

TIMEX®

ENGINEERING SPECIFICATION

M555 – 10-Digit Alarm/Chrono/EL Backlight

IC Programming Specification 1-S-0712-09

July 28, 2021

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M555

10-Digit Alarm/Chrono/EL Backlight

IC Programming Specification

Specification Number: 1-S-0712-09

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DOCUMENT REVISION HISTORY

Revision: A	Date: 08/20/2002	Author: Louise Chan, Jr.
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AFFECTED PAGES	DESCRIPTION
All	Created document.

Revision: B	Date: 08/22/2002	Author: Louise Chan, Jr.
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Summary of changes:	Modified reset operation to include an EL and buzzer test and added alarm test melody diagram.
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AFFECTED PAGES	DESCRIPTION
3	Added EL and buzzer test to the reset operation.
17	Added melody diagram for the alarm test melody.

Revision: C	Date: 08/29/2002	Author: Louise Chan, Jr.
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Summary of changes:	Modified the Chrono split operation and the Alarm setting operation.
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AFFECTED PAGES	DESCRIPTION
8 and 9	Modified alarm setting operation such that the setting and arming of the alarm will be done with one action.
11 and 12	Modified the chrono split operation so that Chrono split time display will now be held for 10s before display returns to the running Chrono time display. All timing actions (including split taking and resetting) will now generate a button beep.
15 and 16	Modified the Flag and Switch matrices to include the changes in the Alarm setting and Chrono split operations.

Revision: D	Date: 10/10/2002	Author: Louise Chan, Jr.
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Summary of changes:	Made changes on the reset sequence display, chrono operation and added hourly chime melody diagram.
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AFFECTED PAGES	DESCRIPTION
3	Changed display for the software revision number and added cancellation of the 2-second timeout by pressing any key.
10-12	Changed maximum chrono time to 24 hours and changed its operation so that it will run out when it reaches the maximum time.
15	Corrected a typo in the switch matrix.
18	Added hourly chime melody diagram.

Revision: E	Date: 01/31/2011	Author: Louise Chan, Jr.
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Summary of changes:	Added auto-EL shutdown feature when EL key is held for more than 9-10 seconds.
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AFFECTED PAGES	DESCRIPTION
2	Removed manufacturing option table since there is none available for this watch model.

14 and A2	Add auto-EL shutdown feature when EL key is held for more than 9-10 seconds.
A2	Added rules for switch input processing.

Revision: F	Date: 03/4/2011	Author: Louise Chan, Jr.
Summary of changes:	Made minor modifications in the Global Features section.	

AFFECTED PAGES	DESCRIPTION
14	Re-phrased the auto-EL shutdown feature in section 7.5.
14	Removed "7.6 Lamp and Piezo" section in Global Features since this behavior will never be observed in the M555 watch.

Revision: 1	Date: 05/10/2011	Author: Louise Chan, Jr.
Summary of changes:	Modified the flashing rate of the ALARM icon when in Alarm mode.	

AFFECTED PAGES	DESCRIPTION
9	Added information about the flashing rate of the ALARM icon while in Alarm mode (see Note 1).
14	Added information about the synchronization of the "ON" part of the ALARM icon flashing with the seconds update.

Revision: 2	Date: 07/06/2015	Author: Patrick G. Patalinghug
Summary of changes:	Use new OS/Trailhawk version, added bond options, scanning features, and sample screen updates.	

AFFECTED PAGES	DESCRIPTION
All	Added bond options for leap year and LCD contrast. Minute will now have 2-digit singled field scanning. Alert is allowed if key is pressed/hold prior alert occurs. Modified initial conditions Time of Day and Alarm. Updated all sample screen format and document formats. Added 7-segment character fonts to support character displays.

Revision: 3	Date: 07/15/2015	Author: Patrick G. Patalinghug
Summary of changes:	Updates on note references and sample screens.	

AFFECTED PAGES	DESCRIPTION
Many	Updated sample screens and notes. Updated Table of contents pages.
16	Allowed auto correction of invalid month date in February, when year bond option is set to default.

Revision: 4	Date: 07/30/2015	Author: Patrick G. Patalinghug
Summary of changes:	Updates on note references and sample screens.	

AFFECTED PAGES	DESCRIPTION
6, 10, 14	Update sample screen notes: Changed contrast level; modified date setting paragraph; and added exception condition for chrono display "HH" data display on top line.

8 17	Modified section 4.4.2 "Leap year operation" Removed "Date settings" from 5. Global features.
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Revision: 5		Date: 08/30/2019	Author: Leo Achilles M. Bellotindos
Summary of changes:	Modified Reset Sequence and Time Mode diagrams/notes. Updated manufacturing options. Added new melodies. Added Appendix E.		

AFFECTED PAGES	DESCRIPTION
2	Updated the LCD Contrast Table values.
3	Changed micro from ML610Q426C to S1C17V25. Updated the LCD drive voltage values. Modified second paragraph of Section 3.2.2. Added Section 3.2.3 Alarm Alert Type.
6	Modified Reset Sequence Diagram and Notes to reflect new sequence used by the Epson version of TRAILHAWK.
9	Modified Time Mode Default State Diagram and Notes.
17	Modified first paragraph of Section 5.5.
A2	Updated START/STOP operation for Time of Day (Default State) in the Switch Matrix Table.
A5	Added melody diagram of Pac-Man Melody.
A6	Added melody diagram of Pac-Man Test Melody.
A8	Added Appendix E – Style Manufacturing Options

Revision: 6		Date: 09/13/2019	Author: Leo Achilles M. Bellotindos
Summary of changes:	Updated M555 image in cover page. Miscellaneous corrections.		

AFFECTED PAGES	DESCRIPTION
6	Added SET button operation in Reset Sequence Diagram.
8	Updated the Date initial value in Section 4.4.4 Initial Conditions.
17	Added description in Section 5.5 Alarm Alert that the lamp will be turned on. Added Section 5.7 Lamp and Piezo.

Revision: 7		Date: 04/21/2021	Author: Leo Achilles M. Bellotindos
Summary of changes:	Miscellaneous updates to support the Coca-Cola version.		

AFFECTED PAGES	DESCRIPTION
3	Updated Section 3.2.3 Alarm Alert Type to include the Coca-Cola Melody.
6	Updated box F4 to show the latest version number. Updated box I4 to show the new initial TOD display.
8	Updated initial year value in Section 4.4.4 Initial Conditions.
9	Updated Note 5 to include the use of the Coca-Cola Test Melody.
17	Updated Section 5.5 Alarm Alert to include the use of the Coca-Cola Melody.
A2	Updated the description for the operation of the START/STOP button in Time of Day Default State.
A7 – A8	Added Coca-Cola Melody diagram.
A9 – A10	Added Coca-Cola Test Melody diagram.
A12	Added P21002 column for the Coca-Cola version bond option settings.

Revision: 8	Date: 07/09/2021	Author: Leo Achilles M. Bellotindos
Summary of changes:	Modified the Coca-Cola melodies.	

AFFECTED PAGES	DESCRIPTION
A7 – A8	Modified the Coca-Cola Melody diagram.
A9 – A10	Modified the Coca-Cola Test Melody diagram.

Revision: 9	Date: 07/28/2021	Author: Leo Achilles M. Bellotindos
Summary of changes:	Miscellaneous updates to support the Space Invaders version.	

AFFECTED PAGES	DESCRIPTION
3	Updated Section 3.2.3 Alarm Alert Type to include the Space Invaders Melody.
9	Updated Note 5 to include the use of the Space Invaders Test Melody.
10	Modified B5 diagram to enclose the minute field in the red box to indicate flashing.
12	Modified D5 diagram to enclose the Alarm time minute field in the red box to indicate flashing.
17	Updated Section 5.5 Alarm Alert to include the use of the Space Invaders Melody.
A2	Updated the description for the operation of the START/STOP button in Time of Day Default State.
A11 – A19	Added Space Invaders Melody diagram and Space Invaders Test Melody diagram.
A20	Added P21028 column for the Space Invaders version bond option settings.

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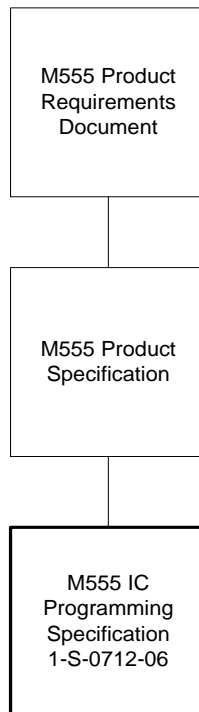
1 INTRODUCTION

1.1 Scope

This specification defines the features, functions, and operation of the M555 10-Digit Alarm/Chrono/EL Backlight.

1.2 Applicable Documents

The diagram below shows this document and its relationship to other documents applicable to the watches. This document is shown with a bold outline, and documents that are not specific to the watches are shaded. Where conflict occurs between two documents, the document that is higher in the hierarchy takes precedence.



2 FEATURES AND FUNCTIONS

- Time of day display in hours, minutes and seconds in 12-hr format or 24-hr format
- Date display with numeric month and day in MM-DD format and a three-letter abbreviation for the day of week
- INDIGLO™ Night-Light
- Optional hourly chime (indicated by a flashing colon)
- Chronograph 1/100-second resolution with split function
- 24 hours maximum Chronograph time
- 24-hour alarm
- Alarm test can be performed by holding START/STOP in Time of Day mode with the colon flashing
- Audible switch closure tone when button beep feature is ON
- Auto-return from SET mode after 2-3 minutes
- Automatic leap year handling (available when year bond option is set to default)

3 INPUT/OUTPUT

3.1 All Clear Switch

The watch shall possess an All Clear switch inside the battery compartment which, when actuated, causes a reset of the microcontroller. See section “4.1 Reset” for more details.

3.2 Manufacturing Options

Manufacturing options are static inputs to the microcontroller from the PCB that can be set at time of manufacture to yield functional variations. Options for different models are fixed for the model’s PCB. Those options that must be alterable on a given PCB are executed with bonds, which, by default, are not installed during manufacture, but may be added to alter functionality. Therefore, the most likely state of the options must correspond to all bonds being absent. The watch shall possess two bond options:

3.2.1 LCD Contrast

LCD contrast bond option shall determine the value of the microcontroller’s LCD contrast setting right after a reset operation.

LCD CONTRAST	Bond Option 2	Bond Option 1
0x07 (3.00V, Default)	Unbonded	Unbonded
0x0F (3.48V)	Unbonded	Bonded
0x09 (3.12V)	Bonded	Unbonded
0x0B (3.24V)	Bonded	Bonded

Below is a complete list of LCD contrast values and its equivalent LCD drive voltage output.

CONTRAST VALUE		LCD DRIVE VOLTAGE
HEX	DECIMAL	EPSON (S1C17V25)
00H	0	2.58 V
01H	1	2.64 V
02H	2	2.70 V
03H	3	2.76 V
04H	4	2.82 V
05H	5	2.88 V
06H	6	2.94 V
07H	7	3.00 V
08H	8	3.06 V
09H	9	3.12 V
0AH	10	3.18 V
0BH	11	3.24 V
0CH	12	3.30 V
0DH	13	3.36 V
0EH	14	3.42 V
0FH	15	3.48 V

3.2.2 Year

Year setting shall determine that the watch shall possess year settings in Time of Day.

Year	Bond Option 3
Include YEAR in TOD setting (Default)	Unbonded
Exclude YEAR in TOD Setting	Bonded

The status of the manufacturing options can be viewed by pressing the START/STOP button during the All Segments OFF part of the Reset Sequence (see Section 4.1 Reset).

3.2.3 Alarm Alert Type

The Alarm Alert Type bond option shall determine which alert type to use for the Alarm mode.

Alarm Alert Type	Bond Option 5	Bond Option 4
Alarm Alert Melody (Default)	Unbonded	Unbonded
Pac-Man Melody	Unbonded	Bonded
Coca-Cola Melody	Bonded	Unbonded
Space Invaders Melody	Bonded	Bonded

The status of the manufacturing options can be viewed by pressing the START/STOP button during the All Segments OFF part of the Reset Sequence (see Section 4.1 Reset).

3.3 Buttons

The watch shall possess four switch buttons. Please refer to Appendix B - Switch Matrix for the functions of each buttons.

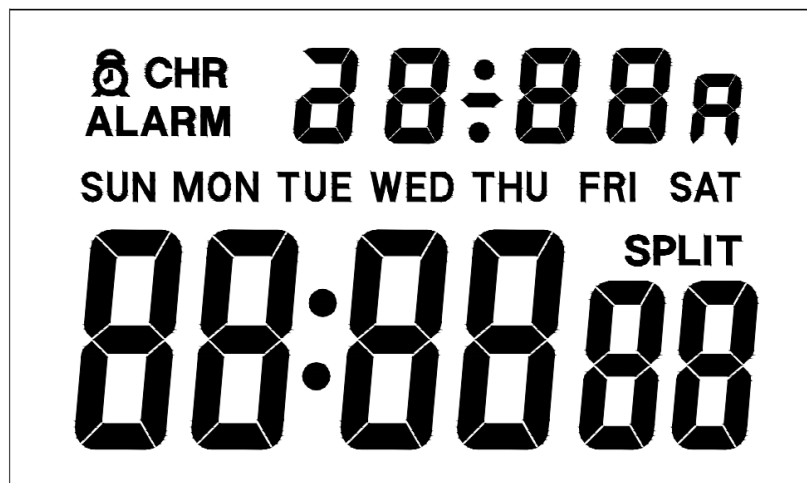
The watch shall not feature the automatic registration of repeat button presses when a button is held (sometimes referred to as typematic action). Holding a button shall cause no action, except where noted.

All actions resulting from button presses shall occur upon button depression, except where noted.

3.4 LCD

3.4.1 LCD Font

The LCD font is shown below with all segments on.



3.4.2 LCD Summary

The LCD has 16 flags. Flag usage is specified in the flag matrix in Appendix A.

3.4.3 Character Font

Characters shall be formed according to the font diagrams shown in Appendix C.

3.5 Tone Generation

The watch shall possess a piezoelectric buzzer that provides the user with audible feedback for actions, and alerts him to various conditions. The complete set of melodies produced by the watch is given in Appendix D.

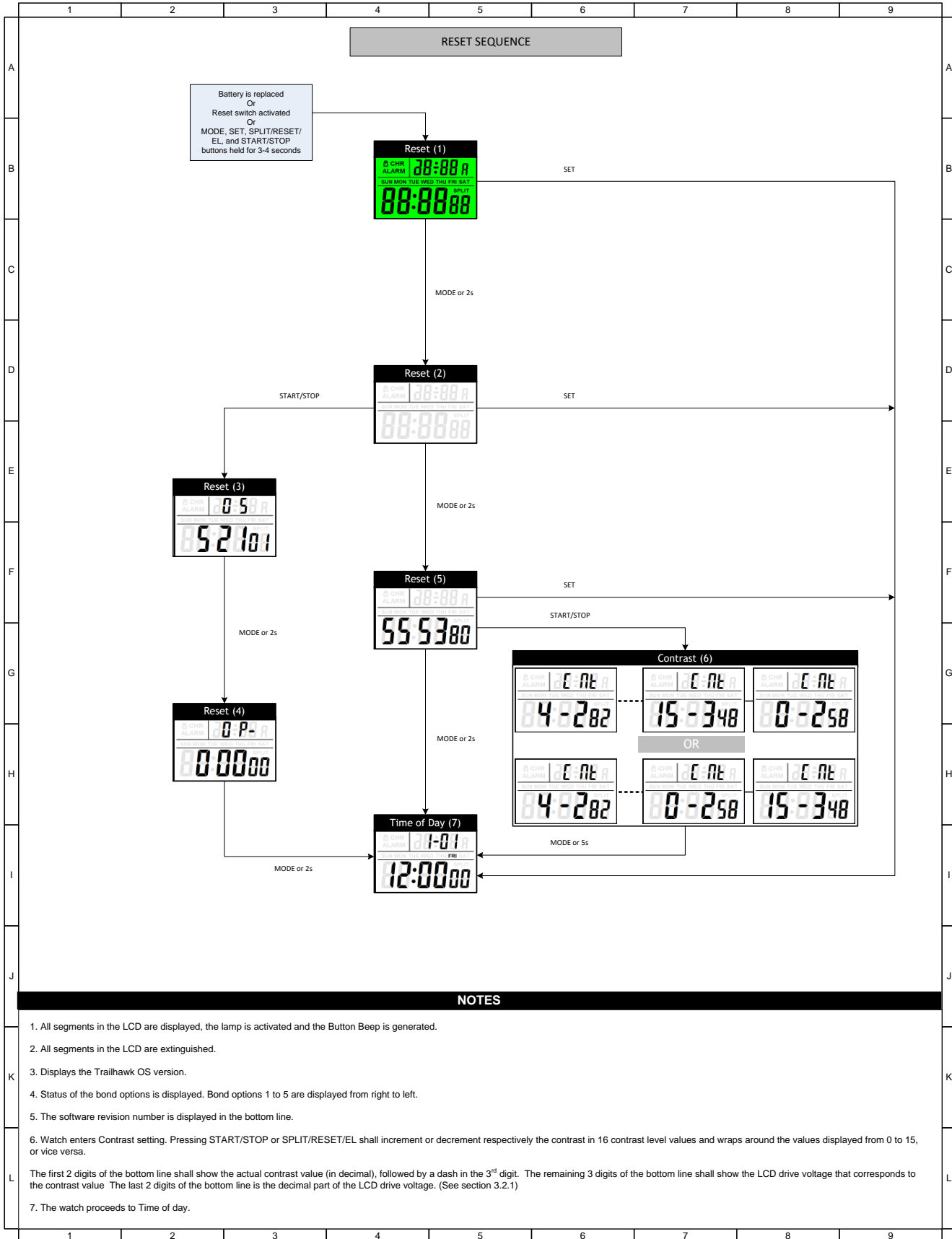
4 OPERATION

4.1 Reset

Reset operation can be accomplished in any one of three ways:

- Installing the battery
- Pressing the All Clear switch
- Pressing the MODE, SET, SPLIT/RESET/EL, and START/STOP buttons simultaneously for 3-4 seconds

For details of the reset operation, refer to the diagram in the next page.

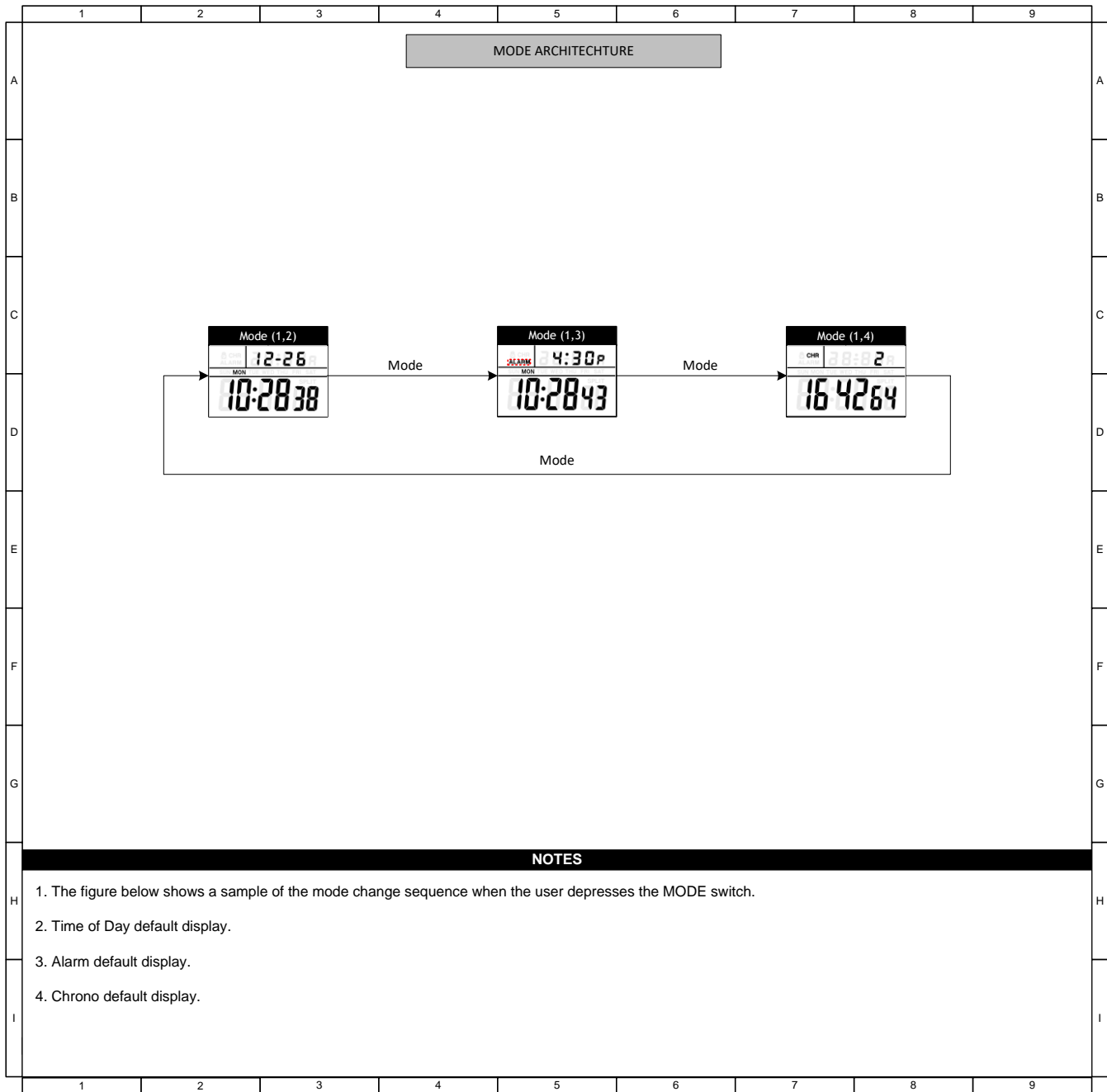


NOTES

1. All segments in the LCD are displayed, the lamp is activated and the Button BEEP is generated.
2. All segments in the LCD are extinguished.
3. Displays the Trailhawk OS version.
4. Status of the bond options is displayed. Bond options 1 to 5 are displayed from right to left.
5. The software revision number is displayed in the bottom line.
6. Watch enters Contrast setting. Pressing START/STOP or SPLIT/RESET/EL shall increment or decrement respectively the contrast in 16 contrast level values and wraps around the values displayed from 0 to 15, or vice versa.
The first 2 digits of the bottom line shall show the actual contrast value (in decimal), followed by a dash in the 3rd digit. The remaining 3 digits of the bottom line shall show the LCD drive voltage that corresponds to the contrast value. The last 2 digits of the bottom line is the decimal part of the LCD drive voltage. (See section 3.2.1)
7. The watch proceeds to Time of day.

4.2 User Interface Architecture

The diagram below shows User Interface architecture used for the watch. The application mode loops in this following sequence Time of Day, Alarm, and Chrono.



4.3 Timing Requirements

All timeouts less than or equal to five seconds must be executed within an error of -125 ms, except where noted.

All timeouts greater than five seconds must be executed within an error of -1 s, except where noted.

1/100 s timing is required for the Chronograph function.

4.4 Time Mode

4.4.1 Mode Description

The operation of the Time mode is defined in the diagrams on the next pages.

4.4.2 Leap Year Operation

When year bond option is set to default (year included in time of day setting), the watch shall correctly handle leap year changes from 2000 to 2099. Otherwise, if year bond option is set to bonded (year excluded in time of day setting), the watch shall always rollover from February 28 to March 1. To accommodate a leap year, the user must manually set the date to be February 29, which shall also roll over to March 1.

4.4.3 Day of Week Calculation

The day of the week is automatically calculated based on the year, month, and day setting.

4.4.4 Initial Conditions

After reset, the Time of Day data will be initialized as follows:

Time: 12:00AM (12-hr format)

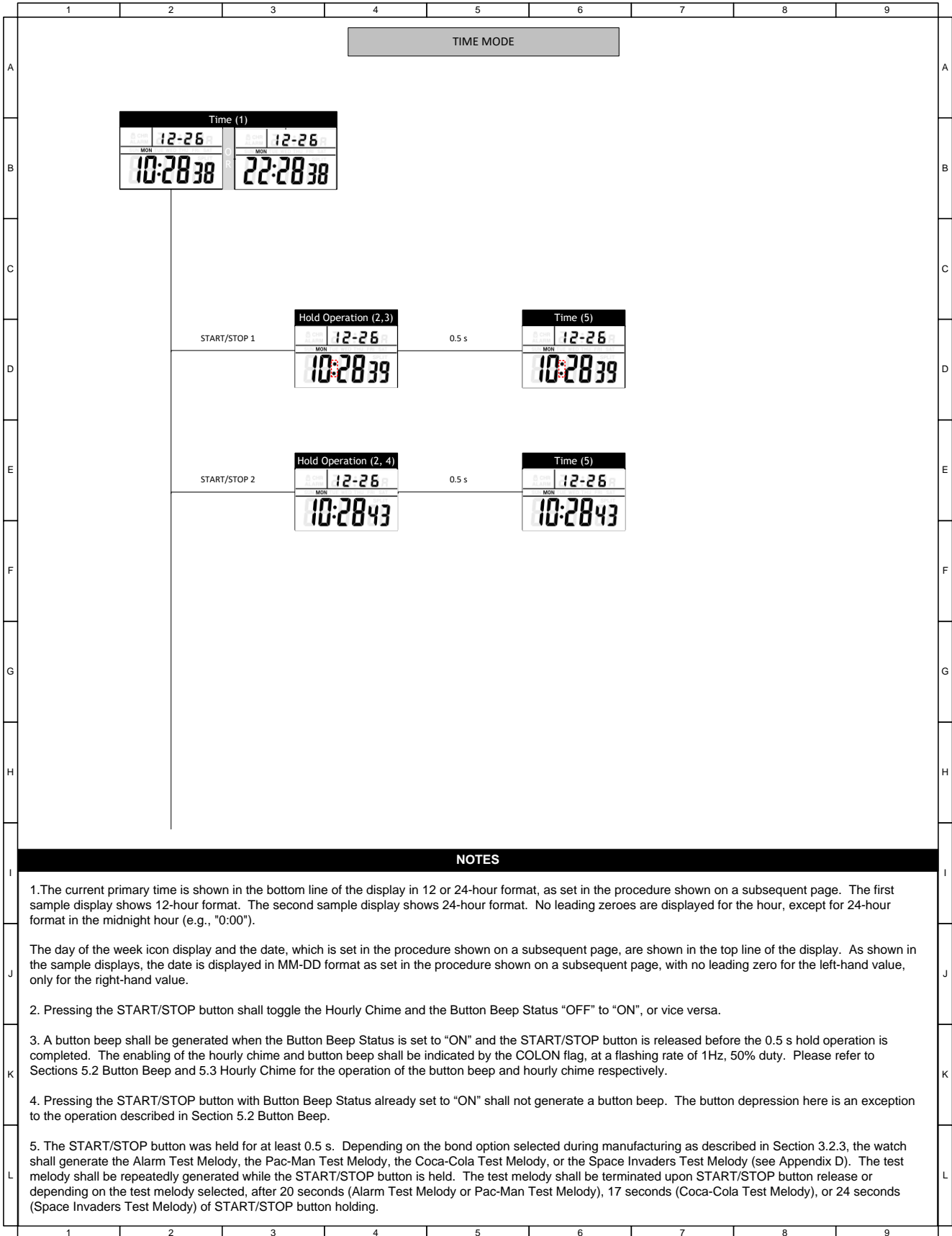
Date: January 01, 2021

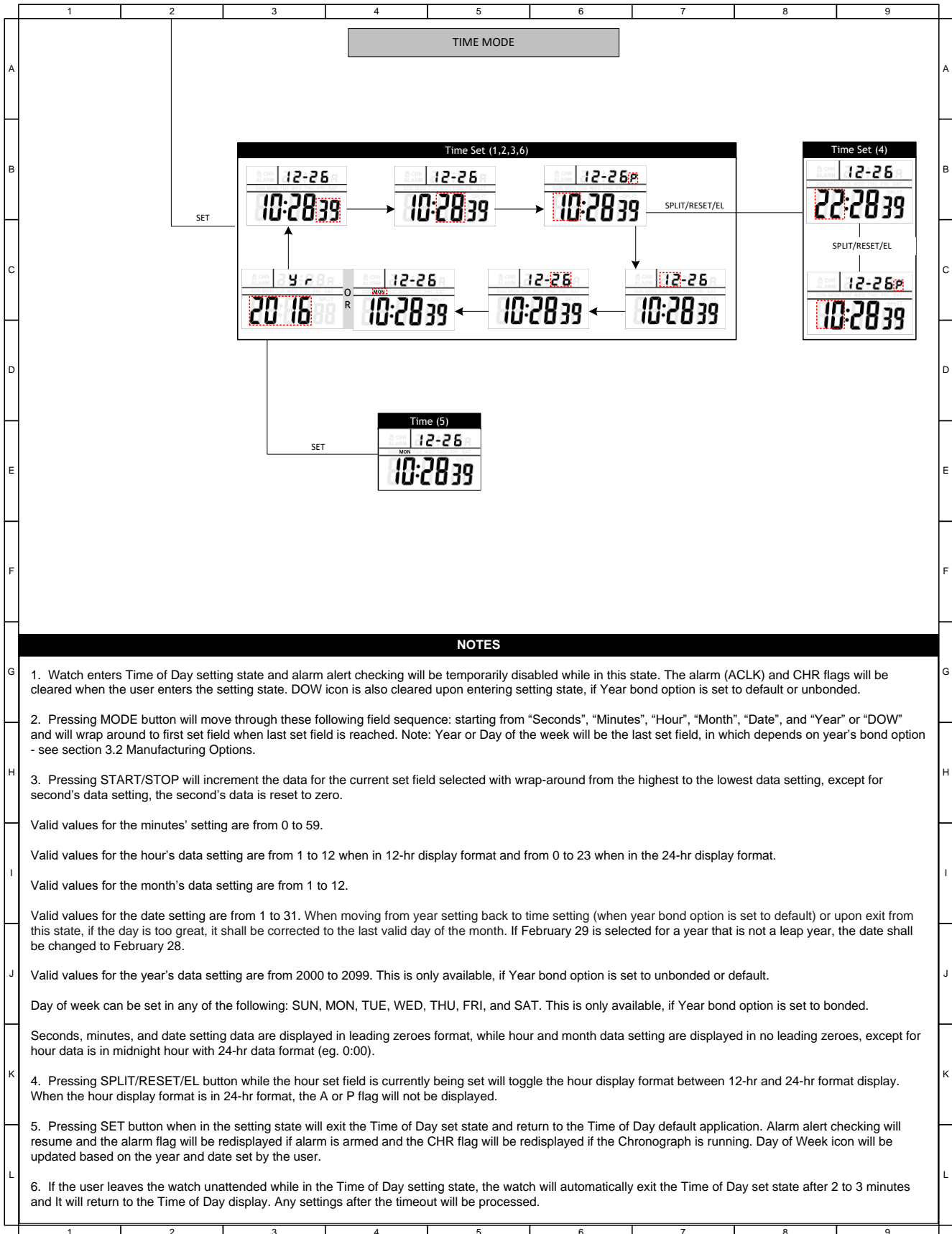
Hourly chime/button beep: OFF (COLON flag is not flashing)

4.4.5 Boundary Conditions

Mode data is bounded as follows:

Year: 2000 – 2099





4.5 Alarm mode

4.5.1 Mode Description

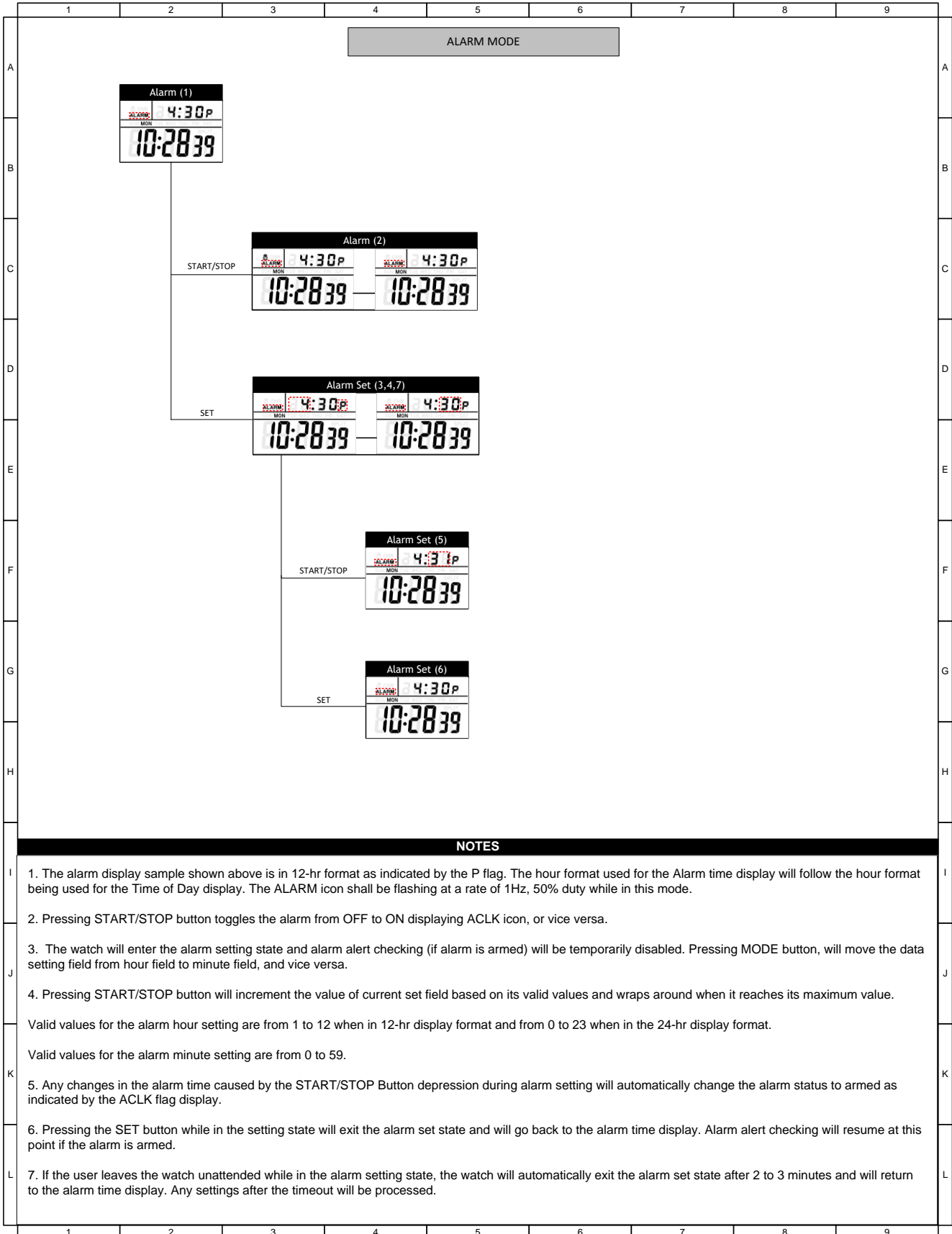
The operation of the Alarm mode is defined in the diagrams on the next pages.

4.5.2 Initial Conditions

After reset, alarm time will be initialized as follows:

Alarm time: 12:00 PM

Alarm Status: Disarmed ("OFF")



NOTES

1. The alarm display sample shown above is in 12-hr format as indicated by the P flag. The hour format used for the Alarm time display will follow the hour format being used for the Time of Day display. The ALARM icon shall be flashing at a rate of 1Hz, 50% duty while in this mode.
2. Pressing START/STOP button toggles the alarm from OFF to ON displaying ACLK icon, or vice versa.
3. The watch will enter the alarm setting state and alarm alert checking (if alarm is armed) will be temporarily disabled. Pressing MODE button, will move the data setting field from hour field to minute field, and vice versa.
4. Pressing START/STOP button will increment the value of current set field based on its valid values and wraps around when it reaches its maximum value.
Valid values for the alarm hour setting are from 1 to 12 when in 12-hr display format and from 0 to 23 when in the 24-hr display format.
Valid values for the alarm minute setting are from 0 to 59.
5. Any changes in the alarm time caused by the START/STOP Button depression during alarm setting will automatically change the alarm status to armed as indicated by the ACLK flag display.
6. Pressing the SET button while in the setting state will exit the alarm set state and will go back to the alarm time display. Alarm alert checking will resume at this point if the alarm is armed.
7. If the user leaves the watch unattended while in the alarm setting state, the watch will automatically exit the alarm set state after 2 to 3 minutes and will return to the alarm time display. Any settings after the timeout will be processed.

5 GLOBAL FEATURES

5.1 Flashing

All data and flag flashing shall occur at a rate of 2Hz, 50% duty unless otherwise noted.

When switching from one set field to another by pressing the MODE switch, flashing shall be implemented such that the digit position(s) where flashing will next occur shall be cleared first for 250ms before normal "ON-OFF" flashing shall occur.

While the user is depressing the START/STOP switch to set the data for a specific set field, flashing will be suspended and will resume once the user releases the START/STOP switch. Before resuming flashing (after the START/STOP switch release), the data for a current set field selected shall first be displayed for 250ms before normal "OFF-ON" flashing shall resume.

Flashing of the COLON flag during the Time of Day mode and the ALARM flag during Alarm mode shall be done such that the "ON" part of the flashing will be synchronized with the second's update.

When setting the TOD time, the second's data blinking must be synchronized with the second's update such that data will be displayed on the time when the second's data changes. Because of this, it is acceptable for the second's data not to be displayed immediately after being set to 0 due to this synchronization.

5.2 Button Beep

When button beep feature is enabled, any button depression will generate a switch closure tone (See Appendix D, page A4) except SPLIT/RESET/EL button functioning as INDIGLO Night Light.

5.3 Hourly Chime

When the hourly chime feature is active, an hourly chime melody will be generated every time the hour's data is updated (every minute rollover). Hourly chime is suspended when current foreground is in TOD setting.

5.4 INDIGLO® Night Light

Pressing the SPLIT/RESET/EL switch while displaying the TOD or Alarm time (but not during setting) will activate the INDIGLO® Night Light lamp. The lamp will remain ON until the user releases the SPLIT/RESET/EL switch.

If the lamp is activated by pressing and holding the lamp button continuously for 10s, then the lamp shall be turned off automatically, regardless of input status.

In an event when alarm alert occurs during lamp holding, the lamp should be OFF at the time audible alert or "On-Time" cycle of the alert, or vice versa, until SPLIT/RESET/EL is release or 10-seconds lamp activation has reached.

Appendix D - Melody Diagram

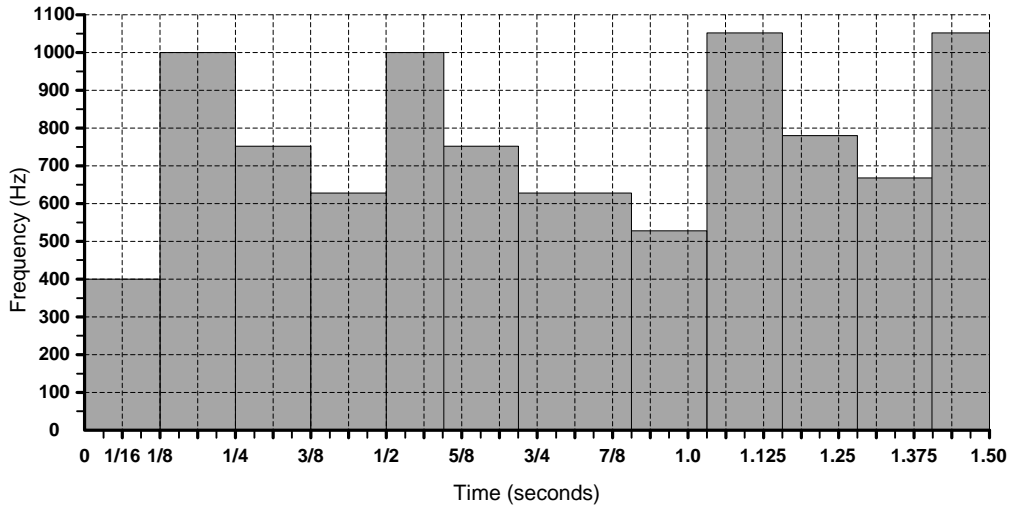
Switch Closure Tone

Alarm Test Melody

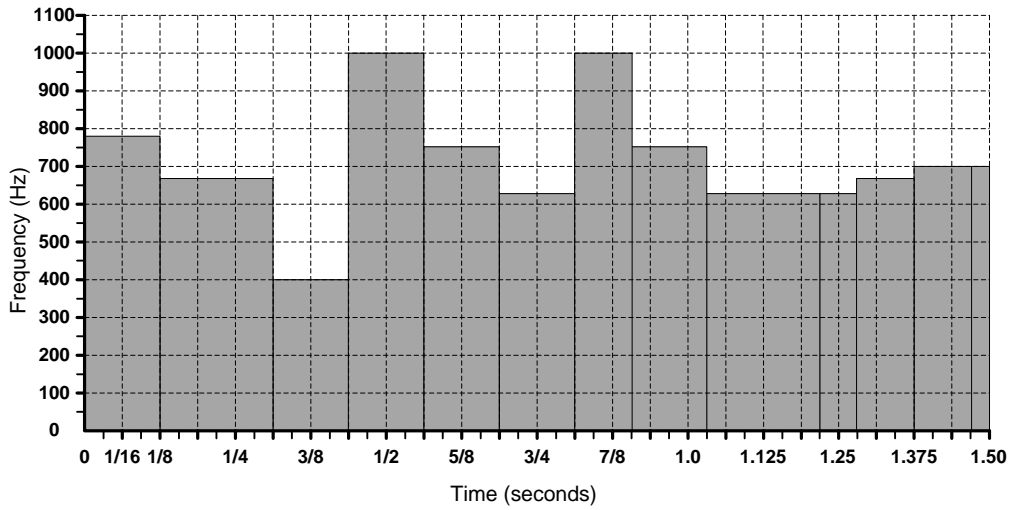
Alarm Alert Melody

Pac-Man Melody

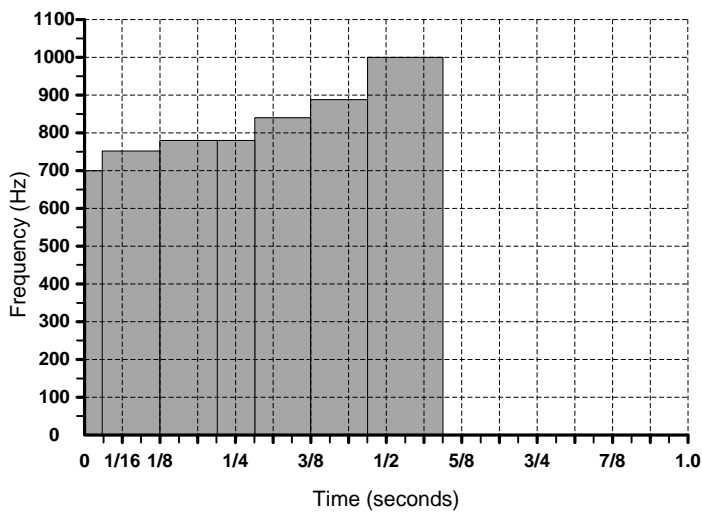
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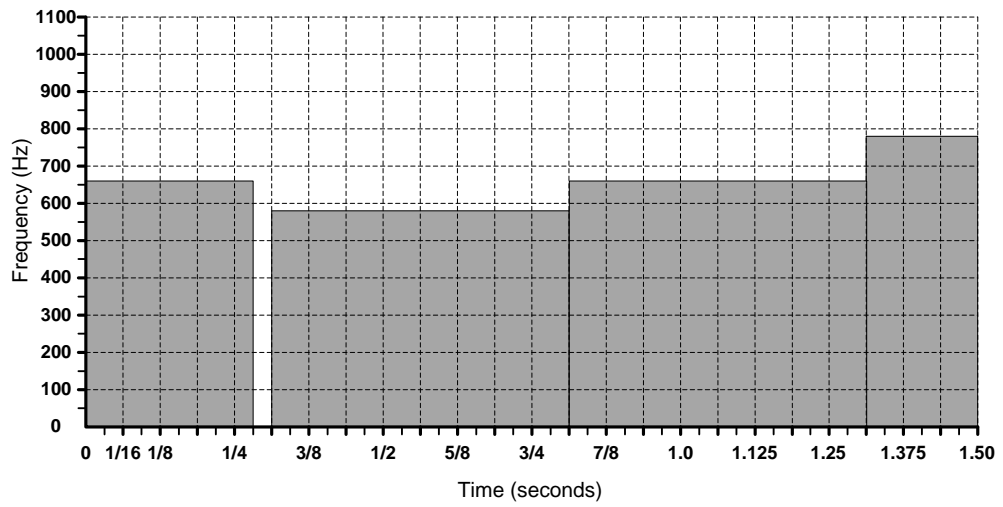


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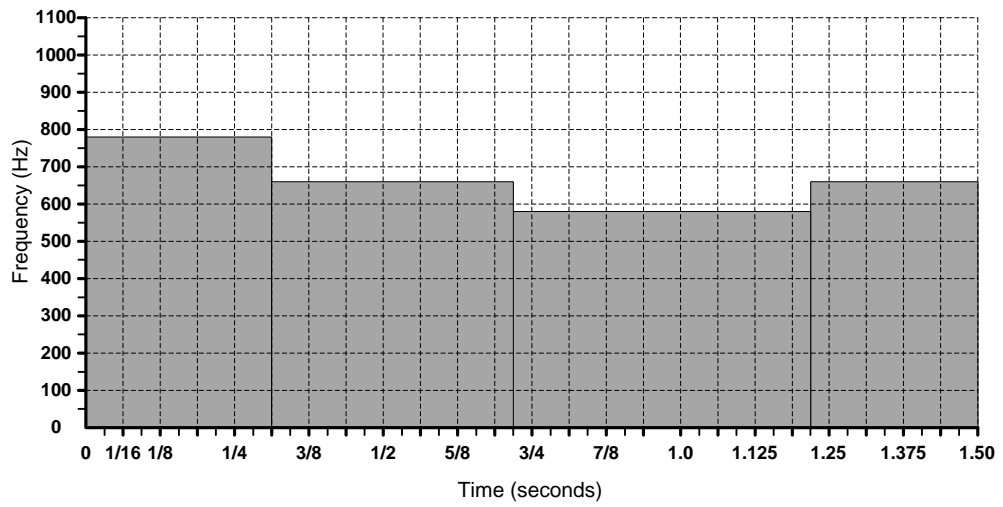


Coca-Cola Melody

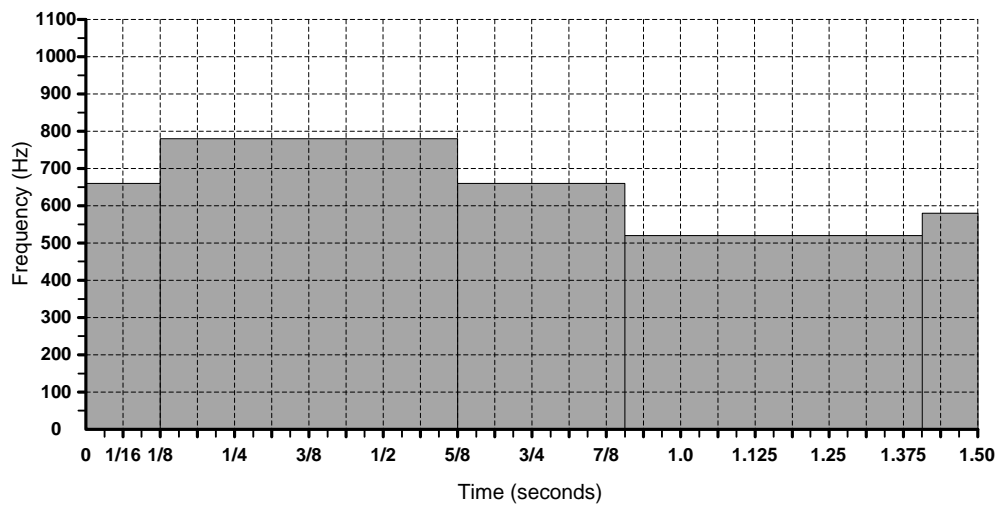
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