTC	Coordinated Universal Time

2 SYSTEM OVERVIEW

2.1 System Description

The model LC-90 Digital Electronic Aircraft Clock is designed to be a generic aircraft cockpit clock and timing reference. The clock will support a wide degree of airframe applications. The clock provides Coordinated Universal Time (UTC) and Date, Manual (MAN) Time and Date, a Chronograph with sweep second pointer, Elapsed Time, and ARINC 429 time and date output/input. The clock's chronograph feature is used for timing in holding patterns, procedure turns, and approaches. The chronograph function can be externally controlled. The elapsed time feature is used to measure trip time. As well as providing a visual time and date reference to the pilots, the clock is capable of receiving and transmitting the time and date information over the aircraft's ARINC 429 bus. The clock's time and date information can be received from another timing source or GPS function. The time and date information can be sent to the Flight Management Computer, Flight Data Recorder, Digital Flight Data Acquisition Unit, and the Cockpit Voice Recorder.

The clock receives its operating power from the aircraft's +28VDC main power bus. For aircraft equipped with a separate +28VDC Standby (Battery) Bus, the clock can use this bus to maintain manual time and date information when the aircraft is non-operational. The lighting power is supplied by the aircraft's panel lighting system. A test signal is also received from the Master Caution Dim and Test System.

The general design guideline for the clock is in accordance with ARINC 731-2. The design philosophy is to use component parts that exceed the environmental operational requirements of the clock. All components are military or industrial grade. No commercial grade components are used in the clock.

2.2 System Features

The LC-90 Digital Electronic Aircraft Clock supports the following features:

2.2.1 Physical Configuration

The case is a 3ATI in accordance with ARINC 408A. The overall physical dimensions are shown in Figure 1 as a reference. For complete mechanical details, refer to drawing AT945040.

2.2.2 Weight:

The total weight of the clock shall not exceed 27 oz (1.688 LB or 766 grams).

2.2.3 Connector:

The aircraft power and signal connections are made through a BACC63CC16-24PN or equivalent connector. This connector will mate with Boeing connector BACC63CB16-24SN or equivalent for aircraft installation. The electrical configuration of the connector is shown in Table 1.

2.2.4 Display and Button Arrangement:

The display is a Liquid Crystal Display with white characters on a dark background. The AT945040 model uses FMTN Display technology. For complete information on the display refer to drawing DND-300-020. The display and button arrangement are shown in Figure 2.

FIGURE 1: Physical Configuration

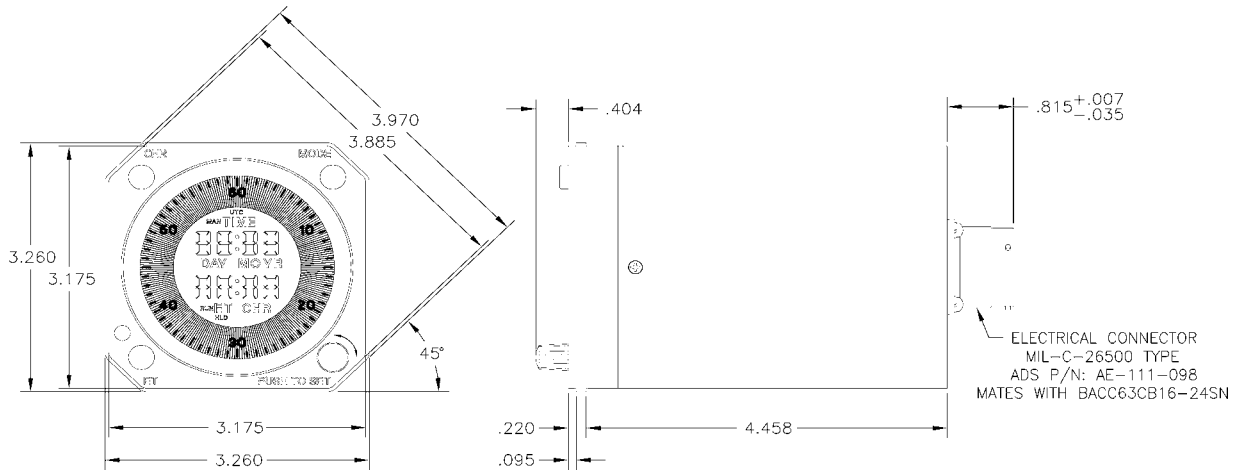
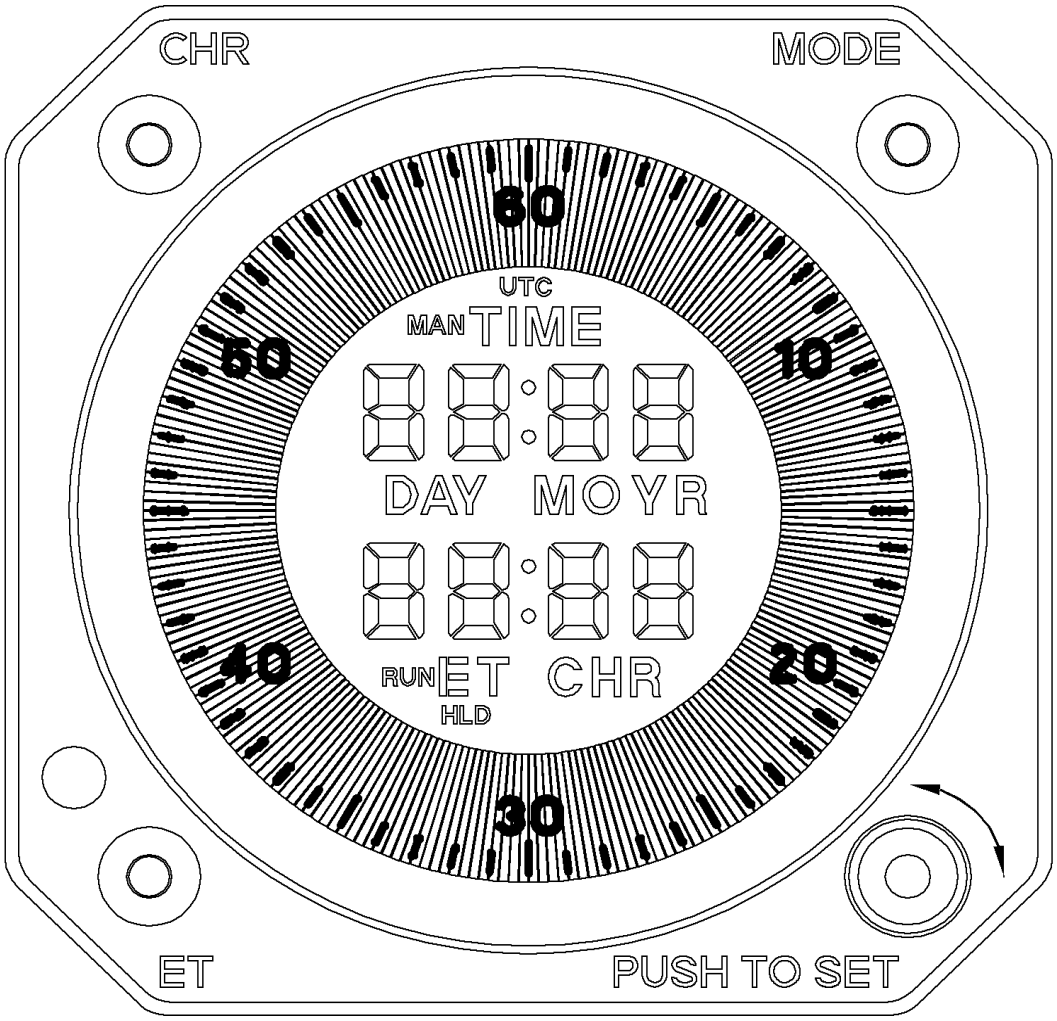


TABLE 1: Connector Electrical Configuration

PIN #	FUNCTION	NOTES
1	5VAC, 400HZ or 0-5VDC LIGHTING POWER	
2	LIGHTING GROUND	
3	+28VDC MAIN INPUT POWER	
4	+28VDC MAIN POWER GROUND	
5	BENCH TEST (FREQUENCY OUTPUT)	REFER TO SECTION 4.7
6	SPARE	
7	CASE GROUND	
8	+28VDC STANDBY POWER	
9	+28VDC STANDBY POWER GROUND	
10	DISPLAY TEST	REFER TO SECTION 4.6
11	SPARE	
12	SPARE	
13	REMOTE	REFER TO SECTION 4.3.2 FOR PROPER CONNECTION OF THE REMOTE CHRONOGRAPH SWITCH IF THE REMOTE CHRONOGRAPH SWITCH IS NOT USED, PINS 13 AND 14 MUST BE SHORTED TOGETHER.
14	CHRONOGRAPH	
15	SWITCH	
16	SPARE	
17	REMOTE CHRONOGRAPH	REFER TO SECTION 4.3.2 FOR PROPER EXTERNAL PIN CONNECTIONS
18	SWITCH PROGRAM PINS	
19	ARINC 429 LINE A INPUT	
20	ARINC 429 LINE B INPUT	
21	SPARE	
22	SPARE	
23	ARINC 429 LINE B OUTPUT	
24	ARINC 429 LINE A OUTPUT	

FIGURE 2: Clock Display and Button Arrangement



2.2.5 Timing Source:

A quartz crystal oscillator controls the time. Accuracy is maintained within one (1) second per day under stabilized temperature conditions.

2.2.6 Clock Power:

2.2.6.1 +28VDC Main Power:

The +28VDC Main Power supplies the main power for the clock. When the aircraft is operational, the +28VDC Main Power supplies the power for the clock's electronics, LED Back-Lighting, and the ARINC 429 system. As long as main power is active, the clock will be fully functional. The main power is capable of withstanding a 200mS power interruption without causing the clock to enter the initialization mode. The LED back-lighting is allowed to flicker during 200mS power interruptions.

Operation of the clock from a main or standby supply having a steady state voltage of less than 18V DC may result in degraded performance. The main reset function will activate when the main power supply falls below a steady state value of 14 +0/-2 volts.

2.2.6.2 +28VDC Standby Power:

The +28VDC Standby Power is only used when the main power is not available for more than 200mS. The +28VDC Standby Power is used to retain the clock's manual time and date data. The standby power can withstand a 200mS power interruption without loss of the manual time or date data. The clock senses the state of the main power bus. If the Main Power bus is off for longer than 200mS, the clock will enter an inactive state. The display will blank, all switch operations will cease, the LED back-lighting will turn off, and the ARINC 429 system functions will cease. No manual time or date data will be lost during this state. When main power is restored, the elapsed time and chronograph will be reset to a "0" state, the buttons will reactivate, the LED back-lighting will reactivate, and the ARINC 429 system will re-initialize.

2.2.6.3 5 VAC, 400Hz or 0-5VDC Lighting Bus:

The 5VAC400Hz or 0-5VDC lighting is variable over a 0 to 5 volt range. The clock's internal lighting circuit controls the pulse width modulation to the LED back-lighting based on the amplitude of the lighting bus and a photodiode, which detects the ambient light in the cockpit.

2.2.7 Power Specifications:

2.2.7.1 +28VDC Main Power:

NOMINAL VOLTAGE:	+28VDC
VOLTAGE RANGE:	+18VDC to +32VDC
NOMINAL CURRENT:	100mA
NOMINAL POWER:	2.8 Watts

2.2.7.2 +28VDC Standby Power:

NOMINAL VOLTAGE:	+28VDC
VOLTAGE RANGE:	+18VDC to +32VDC
NOMINAL CURRENT:	40mA
NOMINAL POWER:	1.12 Watt

2.2.7.3 5 VAC, 400Hz or 0-5VDC Lighting Power:

NOMINAL VOLTAGE:	4.5VAC, 400Hz or 0-5VDC
VOLTAGE RANGE:	0 to 5.0 Volts
NOMINAL CURRENT @4.5V:	1mA
NOMINAL POWER @4.5V:	.028 Watt

2.2.8 Lighting:

The clock is equipped with LED lighting. The LED lighting is controlled by a pulse width modulation (PWM) circuit. The amplitude of the lighting bus and a photodiode sensor mounted on the bezel controls the PWM. In night mode, the PWM circuit is programmed to simulate the dimming curve of standard incandescent lamp back-lighting. For night operation the PWM circuit provides 0.5 ± 0.25 Foot-Lambert intensity when 2.7VAC, 400Hz or DC is applied to the clock's lighting input pins. As the photo sensor detects increasing ambient cockpit light and/or the lighting bus voltage is increased, the dimming curve provides a smooth transition into the higher lighting intensity of the day mode. The day mode provides a minimum of 70 Foot-Lamberts through an active display segment. The back-lighting color is white.

2.2.9 ARINC 429 Data Bus:

The clock contains an ARINC 429 digital data bus for aircraft that are equipped with this feature. The clock is capable of both reception and transmission. The ARINC 429 signals contain both time and date information. Time information is provided in both BCD and BNR formatted words as shown in Figures 3 and 4. Date information is provided in a BCD formatted word as shown in Figure 5. The clock transmits data through connector pins 23 and 24 and receives data through connector pins 19 and 20. The clock will transmit and receive the following labels:

TRANSMIT

Message	ARINC 429 Label
COORDINATED UNIVERSAL TIME (UTC), BCD	125
COORDINATED UNIVERSAL TIME (UTC), BNR	150
DATE	260

RECEIVE

Message	ARINC 429 Label
COORDINATED UNIVERSAL TIME (UTC), BNR	150
DATE	260

2.2.9.1 Transmit Mode:

The clock provides an ARINC 429 serial digital output signal on a low speed (12.5KHz) digital data bus. The bus is capable of driving up to five (5) input loads. The signal bus transmits both time and date information. The output transmission sequence is one word BCD time (label 125), followed by one word BNR time (label 150), followed by one word BCD date (label 260). Each label is sent 5 times a second for a total transmission rate of 15 words per second. The individual transmission rate per word is 200 ± 10 mS.

2.2.9.2 Receive Mode:

The clock is capable of receiving ARINC 429 serial digital signals on a low speed (12.5KHz) data bus or a high speed (100KHz) data bus. Speed selection is automatically accomplished in the clock. The signals may contain both time or date information. Time information shall be provided to the clock in the BNR (Label 150) format. The clock is capable of receiving time data word transmissions at intervals of 200 ± 10 mS. Date information shall be provided to the clock in the BCD (Label 260) format. The clock is capable of receiving date data word transmissions at intervals of 200 ± 10 mS.

2.2.9.3 Time and Date Update:

In order to insure that the initial reception of time or date data is correct, the clock requires three (3) successive valid data receptions. A valid reception is one in which the SSM bits are normal. After three successive valid receptions, the clock will display the received UTC and date information and will use the received time or date data to update the respective internal accumulators. This allows the UTC or date to be placed in sync with an external source, such as GPS or another clock. In the event of transmission failure, the clock will continue to run from its internal time or date accumulators. Time or date data will be based on the last valid reception. The UTC and date data cannot be manually set.

NOTE: The UTC has priority over the date. The clock must receive 3 valid UTC receptions before it will look for valid date receptions.

2.2.10 Time and Date Range Specifications:

UTC:	00 to 23 hours, 00 to 59 minutes
UTC Date:	1 to 31 days, 1 to 12 months, 00 to 99 years
MAN TIME:	00 to 23 hours, 00 to 59 minutes
MAN Date:	1 to 31 days, 1 to 12 months, 00 to 99 years
ELAPSED TIME:	00 to 99 hours, 00 to 59 minutes
CHRONOGRAPH:	00 to 99 minutes, 00 to 59 seconds

NOTE: The clock is year 2000 compliant and leap years are accounted for.

2.2.11 Bench Test (Frequency Output):

The clock is capable of sending its internal timing frequency through the Bench Test (Frequency Output), connector pin 5. This output is intended for use by a service technician.

2.2.12 Display Test:

Some aircraft that use Liquid Crystal Displays in other instruments are equipped with a “Display Test” switch. When activated, this switch will cause all the LCD segments on the clock’s display to cycle at the rate of 2 seconds on and 1 second off.

FIGURE 3: ARINC 429 Label 125 (BCD UTC)

Label 125 represents the word structure for the UTC in BCD format.

BIT NO.	VALUE	DESCRIPTION
1	0	BITS 1 TO 8 CONTAIN THE LABEL
2	1	125 IN OCTAL FORMAT
3	0	
4	1	
5	0	
6	1	
7	0	
8	1	
9	0	SDI BITS (SET = 0)
10	0	SDI BITS (SET = 0)
11	1	0.X MINUTES (BCD)
12	2	0.X MINUTES (BCD)
13	4	0.X MINUTES (BCD)
14	8	0.X MINUTES (BCD)
15	1	UNITS MINUTES (BCD)
16	2	UNITS MINUTES (BCD)
17	4	UNITS MINUTES (BCD)
18	8	UNITS MINUTES (BCD)
19	1	TENS MINUTES (BCD)
20	2	TENS MINUTES (BCD)
21	4	TENS MINUTES (BCD)
22	8	TENS MINUTES (BCD)
23	1	UNITS HOURS (BCD)
24	2	UNITS HOURS (BCD)
25	4	UNITS HOURS (BCD)
26	8	UNITS HOURS (BCD)
27	1	TENS HOURS (BCD)
28	2	TENS HOURS (BCD)
29	X	UNUSED PAD BIT
30	0	SSM BITS (0 = OK, 1 = NCD)
31	0	SSM BITS (SET = 0)
32	X	PARITY (ODD)

NOTE: NCD = NO COMPUTED DATA

FIGURE 4: ARINC 429 Label 150 (BNR UTC)

Label 150 represents the word structure for the UTC in Binary format.

BIT NO.	VALUE	DESCRIPTION
1	0	BITS 1 TO 8 CONTAIN THE LABEL
2	1	150 IN OCTAL FORMAT
3	1	
4	0	
5	1	
6	0	
7	0	
8	0	
9	0	SDI BITS (SET = 0)
10	0	SDI BITS (SET = 0)
11	0	FLAG BIT (SET = 1 or 0)
12	1	BINARY SECONDS
13	2	
14	4	(0 TO 59)
15	8	
16	16	
17	32	
18	1	BINARY MINUTES
19	2	
20	4	(0 TO 59)
21	8	
22	16	
23	32	
24	1	BINARY HOURS
25	2	
26	4	(0 TO 23)
27	8	
28	16	
29	0	SSM BITS (SET = 0)
30	1	SSM BITS (SET = 1)
31	1	SSM BITS (0 = NCD, 1 = OK)
32	X	PARITY (ODD)

NOTE: NCD = NO COMPUTED DATA

FIGURE 5: ARINC 429 Label 260 (BCD DATE)

Label 260 represents the word structure for the DATE in BCD format.

BIT NO.	VALUE	DESCRIPTION
1	1	BITS 1 TO 8 CONTAIN THE LABEL
2	0	260 IN OCTAL FORMAT
3	1	
4	1	
5	0	
6	0	
7	0	
8	0	
9	0	SDI BITS (SET = 0)
10	0	SDI BITS (SET = 0)
11	1	UNIT YEAR (BCD)
12	2	UNIT YEAR (BCD)
13	4	UNIT YEAR (BCD)
14	8	UNIT YEAR (BCD)
15	1	TEN YEAR (BCD)
16	2	TEN YEAR (BCD
17	4	TEN YEAR (BCD)
18	8	TEN YEAR (BCD)
19	1	UNIT MONTH (BCD)
20	2	UNIT MONTH (BCD)
21	4	UNIT MONTH (BCD)
22	8	UNIT MONTH (BCD)
23	1	TEN MONTH (BCD)
24	1	UNIT DAY (BCD)
25	2	UNIT DAY (BCD)
26	4	UNIT DAY (BCD)
27	8	UNIT DAY (BCD)
28	1	TEN DAY (BCD)
29	2	TEN DAY (BCD)
30	0	SSM BITS (0 = OK, 1 = NCD)
31	0	SSM BITS (SET = 0)
32	X	PARITY (ODD)

NOTE: NCD = NO COMPUTED DATA

3. CLOCK INITIALIZATION

3.1 UTC Mode Initialization:

This section specifies the status of the clock's displays, accumulators (time bases), controls, and output signals upon application of +28VDC Main power, after a loss of both main and standby power. Initialization shall not occur with the application of +28VDC Standby Power only.

The initialization phase shall begin upon application of the +28VDC Main Power. When a UTC signal is available, the initialization phase shall be completed upon receipt of 3 valid ARINC 429 time words. If no UTC signal is available, the initialization phase shall be completed by the electronic clock displaying the MAN time values of 00 hours - 00 minutes with the date set to January 01, 1998.

A further condition may occur when UTC data is not available at initialization but becomes available some time after. Under this condition the clock will initialize in the MAN mode and then automatically revert to UTC mode when valid ARINC 429 data becomes available.

This automatic reversion shall NOT take place when a manual time or date setting function has started, or has been completed, before the ARINC 429 data has become available. See Figure 6 for a flow diagram detailing initialization.

3.1.1 UTC Signal Available:

When a UTC time word is received with SSM bits normal for three consecutive words, the clock will perform as follows:

1. Displays

   Time/Date display will show the current UTC time with the colon displayed.

   The Chronograph sweep second hand will be in the "60" position when not in use.

2. Accumulators

   UTC time accumulator will be loaded with the current UTC time data.

   UTC Date accumulator will be loaded with the current UTC date data.

   MAN Time accumulator will be loaded with the current UTC time data.

   MAN Date accumulator will be loaded with the current UTC date data.

   MAN seconds and UTC seconds will be synchronized and advance independently thereafter.

3. ARINC 429 Output

   The ARINC 429 output signal's SSM bits and Flag Bit will be as shown in Table 2, condition A.

4. Controls

   The Push To Set (PTS) knob is not operable in UTC time or date modes. The PTS knob is only operational in the MAN Time or Date modes.

   The ET, CHR, and MODE buttons will be active.

3.1.2 UTC Signal Not Available:

When Label 150 and 260 SSM bits indicate any condition other than normal for three consecutive words (see condition B in Table 2), or there is no signal present (condition C in Table 2), the clock will automatically go into MAN mode for initialization.

3.2 MAN Mode Initialization:

If no UTC time data is available or the reception is invalid, the clock will initialize in the MAN Time mode. The MAN Time accumulator will be preset to 00 hours, 00 minutes, 00 Seconds. The MAN Date accumulator will be preset to January 01, 1998. The MODE button is pressed to toggle between MAN Time and MAN Date mode.

The PTS knob is used to change the MAN Time or Date to a desired time or date such as local or destination time/date (see Push To Set knob, section 4.2).

1. Displays

   In MAN Time mode the time/date digits will display time as 00:00 with the colon displayed.

   If ET or CHR is active, the display will activate the ET/CHR digits and nomenclature as required. The CHR sweep second had will be at the 12:00 position if not in use.

2. Controls

   The PTS knob, ET button, CHR button, and MODE button are active.

3. ARINC 429 Output

   The ARINC 429 output signal's SSM bits and Flag Bit will be as shown in Table 2, conditions B or C.

FIGURE 6: Initialization Flow Diagram

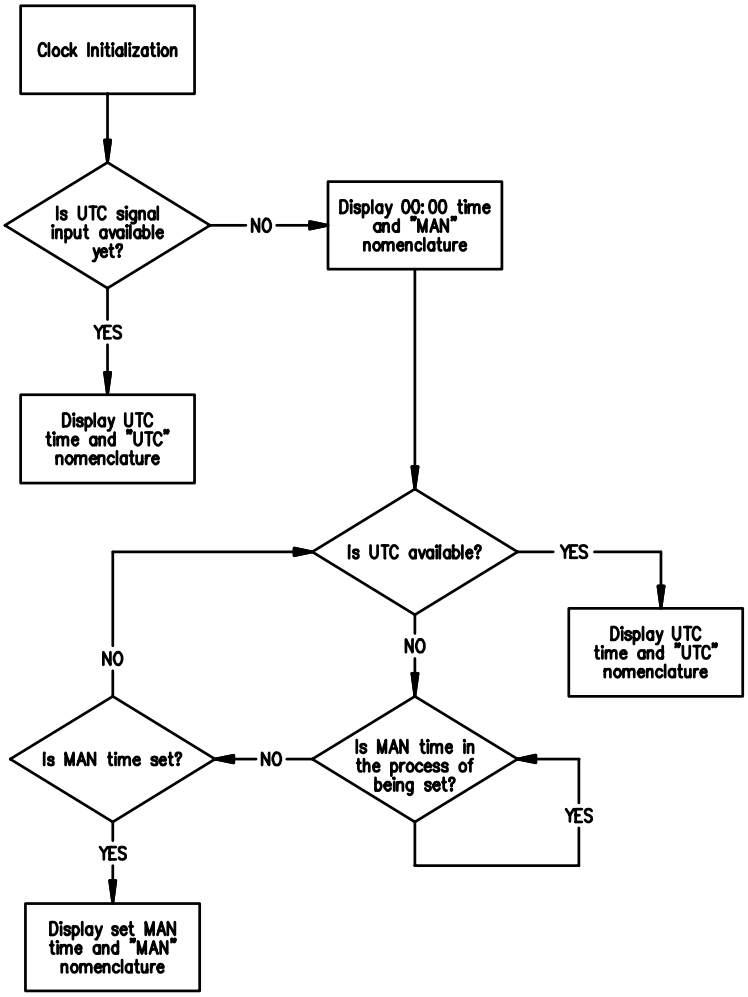


TABLE 2: ARINC 429 Input/Output Signals in Initialization

REL COND	INPUT STATUS					OUTPUT STATUS							
	LABEL 150			LABEL 260		LABEL 150			LABEL 125		LABEL 260		DISPLAY RESPONSE
	SSM	FLAG	SDI	SSM	SDI	SSM	FLAG	SDI	SSM	SDI	SSM	SDI	
A	NORM	0 OR 1	ANY	NORM	ANY	110	1	00	00	00	00	00	Display Input UTC Time and Date
B	NOT NORM	D/C	ANY	NOT NORM	ANY	010	0	00	01	00	01	00	Goes to MAN Time mode for Initialization
C	NOT PRES	D/C	ANY	NOT PRES	ANY	010	0	00	01	00	01	00	Goes to MAN Time mode for Initialization

General Notes:
SSM NCD - 010 for Label 150, 01 for Labels 125 and 260
ANY - Clock must accept any bit combination
D/C - Don’t care
Flag - Bit 11 on Label 150

TABLE 3: ARINC 429 Input/Output Signals in Normal Operation

REL COND	MODE SWITCH POSITION		INPUT STATUS					OUTPUT STATUS							
			LABEL 150			LABEL 260		LABEL 150			LABEL 125		LABEL 260		DISPLAY RESPONSE
	UTC	MAN	SSM	FLAG	SDI	SSM	SDI	SSM	FLAG	SDI	SSM	SDI	SSM	SDI	
A	X		NORM	0 OR 1	ANY	NORM	ANY	110	1	00	00	00	00	00	Display Input UTC Time and Date
	X		NOT NORM	D/C	ANY	NOT NORM	ANY	110	0	00	00	00	00	00	Displays "--:--" for Time and "--:--" for Date
	X		NOT PRES	D/C	ANY	NOT PRES	ANY	110	0	00	00	00	00	00	Displays "--:--" for Time and "--:--" for Date
B		X	NORM	0 OR 1	ANY	NORM	ANY	110	1	00	00	00	00	00	Displays Updateable MAN Time and Updateable MAN Date
		X	NOT NORM	0	ANY	NOT NORM	ANY	110	0	00	00	00	00	00	Displays Updateable MAN Time and Updateable MAN Date
		X	NOT PRES	0	ANY	NOT PRES	ANY	110	0	00	00	00	00	00	Displays Updateable MAN Time and Updateable MAN Date

General Notes:
SSM NCD - 010 for Label 150, 01 for Labels 125 and 260
ANY - Clock must accept any bit combination
D/C - Don't care
Flag - Bit 11 on Label 150

4. CLOCK OPERATION

4.1 MODE Button Operation:

The MODE button selects the operating mode being displayed in the Time/Date upper display window. Each time the mode button is pressed, the clock will advance through its various functions. The MODE button operates as follows:

4.1.1 UTC Time/Date Active:

If valid UTC data has been detected during the initialization phase, the clock will start in the UTC Time mode. The MODE button increments through the following functions:

Press 1: Clock enters UTC Date mode
Press 2: Clock enters MAN Time mode
Press 3: Clock enters MAN Date mode
Press 4: Clock returns to UTC Time mode (cycle repeats)

4.1.1.1 UTC Time Mode:

The clock starts in the UTC Time mode. UTC time appears in the upper display window. The legend “UTC” and “TIME” will activate. UTC time is displayed in standard 24 hours format as HH:MM. The colon is active.

4.1.1.2 UTC Date Mode:

On the first press of the MODE button, the clock will enter the UTC Date mode. UTC Date is displayed in DAY/Month/Year format. The day information appears in the left two digits and the month information appears in the right two digits. The legend “DAY MO” will activate. When the year information appears, the left two digits are blank, the year is displayed in the right two digits. The legend “YR” will activate. The colon is not active in this mode. The date information is displayed in the following pattern:

DAY MO	DISPLAYED AS “01 01"	1 SECOND “ON”
DISPLAY BLANK		½ SECOND “OFF”
YR	DISPLAYED AS “ 98"	1 SECOND “ON”
DISPLAY BLANK		½ SECOND “OFF”

The pattern keeps repeating until the MODE button is pressed again.

4.1.1.3 MANUAL Time Mode:

On the second press of the MODE button, the clock will enter the MAN Time mode. MAN Time will appear in the upper display window. The legend “MAN” and “TIME” will activate. MAN Time is displayed in standard 24 hours format as HH:MM. The colon is active.

4.1.1.4 MANUAL Date Mode:

On the third press of the MODE button, the clock will enter the MAN Date mode. MAN Date is displayed in DAY/Month/Year format. The day information appears in the left two digits and the month information appears in the right two digits. The legend “DAY MO” will activate. When the year information appears, the left two digits are blank, the year is displayed in the right two digits. The legend “YR” will activate. The colon is not active in this mode. The date information is displayed in the following pattern:

DAY MO	DISPLAYED AS “01 01"	1 SECOND “ON”
DISPLAY BLANK		½ SECOND “OFF”
YR	DISPLAYED AS “ 98"	1 SECOND “ON”
DISPLAY BLANK		½ SECOND “OFF”

The next press of the MODE button will return the clock to the UTC Time mode.

4.1.2 UTC Time/Date Invalid or Not Present:

If the clock does not receive valid ARINC 429 data or the system is not present in the aircraft, the clock will start in the MAN Time mode. The MODE button will increment through the following functions:

Press 1: Clock enters the MAN Date mode
Press 2: Clock returns to MAN Time mode (cycle repeats)

Operation of the MAN Time is the same as in section 4.1.1.3. Operation of the MAN Date is the same as in section 4.1.1.4.

4.2 PUSH TO SET Knob:

The PUSH TO SET (PTS) knob is used to enter MAN Time or MAN Date information into the clock. In general, the PTS knob functions as follows:

1) Select the MAN Time or MAN Date to be set (see MODE button).

2) Push and release the PTS knob until the digits to be set are displayed.

3) Rotate the PTS knob clockwise or counter-clockwise until the desired value is displayed. When setting a value, DO NOT push the knob in while rotating the knob.

4) Push the PTS knob to move to the next set function or exit the set routine.

4.2.1 MAN Time Set Operation:

Place the clock in the MAN TIME mode. To set the MAN Time perform the following steps.

1) Press the PUSH TO SET knob: Sets the MAN hours digits.

   The MAN minutes digits will turn OFF. The hour digits will remain active. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 23, the hour digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the hour digits will roll over to 23. Set the clock to the appropriate MAN hour.

2) Press the PUSH TO SET knob: Sets the MAN minutes digits.

   The MAN hour digits will turn OFF. The MAN minute digits will activate. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 59, the minute digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the minute digits will roll over to 59. Set the clock to the appropriate MAN minutes.

3) Press the PUSH TO SET knob: Exits set routine and starts MAN Time accumulation

The seconds cannot be manually set. The seconds are set to zero at initialization and start accumulating after the first manual time set. If the ARINC 429 UTC data is present at initialization, the seconds are synchronized with the UTC seconds initially and increment independently thereafter. Setting of the hours and minutes does not affect the seconds. If the seconds transition from 59 to 00 while the time is being set, the affected minutes and hours digits will be updated accordingly upon leaving the time set routine. As an example, if the seconds transition from 59 to 00 while the clock is being set from 10:29 to 10:59, the time displayed when the set routine is completed will be 11:00.

The MAN Time accumulator continues to run during the time set operation. If, during the setting of time, the hours or minutes have not been set after 59 +0/-0.5 seconds, the clock will go out of set mode and the current time displayed in the MAN Time accumulators will be displayed.

4.2.2 MAN Date Set Operation:

Place the clock in the MAN Date mode. To manually set the date, perform the following steps.

1) Press the PUSH TO SET knob: Sets the MAN Day digits.

   The date cycle will stop. The legend “DAY” will activate. The day digits will appear in the left two digits in the display window. The right two digits will be blank. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 31, the day digits will roll over to 1. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 1, the day digits will roll over to 31. Set the MAN Day digits to the current day.

2) Press the PUSH TO SET knob: Sets the MAN Month digits.

   The day digits will turn off. The “DAY” legend will turn off. The “MO” legend will activate. The month digits will activate in the right two digit locations. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 12, the month digits will roll over to 1. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 1, the month digits will roll over to 12. Set the MAN Month digits to the current month.

3) Press the PUSH TO SET knob: Sets the MAN Year digits.

   The month digits will turn off. The “MO” legend will turn off. The legend “YR” will activate. The year digits will activate in the same location as the month digits. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 99, the year digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the year digits will roll over to 99. Set the MAN Year digits to the last two digits of the current year.

4) Press the PUSH TO SET knob:

   The clock will return to the DATE cycle mode. MAN Date accumulation will begin.

If the month or year value entered is invalid for the set day value, the clock will return to the day set mode for correction. The clock accounts for leap years when determining if the selected day, month, and year values are compatible with each other. The clock can determine valid date settings for the years 1998 through 2097.

The MAN Date accumulator continues to increment while the date is being set. If, during the setting of the date, the Day, Month, or Year has not been set for 59 +0/-0.5 seconds, the clock will exit the set routine and the current date stored in the date accumulator will be displayed.

4.3 CHRONOGRAPH (CHR) Button:

The Chronograph function operates independently of the time/date mode selected. Chronograph time is computed in minutes and seconds. The Chronograph display range is from 0 minutes - 0 seconds to 99 minutes - 59 seconds.

When the CHR button is pressed the legend “CHR will activate under the ET/CHR display window. The minutes will be digitally displayed with right justification in the ET/CHR display window. The colon is not active in this mode. The sweep second pointer displays the seconds.

The Chronograph is controlled by either the CHR button located on the bezel or by a remote switch. The switches have equal priority. The Chronograph operates as follows:

1) Press the CHR button (or remote CHR switch):

   The chronograph will activate in the ET/CHR display window. The colon will be off and the legend “CHR” will appear below the lower display window. The display window will have a 0 in the right most digit location. The sweep Second Pointer will start to move in a clockwise direction. After one complete rotation, a “1" will appear in the lower display window. Chronograph time is accumulating.

2) Press the CHR button (or remote CHR switch):

   The sweep Second Pointer will stop moving. Chronograph time will stop accumulating.

3) Press the CHR button (or remote CHR switch):

   The “CHR” legend will turn off and the sweep Second Pointer will return to the “60" legend. The sweep second pointer will always remain at the “60” position until started again. The ET/CHR display window will blank.

4.3.1 Chronograph Priority:

The Chronograph (CHR) has priority over the Elapsed Time (ET). If the CHR function is activated while the ET function is active, the CHR function will take control of the ET/CHR display window. The “ET” legend will deactivate. However, the “RUN” or “HLD” Elapsed Time legends will continue to be displayed. Upon reset of the Chronograph function the Elapsed Time will return to the ET/CHR display window and the “ET” legend will activate. No Elapsed Time will be lost during the Chronograph operation.

4.3.2 Remote Chronograph Switch:

The clock is equipped with provisions for a remote Chronograph switch. The clock can operate with either a momentary type switch or an alternate action type switch. The clock's connector configuration is dependent on which type of switch is selected. The following describes the various connector configurations. Connector configurations are shown in Figure 7.

4.3.2.1 Connector Configuration when No External CHR Switch is used:

When no external CHR switch is used, connector pins 13 and 14 must be jumped together. This jumper must be in place before power is applied to the clock. See figure 7.

4.3.2.2 Connector Configuration for a Momentary Action Switch:

When a Momentary Action switch is used, connector pin 13 is connected to the normally closed switch contact. Pin 14 is connected to the common switch pin. Pin 15 is connected to the normally open switch pin. See figure 7.

4.3.2.3 Connector Configuration for an Alternate Action Switch:

When an alternate action switch is used, two different sets of connections must be made. The clock must be externally programmed to accept an alternate action switch. This is accomplished by placing a jumper from pin 17 to pin 18. This jumper must be in place before power is applied to the clock. Connect the switch by attaching connector pin 14 to the switch's common connection. Connector pins 13 and 15 are attached to the switch's alternate action connections. See figure 7.

4.4 Elapsed Time (ET) Button:

The Elapsed Time function operates independently of the time/date mode selected. Elapsed Time is computed in hours and minutes. Seconds are accumulated internally and used to update the display accordingly. The colon is active in this mode. The Elapsed Time display range is from 00 hours - 00 minutes to 99 hours - 59 minutes.

The “ET” button is used to start, stop, and reset the elapsed time. The “ET” button functions as an alternate action switch. If the elapsed time is not running, than the first press of the button will start the elapsed time. If the elapsed time is running, than the first press of the button will stop the elapsed time. To reset the elapsed time, press and hold the “ET” button for approximately 1 second. The elapsed time can be started, stopped, or reset anytime the clock is in the elapsed time mode. The Elapsed Time button operates as follows:

1) Press ET button:

   The “ET” and “RUN” legends will activate. The ET/CHR display window will display 00:00. The Elapsed Time will start to accumulate. After one minute has passed, a “1” will appear in the right most digit.

2) Press the ET button:

   The elapsed time will stop accumulating. The “RUN” legend will turn off and the “HLD” legend will turn on.

3) Press the ET button:

   The elapsed time will start accumulating time from the point at which it was stopped. The “HLD” legend will turn off and the “RUN” legend will activate.

4) To Reset the Elapsed Time:

   The elapsed time can be reset in either the run or hold modes. To reset the elapsed time, press and hold the ET button for approximately one (1) second. The elapsed time display will show 00:00 briefly and then go blank. The colon will be off. The legends “ET” and “RUN” or “HLD” will go off.

4.5 ARINC 429 Operation:

The clock contains an ARINC 429 digital data bus for aircraft that are equipped with this feature. The clock is capable of both reception and transmission. The ARINC 429 signals contain both time and date information. Time information is provided in both BCD and BNR formatted words as shown in Figures 3 and 4. Date information is provided in a BCD formatted word as shown in Figure 5.

4.5.1 ARINC 429 Output Bus:

The clock provides an ARINC 429 serial digital output signal on a low speed (12.5KHz) digital data bus. The bus is capable of driving up to five (5) input loads. The signal bus transmits both time and date information. The output transmission sequence is one word BCD time (label 125), followed by one word BNR time (label 150), followed by one word BCD date (label 260). Each label is sent 5 times a second for a total transmission rate of 15 words per second. The individual transmission rate per word is 200 ± 10 mS. The clock transmits data through connector pins 23 and 24. The clock will transmit the following labels:

TRANSMIT

Message	ARINC 429 Label
COORDINATED UNIVERSAL TIME (UTC), BCD	125
COORDINATED UNIVERSAL TIME (UTC), BNR	150
DATE	260

4.5.2 ARINC 429 Receive Bus:

The clock is capable of receiving ARINC 429 serial digital signals on a low speed (12.5KHz) data bus or a high speed (100KHz) data bus. Speed selection is automatically accomplished in the clock. The signals may contain both time or date information. Time information shall be provided to the clock in the BNR (Label 150) format. The clock is capable of receiving time data word transmissions at intervals of 200 ± 10 mS. Date information shall be provided to the clock in the BCD (Label 260) format. The clock is capable of receiving date data word transmissions at intervals of 200 ± 10 mS. The clock receives data through connector pins 19 and 20. The clock will receive the following labels:

RECEIVE

Message	ARINC 429 Label
COORDINATED UNIVERSAL TIME (UTC), BNR	150
DATE	260

The ARINC 429 input bus is continuously monitored for ARINC 429 UTC Time and Date data reception.

If the ARINC 429 BNR time word, Label 150, SSM bits should indicate a condition other than normal for 3 consecutive words or the input signal is not present during any 3.0 second time period, the UTC time digits will display dashes with the colon active. The clock's ARINC 429 time output will continue to be updated normally (SSM bits normal) using the internally accumulated UTC time data. UTC Label 150 will have its flag bit set to "0" to indicate that the signal source is not UTC generated. Refer to Table 3, condition A for input "NOT NORMAL" or "NOT PRESENT". The ARINC 429 data input bus will continue to be monitored. The UTC time accumulator will not be update and displayed from the ARINC 429 input bus until three consecutive BNR time words (Label 150) having the SSM bits normal are again received. The status of the BCD date word, Label 260, will have no affect on the BNR time word or the UTC time accumulator.

If the ARINC 429 BCD date word, Label 260, SSM bits should indicate a condition other than normal for 3 consecutive words or the input signal is not present during any 3.0 second time period, the UTC date DAY/MO and YR digits will display dashes with no colon. The clock's ARINC 429 date output will continue to be updated normally (SSM bits normal) using the internally accumulated UTC date data. Refer to Table 3, condition A for input "NOT NORMAL" or "NOT PRESENT". The ARINC 429 data input bus will continue to be monitored. The UTC date accumulator will not be update and displayed from the ARINC 429 input bus until three consecutive BCD date words (Label 260) having the SSM bits normal are again received. The status of the BNR time word, Label 150, will have no affect on the BCD date word or the UTC date accumulator.

4.6 Display Test:

All the segments on the Liquid Crystal Display can be activated by this input. In order to activate this feature, it is necessary to apply DC Ground to connector pin 10. It is suggested that a single throw, single pole switch be used as a test switch. The display test operates as follows:

Apply a ground potential to connector pin 10:.

The clock enters the display test mode. All display segments will energize for approximately 2 seconds. Then the segments will blank for approximately 1 second. The pattern will repeat until the ground potential is removed from pin 10. No time will be lost in any function that is running when the clock is in the segment test mode.

Remove the ground potential from connector pin 10:

The clock returns to the previous mode of operation.

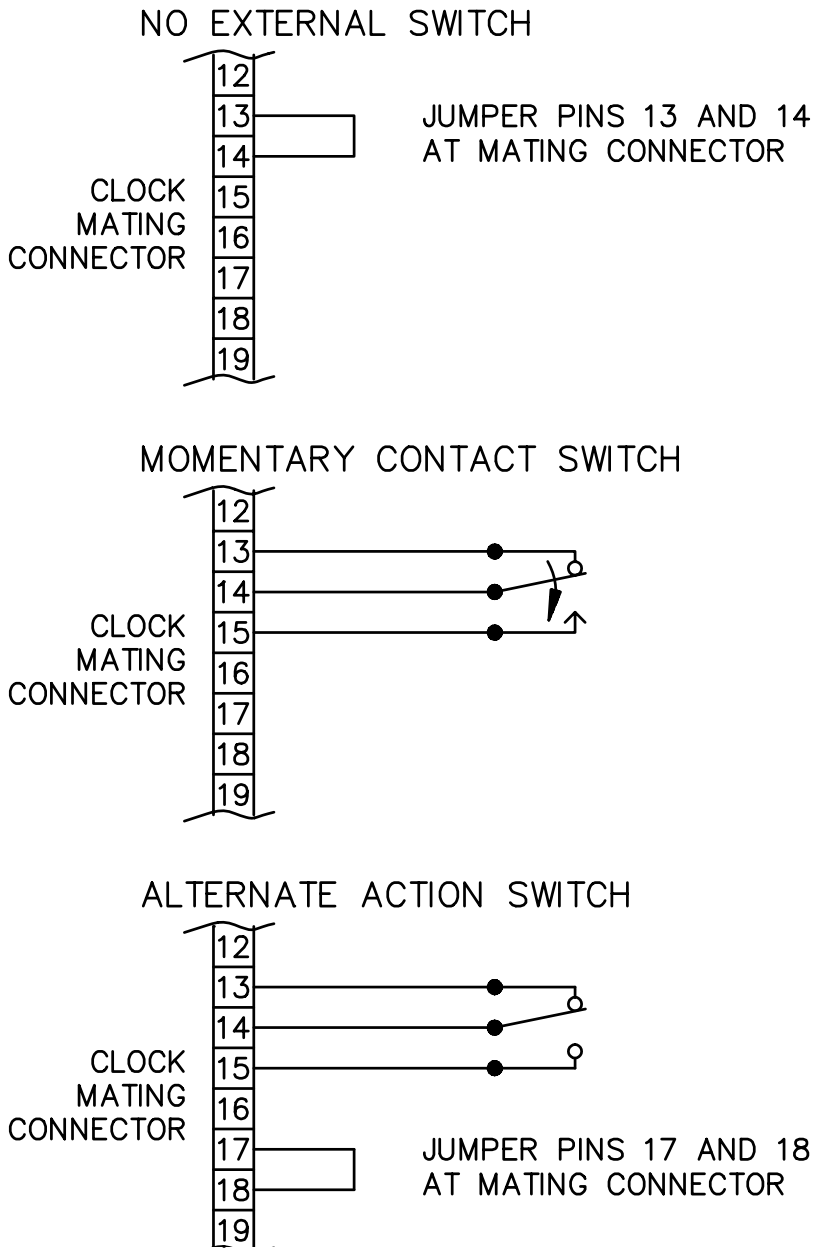
4.7 Bench Test (Frequency Output):

The clock is capable of sending its internal timing pulses through the Bench Test (Frequency Output), connector pin 5. Attach a frequency counter to connector pin 5. Connect the frequency counter's ground lead to the Standby DC ground (connector pin 9). Set the counter to measure frequency. On the counter, observe that the frequency is 32.768KHz ± 10Hz. This output is intended for use by a service technician.

4.8 LED Back-lighting:

The intensity of the clock's LED back-lighting is controlled by a combination of the amplitude of the aircraft's 5VAC, 400Hz, or the variable 0- 5VDC lighting bus and the amount of ambient cockpit light detected by the photo sensor mounted on the clock's bezel. In night conditions, the intensity is primarily controlled by the amplitude of the aircraft's lighting bus. In this mode, the back-lighting is programmed to follow the standard dimming curve of an incandescent lamp. As the ambient lighting intensity of the cockpit begins to rise, the back-lighting is controlled by the combination of the photo sensor and the lighting bus amplitude. In high ambient sunlight conditions, the clock can adjust its back-lighting to provide 70 foot-lamberts of lighting intensity through an active segment. The clock has a 1 to 3 second delay in responding to changes in ambient lighting. This prevents any erratic changes in the back-lighting due to shadows or shafting sunlight that may momentarily fall on the photo sensor.

FIGURE 7: External Chronograph Switch Configurations



5. TEST PROCEDURES

5.1 General Requirements:

Unless otherwise specified, tests are to be conducted under the following conditions:

Temperature:	Room Ambient +21°C ± 10°C
Relative Humidity:	90% or less
Barometric Pressure:	28 to 32 inches of Mercury

Before applying power to the clock, insure that the mating connector is properly wired for the selected features, such as the remote Chronograph switch, a display test switch, the ARINC 429 system, etc. Attach the connector to clock. Do not apply the +28VDC Main power and/or the +28VDC Standby power until instructed to do so. Application sequence of the power is not critical.

5.2 Power On Initialization:

5.2.1 Initialization With ARINC 429 System Non-Operational:

Before applying power to the clock, insure that the clock is connected to a suitable ARINC 429 test set and that the send section of the ARINC 429 test set is turned off. Apply +28VDC Main power to the clock. After the internal initialization is complete, the clock face displays the following:

Visually observe that the clock's display appearance is as follows:

a) The legend "MAN" and "TIME" will be active and 00:00 time will be displayed in the upper display window. Time will not accumulate.

b) No legends will be displayed above or below the lower display window. The lower display window will be blank.

c) The legends 10, 20, 30, 40, 50, and 60 and the tick marks will be active.

d) The sweep Second Pointer will be active and positioned at the "60" legend location.

5.2.1.1 MODE Button Operation:

Perform the following operations and visually observe the results:

1) Press the MODE button:

The MAN TIME function will turn off and the clock will enter the MAN Date function. The “MAN” and “TIME” legends will turn off. The colon will be off. The window will display the date as 01 01 - blank - 98 - blank. The “DAY” “MO” legends and the “YR” legend will alternately activate with their respective data. The sweep Second Pointer will be positioned at the “60" legend.

2) Press the MODE button:

The MAN Date function will turn off and the clock will return to the MAN TIME function.

5.2.1.2 Chronograph Operation:

Perform the operations in section 4.3 and visually observe that the Chronograph operates as described in section 4.3.

5.2.1.3 Elapsed Time Operation:

Perform the operations in section 4.4 and visually observe that the Elapsed Time operates as described in Section 4.4.

5.2.1.4 ARINC 429 Operation:

In actual operation the clock cannot discern the difference between the ARINC 429 system being off or if the system is in a failure mode sending invalid data. In either case, the clock responds the same to both conditions. Observe the following.

1) ARINC 429 Output Test:

Since initialization is not considered to be complete until MAN Time and Date are entered into the clock, the SSM bits in the ARINC 429 words are set to indicate “No Computed Data”. This tells the other devices listening on the ARINC 429 system that the clock is in initialization and the time and date information has not yet been entered into the clock. The clock will transmit 00:00:00 time and 01 01 98 date information.

On the ARINC 429 tester, visually observe the data being sent from the clock. The SSM bits for each label will be set as follows:

Label 125, BCD Time: SSM bit 30 = 1, bit 31 = 0

Label 150, BNR Time: SSM bit 29 = 0, bit 30 = 1, bit 31 = 0

Label 260, BCD Date: SSM bit 30 = 1, bit 31 = 0

See Table 2, Relative Conditions B or C, Labels 150 and 260 “NOT VALID” or “NOT PRESENT”.

2) ARINC 429 Input Test:

On the ARINC 429 tester, set the SSM bits in Label 150 to “010” and the SSM bits in Label 260 to “10” to represent a “NO COMPUTED DATA” condition.

SEND LABEL 260 and LABEL 150 to the clock.

Visually observe the following:

The information displayed on the clock’s face shall not change.

The clock’s ARINC 429 output data still indicates a “NO COMPUTED DATA” condition for Labels 150 and 260. See Table 2, Relative Conditions B or C, Labels 150 and 260 “NOT VALID” or “NOT PRESENT”.

3) Valid ARINC 429 Output Data Test:

Manually enter a valid MAN Time and Date into the clock by following the procedures listed in sections 4.2.1 and 4.2.2. On the ARINC 429 tester, visually observe the following:

The time and date being sent from the clock is the same as the MAN Time and Date being displayed on the clock's face.

On the ARINC 429 tester, the SSM bits are now indicating a valid data condition for Labels 150 and 260. The flag bit in Label 260 is set to "0". The tester's time and date should match the clock's time and date. Refer to Table 3, condition B, for ARINC 429 input data "NOT NORMAL" and/or "NOT PRESET" conditions.

THIS CONCLUDES THE TESTS FOR SECTION 5.2.1. TURN OFF ALL +28VDC POWER TO THE CLOCK. TURN OFF THE ARINC 429 DATA SEND TO THE CLOCK. WAIT AT LEAST 5 MINUTES BEFORE PROCEEDING TO THE NEXT SET OF TESTS.

5.2.2 Initialization with the ARINC 429 System Operational:

Set the ARINC 429 tester to send valid UTC time and date data to the clock. Activate the send system. Apply +28VDC Main power to the clock.

Visually observe that the clock's display appearance is as follows:

a) The legend "UTC" and "TIME" will be active and UTC time will be displayed in the upper display window. The clock displays the same time as the time being sent from the ARINC 429 tester.

b) No legends will be displayed above or below the lower display window. The lower display window will be blank.

c) The legends 10, 20, 30, 40, 50, and 60 and the tick marks will be active.

d) The sweep Second Pointer will be active and positioned at the "60" legend location.

NOTE: The legend "MAN" and "00:00" time may appear briefly in the time/date window until the clock detects 3 valid ARINC 429 UTC time receptions. This is normal clock operation.

5.2.2.1 MODE Button Operation:

Perform the following operations and visually observe the results:

1) Press the MODE button:

   The UTC TIME function will turn off and the clock will enter the UTC Date function. The “MAN” legend will turn off. The colon will be off. The window will display the UTC date data. The “DAY” “MO” legends and the “YR” legend will alternately activate with their respective data. Visually observe that the UTC date data is the same as the ARINC 429 tester’s date data. The sweep Second Pointer will be positioned at the “60" legend.

2) Press the MODE button:

   The UTC Date function will turn off and the clock enter the MAN TIME function. Visually observe that the MAN TIME is now set to the UTC TIME.

3) Press the MODE button:

   The MAN TIME function will turn off and the clock will enter the MAN Date function. Visually observe that the MAN Date is now set to the UTC Date.

4) Press the MODE button:

   The clock will return to the UTC TIME mode.

5.2.2.2 Chronograph Operation:

Perform the same operations and visually observe the same results as in section 5.2.1.2.

5.2.2.3 Elapsed Time Operation:

Perform the same operations and visually observe the same results as in section 5.2.1.3.

5.2.2.4 ARINC 429 Operation:

The clock's UTC time and date data is in sync with the data coming from the ARINC 429 system. At this point, the MAN Time and Date data is set to the UTC Time and Date data. Perform the following operations and observe the results:

1) ARINC 429 Output Test:

On the ARINC 429 tester, visually observe that the SSM bits in the ARINC 429 words being sent from the clock are set to indicate "Computed Data". This tells the other devices listening on the ARINC 429 system that the clock's UTC time and date information is valid. The SSM bits for each label will be set as follows:

Label 125, BCD Time: SSM bit 30 = 0, bit 31 = 0

Label 150, BNR Time: SSM bit 29 = 0, bit 30 = 1, bit 31 = 1, Flag Bit = 1

Label 260, BCD Date: SSM bit 30 = 0, bit 31 = 0

Refer to Table 2, Relative condition "A" with label 150 and 260 "NORMAL".

On the tester, visually observe that the transmission rate for each label shall be 200 $\pm$ 10 mS.

2) ARINC 429 UTC Time Test:

With the clock displaying UTC time data, Set the SSM bits for Label 150 to "010" (NO COMPUTED DATA) on the ARINC 429 tester.

Visually observe the following on the clock's display:

The clock's UTC time display will display "--:--" in the time window.

Visually observe the following on the ARINC 429 tester:

The clock's ARINC 429 output will continue to be updated normally (SSM bits normal) using the internally accumulated UTC time. The flag bit in Label 150 will be set to a "0" to indicate that the signal source is not being generated by the incoming ARINC 429 UTC time data. Refer to Table 3, condition A.

Reset the UTC time data SSM bits to "011" on the ARINC 429 tester.

Visually observe that the clock's UTC TIME operation returns to normal and that the clock's time matches the time being sent from the tester.

Visually observe on the tester that the flag bit in Label 150 has returned to a “1”.

Turn OFF the tester’s UTC time data send to the clock. Wait at least 3 seconds.

Visually observe that the clock’s UTC time display shows “--:--“ in the time window.

Visually observe that the time being received on the tester is correct and that the flag bit in Label 150 is set to “0”.

Turn ON the tester’s UTC time data send to the clock.

Visually observe that the clock’s UTC TIME operation returns to normal and that the clock’s time matches the time being sent from the tester.

Visually observe on the tester that the flag bit in Label 150 has returned to a “1”.

3) ARINC 429 UTC Date Test:

Using the MODE button, set the clock in the UTC Date mode. With the clock displaying UTC date data, Set the SSM bits for Label 260 to “01” (NO COMPUTED DATA) on the ARINC 429 tester.

Visually observe the following on the clock’s display:

The clock’s UTC date display will display “-- --“ for the DAY/MO and “ --“ for the YR in the date window.

Visually observe the following on the ARINC 429 tester:

The clock’s ARINC 429 output will continue to be updated normally (SSM bits normal) using the internally accumulated UTC date. Refer to Table 3, condition A.

Reset the UTC Date data SSM bits to “00” on the ARINC 429 tester.

Visually observe that the clock’s UTC Date operation returns to normal and that the clock’s date matches the date being sent from the tester.

Turn OFF the tester’s UTC date data send to the clock. Wait at least 3 seconds.

The clock’s UTC date display will display “-- --“ for the DAY/MO and “ --“ for the YR in the date window.

Visually observe that the date being received on the tester is correct.

Turn ON the tester’s UTC date data send to the clock.

Visually observe that the clock's UTC date operation returns to normal and that the clock's date matches the date being sent from the tester.

5.3 Manual (MAN) Time and Date Set Procedure:

Regardless of the clock's initialization mode, the manual (MAN) time and date can always be manually set. This allows the crew to set the MAN TIME to local time or destination time.

5.3.1 MAN TIME Set:

In order to set the MAN TIME, the clock must be in the MAN TIME mode. Press and release the MODE button until the clock enters the MAN TIME mode. Perform the following operations and visually observe the results.

1) Press the PUSH TO SET knob:

   The MAN minutes digits will turn OFF. The hour digits will remain active. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 23, the hour digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the hour digits will roll over to 23. Set the clock to the appropriate MAN hour.

2) Press the PUSH TO SET knob:

   The MAN hour digits will turn OFF. The MAN minute digits will activate. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 59, the minute digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the minute digits will roll over to 59. The internal seconds accumulator is automatically set to "0" when the clock enters the minutes set function. Set the clock to the appropriate MAN minutes.

3) Press the PUSH TO SET knob:

   The clock will exit the MAN TIME set mode. MAN TIME accumulation will begin.

5.3.2 Time Out Test for MAN TIME:

If no activity is sensed from the PTS knob while in the MAN TIME set mode within 59 +0/-0.5 seconds, the clock will exit the time set operation and the last valid set time will appear on the clock display.

1) Press the PUSH TO SET knob:

   The clock will enter the MAN TIME set mode. Wait 1 full minute. Visually observe that the clock has exited the MAN TIME set mode and that the original time has returned to the MAN TIME display window.

5.3.3 MAN Date Set:

In order to set the MAN date, the clock must be in the MAN date mode. Press and release the MODE button until the clock enters the MAN date mode. The clock will enter the date cycling mode. Perform the following operations and visually observe the results.

1) Press the PUSH TO SET knob:

   The date cycle will stop. The legend “DAY” will activate. The day digits will appear in the left two digits in the lower display window. The right two digits will be blank. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 31, the day digits will roll over to 1. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 1, the day digits will roll over to 31. Set the day digits to the current day.

2) Press the PUSH TO SET knob:

   The day digits will turn off. The “DAY” legend will turn off. The “MO” legend will activate. The month digits will activate in the right two digit locations. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 12, the month digits will roll over to 1. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 1, the month digits will roll over to 12. Set the month digits to the current month.

3) Press the PUSH TO SET knob:

The month digits will turn off. The “MO” legend will turn off. The legend “YR” will activate. The year digits will activate in the same location as the month digits. Rotate the PTS knob clockwise. The numbers will increase in value. When the value reaches 99, the year digits will roll over to 00. Rotate the PTS knob counterclockwise. The numbers will decrease in value. When the value reaches 00, the year digits will roll over to 99. Set the year digits to the last two digits of the current year.

4) Press the PUSH TO SET knob:

The clock will return to the DATE cycle mode.

5.3.4 Time Out Test for MAN Date:

If no activity is sensed from the PTS knob while in the MAN Date set mode within 59 +0/-0.5 seconds, the clock will exit the date set operation and the last valid set date will appear on the clock display.

1) Press the PUSH TO SET knob:

The clock will enter the MAN date set mode. Wait 1 full minute. Visually observe that the clock has exited the MAN date set mode and that the original date has returned to the MAN date display window.

5.4 Chronograph Test:

To test the Chronograph mode, perform the following operations:

1) Press the CHR button:

The chronograph will activate in the ET/CHR display window. The colon will be off and the legend “CHR” will appear below the lower display window. The display window will have a 0 in the right most digit location. The sweep Second Pointer will start to move in a clockwise direction. After one complete rotation, a “1" will appear in the lower display window. Chronograph time is accumulating.

2) Press the CHR button:

The sweep Second Pointer will stop moving. Chronograph time will stop accumulating.

3) Press the CHR button:

The “CHR” legend will turn off and the sweep Second Pointer will return to the “60" legend. The sweep second pointer will always remain at the “60” position until started again. The ET/CHR display window will blank.

5.4.1 External Chronograph Switch Operation:

The external CHR switch will operate in the same sequence as outlined in section 5.4. The Chronograph can be operated from both the external CHR switch and the clock’s “CHR” button. One switch does not lock out the other switch.

5.4.1.1 Momentary Type External CHR Switch test

Attach a momentary type external CHR switch as described in section 4.3.2.2 and Figure 7. Perform the following operations and visually observe the results.

1) Press the External CHR Switch:

The chronograph will activate in the ET/CHR display window. The colon will be off and the legend “CHR” will appear below the lower display window. The display window will have a 0 in the right most digit location. The sweep Second Pointer will start to move in a clockwise direction. After one complete rotation, a “1" will appear in the lower display window. Chronograph time is accumulating.

2) Press the External CHR Switch:

The sweep Second Pointer will stop moving. Chronograph time will stop accumulating.

3) Press the External CHR button:

The “CHR” legend will turn off and the sweep Second Pointer will return to the “60" legend. The sweep second pointer will always remain at the “60” position until started again. The ET/CHR display window will blank.

5.4.1.2 Alternate Action Type External CHR Switch Test

Attach an alternate action type external chronograph switch and the pin jumper as described in section 4.3.2.3 and Figure 7. Perform the following operations and visually observe the results.

1) Press the External CHR Switch:

The chronograph will activate in the ET/CHR display window. The colon will be off and the legend “CHR” will appear below the lower display window. The display window will have a 0 in the right most digit location. The sweep Second Pointer will start to move in a clockwise direction. After one complete rotation, a “1" will appear in the lower display window. Chronograph time is accumulating.

2) Press the External CHR Switch:

The sweep Second Pointer will stop moving. Chronograph time will stop accumulating.

3) Press the External CHR Switch:

The “CHR” legend will turn off and the sweep Second Pointer will return to the “60" legend. The sweep second pointer will always remain at the “60” position until started again. The ET/CHR display window will blank.

5.4.2 Chronograph Priority Test:

The Chronograph has priority over the other Elapsed Time in the lower display window. If Elapsed Time is active when the Chronograph is activated by the clock’s “CHR” switch or the external CHR switch, the Elapsed Time will be replaced by the Chronograph in the lower display window. When the Chronograph is reset the Elapsed Time will reappear in the display window. No time accumulation will be lost while the Chronograph is activated. Perform the following operations and visually observe the results.

1) Press the external CHR button:

Visually observe the “CHR” legend activates and the “ET” legend goes off. The sweep Second Pointer will start to move from the “60" mark.

2) Press the external CHR button:

Visually observe that the sweep Second Pointer has stopped moving.

3) Press the external CHR button:

Visually observe that the Elapsed Time returns to the lower display window. The legend “CHR” will turn OFF and the legend “ET” will turn ON. The Chronograph will be reset to a “0" state.

5.5 Elapsed Time Operation:

Perform the following operations and visually observe the results.

1) Press the ET button:

The legends “ET” and “RUN” will activate. The clock displays “00:00” in the lower display window with the colon active. The elapsed time seconds will start to accumulate internally. After one complete minute has passed, a “1" will appear in the lower display window. Allow one or two minutes to accumulate.

3) Press the ET button:

The elapsed time will stop accumulating. The legend “RUN” will turn off and the legend “HLD” will activate. Allow one or two minutes to pass.

4) Press the ET button:

The elapsed time will start accumulating time from the point at which it was stopped. The legend “HLD” will turn off and the legend “RUN” will activate.

5) To Reset the Elapsed Time:

The elapsed time can be reset in either the run or stop modes. To reset the elapsed time, press and hold the ET button for approximately one (1) second. The display will briefly display “00:00” and then go blank. The legends “ET” and “RUN” or “HLD” will turn off.

5.6 Display Test

Connect a single pole - single throw test switch between the clock’s hot battery DC ground (connector pin 9) and the display test input (connector pin 10). Ensure that the switch is in the open position.

1) Apply the Hot Battery DC ground to pin 10 by closing the test switch:

Visually observe that the clock enters the display test mode. All display segments will energize for approximately 2 seconds. Then the segments will blank for approximately 1 second. The pattern will repeat until the ground potential is removed from pin 10. No time will be lost in any function that is running when the clock is in the segment test mode.

2) Open the test switch:

Visually observe that the clock has returned to the previous mode of operation.

5.7 Bench Test (Frequency Output):

The clock is capable of sending its internal timing frequency through the Bench Test (Frequency Output), connector pin 5. Attach a frequency counter to connector pin 5. Connect the frequency counter's ground lead to the +28VDC Standby DC ground (connector pin 9). Set the counter to measure frequency. On the counter, observe that the output frequency is 32,768 ± 10Hz. This output is intended for use by a service technician.

5.8 Lighting Operation:

The clock is equipped with LED back-lighting that is capable of providing a standard incandescent lighting dimming curve and day lighting mode. The lighting intensity is controlled from the aircraft's 5VAC, 400Hz lighting bus and the photo sensor mounted on the bezel. In a night condition, the photo sensor detects the dark environment and the amplitude of the lighting bus controls the PWM of the LED back-lighting. The PWM circuit is programmed to follow a standard incandescent lighting curve through the 0 to 4.5 volt range. As the cockpit ambient lighting continues to rise, the photo sensor and the lighting bus amplitude combine to control the intensity of the LED back-lighting. As the ambient light continues to increase the LED back-lighting continues to increase until the day mode brightness level is reached. The day mode provides high intensity back-lighting for operating under direct sunlight conditions. The lighting bus power is applied to connector pins 1 and 2. It will be necessary to measure the lighting voltage as close to the connector pins as possible because of the losses occurring in the connection wires.

Perform the following operations and visually observe the results.

Place the clock in a room that can be sealed from outside light. Turn the room lights OFF.

1) Apply 0.0 volt to the lighting pins:

   Visually observe that the back-lighting is at a very low intensity.

2) Slowly increase the lighting voltage:

   Visually observe that the back-lighting increases in brightness.

3) Slowly increase the lighting voltage to approximately 4.5 volts.

   Visually observe that the back-lighting continues to increases in intensity as the lighting voltage is increased.

Lower the lighting bus voltage to 0.0 volts. Turn the room lights ON.

4) Visually observe that the back-lighting is ON.

5) While slowly raising the lighting bus voltage, visually observe that the back-lighting increases in intensity.

Turn the lighting bus voltage OFF. Shine a high intensity flash light onto the bezel photo sensor.

6) Visually observe that the back-lighting increases significantly in intensity.

7) Turn the flash light OFF and visually observe that the back-lighting returns to its normal intensity.

NOTE: It may take 1 to 3 seconds for the back-lighting to respond to a change in ambient light intensity. This is normal operation for the clock.

5.9 Time Accuracy Test:

Set the clock's time to a known time standard. Allow 24 hours to pass. Compare the clock's time against the known time standard. The clock's time shall be no more than one (1) second from the known time standard. This test is conducted with the clock temperature stabilized at +25°C ± 3°C.

5.10 MAN Time and Date Memory Retention Test:

Apply +28VDC Standby power to the clock. Make note of the MAN Time and Date. Turn OFF the +28VDC Main power to the clock.

Observe the following:

The display face will be blank.

All bezel buttons and all external switch functions will not be operational.

The ARINC 429 System will not be operational.

The LED back-lighting will be off.

WAIT A MINIMUM OF TWO MINUTES.

Apply +28VDC Main power to the clock.

Observe the following.

The MAN Time and Date is restored with no time or date loss.

Any uncompleted set functions (time or date) have been discarded.

The Elapsed Time and the Chronograph have been reset to a “0” state.

The ARINC 429 system will reactivate and re-initialize.

All bezel button functions and external switches will reactivate.

The LED back-lighting will activate.

5.11 Low Voltage Detection Test:

With the clock fully operative, slowly lower the +28VDC Main power’s steady state voltage.

When the steady state voltage of the +28VDC Main power falls below between 14 and 12 volts, the clock will enter a reset state.

Observe the following:

The display face will be blank.

All bezel buttons and all external switch functions will not be operational.

The ARINC 429 System will not be operational.

The LED back-lighting will be off.

The clock shall be inoperative.

Slowly raise the +28VDC Main power voltage. When the voltage reaches 14VDC, or slightly before 14VDC, the clock shall reinitialize.

Observe the following:

The clock will reinitialize in the same manner as if +28VDC main power has just been applied to the clock.

Return the +28VDC Main power to +28VDC.

The initialization mode will be dependent on the status of the ARINC 429 system.

5.12 Failure Criteria:

The clock shall have failed the operating testing if the clock fails to perform any of the functional tests set forth in Section 5.