**GRAND HAVEN MUSICAL FOUNTAIN**

**FOUNTAIN COMMAND LANGUAGE [FCL]**

**FOUNTAIN COMMAND WORD [FCW] REFERENCE**

**Version 3.00.18 11/03/2014**

**Table of Contents**

1. [LANGUAGE COMMAND STRUCTURE 2](#_TOC_250021)
2. [ADDRESS 3](#_TOC_250019)
   1. [Table 1 ­ Addresses for physical devices (Existing 2013) 3](#_TOC_250018)
   2. Table 2 - Addresses for physical devices (New 2014)…………...….………4-5
3. [DATA (or FUNCTION) 6](#_TOC_250016)
   1. [Table A – Module water level 6](#_TOC_250015)
   2. [Table B – Curtains and Peacock water level 6](#_TOC_250014)
   3. [Table C – Light colors 6](#_TOC_250013)-7
   4. [Table D1-D3 – Sweep Speed & Mode 7](#_TOC_250012)
   5. [Table E – Selected special lights 8](#_TOC_250011)
   6. [Table F – Cataloged configurations 8](#_TOC_250010)

G.[Table G – Module Light Shifting 8](#_TOC_250007)

1. [Table H –Module water JUMP data 8](#_TOC_250006)
2. [Table I – Module water & light exchange pattern 8](#_TOC_250005)
3. Table J - Sweep Special - Sweep Between Limits or Hold at Limit……….....9
4. Table K - LED Color Select…………………………………………...…………….10
5. Table L - FADE………..………………………......................................................10

M.Table M - STROBE…………………………………………………………………...10

N.Table N - Maintenance………………………………………………………………10

1. [PROGRAM EXAMPLE ………………………………………………………………..1](#_TOC_250001)1
2. Revision History………………………………………………………………………...12

# LANGUAGE COMMAND STRUCTURE

The Grand Haven Musical Fountain (GHMF) is “driven” or made to perform by numeric command data transmitted via an Ethernet connection between PLC and computer. In the case of the Grand Haven Musical Fountain the data is custom and it has evolved into a command language with each command containing an “address” to identify a part of the fountain and “data” for action to be initiated. Each command in this fountain command language is called a Fountain Command Word or FCW. The commands are described in detail below.

Command lines begin with a time signature followed by one to ten commands separated by a space. The time signatures are coordinated with the music clock. This system supports time to an accuracy of 0.1 second. During the process of transcription, this time is modified in order to coordinate precisely with the view of the audience some 400 yards away from the fountain. The adjustment is to subtract enough time for the sound to travel the 400 yards.

Command lines contain one to ten individual commands in the format of AAA­DDD with a dash separating two three digit numbers. The number AAA is the address from the ADDR column of TABLE 1. The number DDD is the data (or “function”) taken from the Table specified in the “FCN” column of the address tables. The DDD number is generally (but not always) interpreted as the SUM total of the “sum” column for individual features shown in the selected rows of Tables A thru Z.

The AAA & DDD numbers are as seen in computer listings using any convenient text editor. At the fountain PLC enclosure panel, the numbers are shown or entered on the PanelView display. Note that the original A/B PLC numbers are base 16 (HEX or binary coded decimal-BCD) while this and other documents along with the computers used to program GHMF are base10 (decimal). Due to the number base duplicity and the difficulty of conversion between number bases without the aid of a computer, the HEX/BCD base numbers are listed in the “A/B” column of the tables. Both decimal and HEX/BCD number codes are available for display or entry on the PanelView operator interface at the fountain. This allows the operator to use whichever number system he is more familiar with and continues to support the legacy (HEX/BCD) codes.

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# ADDRESS

## Table 1 ­ Addresses for physical devices – Legacy FCW (2013)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***ADDR*** | | ***FCN*** | ***Description of fountain action location*** | | | | ***BCD*** | |
| 001 | | A1 | W1 - Module Outside Ring Water with 10 foot diameter | | | | 01 | |
| 002 | | A1 | W2 - Module Second ring Water with 7 foot diameter | | | | 02 | |
| 003 | | A1 | W3 - Module Third ring Water with 4 foot diameter | | | | 03 | |
| 004 | | A1 | W4 - Module Inner ring Water with 2 foot diameter | | | | 04 | |
| 005 | | A1 | W5 - Module Center water – Single Spout | | | | 05 | |
| 006 | | A1 | W6 - Sweep water on left and right of module | | | | 06 | |
| 007 | | A1 | W7 - A=Bazooka, B =Tall water center spout (VOICE) | | | | 07 | |
| 008 | | A1 | W8 - Candelabra water in front of module | | | | 08 | |
| 009 | | B | W9 - Front (A) /Back (B) Curtain Water & Peacock (Back+ Bypass) | | | | 09 | |
| 016 | | E | Selected Lights from the table | | | | 10 | |
| 017 | | C1/K | Module #1 Lights (left hand side as viewed from river) | | | | - | |
| 018 | | C1/K | Module #2 Lights | | | | - | |
| 019 | | C1/K | Module #3 Lights | | | | - | |
| 020 | | C1/K | Module #4 Lights | | | | - | |
| 021 | | C1/K | Module #5 Lights | | | | - | |
| 022 | | C1/K | Module #6 Lights | | | | - | |
| 023 | | C1/K | Module #7 Lights (right hand side as viewed from river) | | | | - | |
| 024 | | C2 | Back Curtain Lights (Green & Yellow only) | | | | - | |
| 025 | | C1/K | Peacock Light Group A | | | | - | |
| 026/041 | | C1/K | Peacock Light Group B [041 = Legacy for Playback Only] | | | | - | |
| 027 | | C1/K | Peacock Light Group A + B | | | | - | |
|  | |  |  | | | |  | |
| 033 | | D1 | Sweep motion in T mode – Left and Right Sync TOGETHER | | | | 21 | |
| 034 | | D1 | Sweep motion in O mode – Left and Right Sync OPPOSED | | | | 22 | |
| 035-040 | |  | SEE TABLE 2 | | | |  | |
| 042 &047 | |  | SEE TABLE 2 | | | |  | |
|  | |  |  | | | |  | |
| 048 | | A1 | Water Modules W1-W6 & Wedding Cake formation | | | | 30 | |
| 049 | | C1/K | Module A lights (ODD 1, 3, 5, 7, modules) | | | | - | |
| 050 | | C1/K | Module B lights (EVEN 2. 4. 6, modules) | | | | - | |
| 051/052 | | C1/K | Module A and B lights [052 = Legacy for Playback Only] | | | | - | |
|  | 053 | C1/K |  | LEGACY reserved – [ALL LIGHTS} |  | - | |
| 054 | | F | Automatic cataloged formations [Voice water & light] | | | | 36 | |
|  | |  |  | | | |  | |
| 069 | | H | Repeat JUMP water level (Pulse) Sweep Water @ 0.5 sec. | | | | 45 | |
| 080 | | I | Interchange A and B module formations of water and light | | | | 50 | |
| 085 | | G | Shift or Rotate Module 1 thru 7 lights – USE WITH Address 086 | | | | - | |
| 086 | | Time | Set shift timer interval – in 0.01 sec [025­255] LEGACY ONLY | | | | - | |
| 099 | | M | TURN OFF everything and reset to idle condition – FCN = 0 | | | | 63 | |

## Table 2 ­ Addresses for physical devices – new FCW (2014)

|  |  |  |  |
| --- | --- | --- | --- |
| 035 | J | Sweep to Limit – Both Left & Right Sweeps | 23 |
| 036 | J | Sweep to Limit – Left Sweep | 24 |
| 037 | J | Sweep to Limit – Right Sweep | 25 |
| 038 | D2 | Sweep Speed – Left Sweep | 26 |
| 039 | D2 | Sweep Speed – Right Sweep | 27 |
| 040 | D2 | Sweep Speed – Both Left & Right Sweeps | 28 |
| 041 |  | SEE TABLE 1 |  |
| 042 | D3 | Sweep Mode (Left & Right) – Independent, Together or Opposed | 2A |
|  |  |  |  |
| 047 | A2 | Multi-Valve – W1-W6 progressive level to Wedding Cake | 2F |
| 048-054 |  | SEE TABLE 1 |  |
| 055 | K | CENTER SPOUT (VOICE) – ALL COLORS |  |
| 056 | K | FRONT CURTAIN – EXCLUDES BACK CENTER MODULE SPOTS |  |
| 057 | K | BACK CURTAIN - INCLUDES ALL COLORS |  |
|  |  |  |  |
| 117 | L | MODULE 1 (017) ALL LEDs – FADE UP OR DOWN | - |
| 118 | L | MODULE 2 (018) ALL LEDs – FADE UP OR DOWN | - |
| 119 | L | MODULE 3 (019) ALL LEDs – FADE UP OR DOWN | - |
| 120 | L | MODULE 4 (020) ALL LEDs – FADE UP OR DOWN | - |
| 121 | L | MODULE 5 (021) ALL LEDs – FADE UP OR DOWN | - |
| 122 | L | MODULE 6 (022) ALL LEDs – FADE UP OR DOWN | - |
| 123 | L | MODULE 7 (023) ALL LEDs – FADE UP OR DOWN | - |
|  |  |  |  |
| 127 | L | PEACOCK LED GROUP A & B (027) – FADE UP OR DOWN | - |
| 149 | L | MODULE A LEDS (049) – FADE UP or DOWN |  |
| 150 | L | MODULE B LEDS (050) – FADE UP or DOWN |  |
| 155 | L | CENTER SPOUT (VOICE/055) – FADE UP or DOWN |  |
| 156 | L | FRONT CURTAIN (056) – FADE UP OR DOWN |  |
| 157 | L | BACK CURTAIN (057) – FADE UP OR DOWN |  |
|  |  |  |  |
| 501-541 | K | LED FIXTURE 1- 41 Color Select. Ex. 501 = Module 1 | - |
| 601-641 | L | LED FIXTURE 1- 41 – FADE UP OR DOWN. | - |
|  |  | Must be followed by same fixture FCW for color & intensity select. |  |

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# DATA (or FUNCTION)

## 

## Table A1 – Module water level - Legacy

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected water height*** | ***A/B*** |
| 0 | Water level off and bypass valve closed | 0 |
| 1­5 | \*Water level setting – height from 1 to 5 | 1­5 |
| 6 | \*\*Wedding Cake – (048d only) | 6 |
| 16 | Module A water valves (odd numbered) only | 10 |
| 32 | Module B water valves (even numbered) only | 20 |
| 64 | Connect A to B thru bypass valve | 40 |

\*\*Wedding cake (6) water levels – Ring 1 = 1, Ring 2 = 2, Ring 3 = 3, Ring 4 = 4, Ring 5 = 5, Sweep = 5

\*With Address 048d Levels 0-5 Sets ALL multi-water modules W1-W6 to chosen level.

## Table A2 – Module water level – New 2014

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected water height*** | ***A/B*** |
| 0 | Water level off and bypass valve closed | 0 |
| 1­5 | \*Water level height from 1 to 5 progressive | 1­5 |
| 6 | \*\*Wedding Cake – (047d only) | 6 |
| 16 | Module A water valves (odd numbered) only | 10 |
| 32 | Module B water valves (even numbered) only | 20 |
| 64 | Connect A to B thru bypass valve | 40 |

\*\*Wedding cake (6) water levels – Ring 1 = 1, Ring 2 = 2, Ring 3 = 3, Ring 4 = 4, Ring 5 = 5, Sweep = 5

\*All other levels – Sets progressive level up to chosen Ring #. Example – (4) Sets Ring 1 = 1, Ring 2 = 2, Ring 3 = 3, Ring 4 = 4. Example - (2) Sets Ring 1 =1 , Ring 2=2.

## Table B – Curtains and Peacock water level

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected water height (non ­ water module)*** | ***A/B*** |
| 0 | Water level off and Peacock toggle valve closed | 0 |
| 1­5 | Water level setting – Select a height from 1 to 5 | 1­5 |
| 16 | Front Curtain water valves only | 10 |
| 32 | Back Curtain water valves only | 20 |
| 96 | Peacock ON / Back Curtain OFF ­ Bypass valve | 40 |

Data 32 & 96 are mutually exclusive. All others may sum.

## Table C1 – Legacy Light colors

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected colors for Module Lights*** | ***A/B*** |
| 0 | All OFF [all ADDR] | - |
| 1 | Turn on RED [all ADDR except 024d] | - |
| 2 | Turn on BLUE [all ADDR except 024d] | - |
| 4 | Turn on AMBER [all ADDR except 024d] | - |
| 8 | Turn on WHITE [all ADDR except 024d, 25-27d + 41d] | - |

## 

## 

## Table C2 – Legacy Light colors Back Curtain

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected colors for Module Lights*** | ***A/B*** |
| 0 | All OFF [all ADDR] | - |
| 16 | Turn on GREEN Back Curtain [only ADDR 024d] | - |
| 32 | Turn on YELLOW Back Curtain [only ADDR 024d] | - |

## Tables D1 – D2 – D3

## Table D1 – Sweep speed, Legacy command pre-2014

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected motion for sweep mode*** | ***A/B*** |
| 00 | All STOP & RETURN TO CENTER | 00 |
| 01 | SHORT Sweep motion | 01 |
| 02 | LONG Sweep motion | 02 |
| 08 | SWEEP PAUSE | 08 |
| 16 | LARGO – as slow as it goes (hardly moves) | 10 |
| 32 | ADAGIO ­­ SLOW speed from original \* | 20 |
| 48 | ANDANTE | 30 |
| 64 | MODERATO ­­ MEDIUM speed from original \* | 40 |
| 80 | ALLEGRETTO | 50 |
| 96 | ALLEGRO ­­ FAST speed from original \* | 60 |
| 102 | PRESTO – as fast as it goes (breathing heavy) | 70 |

NOTE: speed entries marked \* are grandfathered from older control programs. Note2: [1 - 8] and [16 -102] are exclusive – the selected numbers are then totaled. Use Data = 8 to Pause and any other Data value to resume.

## Table D2 – Sweep speed, new command 2014

|  |  |  |
| --- | --- | --- |
| ***data*** | ***Selected motion for sweep mode*** | ***A/B*** |
| 00 | All STOP & RETURN TO CENTER | 00 |
| 08 | SWEEP PAUSE | 08 |
| 16 | LARGO – as slow as it goes (hardly moves) | 10 |
| 32 | ADAGIO ­­ SLOW speed from original \* | 20 |
| 48 | ANDANTE | 30 |
| 64 | MODERATO ­­ MEDIUM speed from original \* | 40 |
| 80 | ALLEGRETTO | 50 |
| 96 | ALLEGRO ­­ FAST speed from original \* | 60 |
| 102 | PRESTO – as fast as it goes (breathing heavy) | 70 |

NOTE: speed entries marked \* are grandfathered from older control programs. These selections are mutually exclusive. Use Data = 8 to Pause and any other Data value to resume.

## Table D3 – Sweep Mode – new command 2014

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***data*** | ***Selected Lights on/off (address extension)*** | | | ***A/B*** |
| 0 | Sweep Independent – NOT SYNCHRONIZED | | | 0 |
| 1 | Sweeps Left & Right Sync TOGETHER | | | 1 |
| 2 |  | Sweeps Left & Right Sync OPPOSED |  | 2 |

NOTE: These selections are mutually exclusive not additive.

## Table E – Selected special lights

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***sum*** | ***Selected Lights on/off (address extension)*** | | | ***A/B*** |
| 0 | All OFF | | | 0 |
| 2 | Top of hill – Cross / Star / Anchor ­ Highlight | | | 2 |
| 4 |  | White Beacons on end of fountain apron |  | 4 |
| 8 | (superceded White module lights: see 053­08) | | | 8 |

1. ***Table F – Cataloged configurations***

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected Creations or groups*** | ***A/B*** |
| 0 | All OFF | 0 |
| 1 | Voice of the Fountain water and lights ON | 1 |

## Table G – Module light shifting

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***Selected Module light shifting actions*** | ***A/B*** |
| 00 | STOP all shifting & reset | - |
| 01 | Motion to the RIGHT (toward higher # Modules) | - |
| 02 | Motion to the LEFT (toward lower # Modules) | - |
| 16 | Shift w/o end-carry (end module color is lost after shift) | - |
| 32 | Shift light with end-carry(loop or rotate or ring) | - |
| 64 | REPEAT shifting at timed interval | - |

## Table H – Module water JUMP data

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***AUTO­JUMP type selection for water*** | ***A/B*** |
| 0 | STOP JUMPING and return to preset level | 00 |
| 6 | ADDRESS the Sweep Water formation | 06 |
| 16 | JUMP “A” module water level | 10 |
| 32 | JUMP “B” module water level | 20 |
| 64 | JUMP “0” phase or “1” phase of cycle timers | 40 |

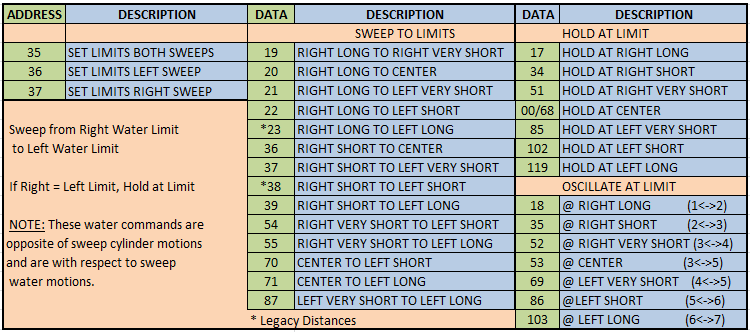
NOTE - Pulsate Only works with Sweeps. i.e. Add “6” to each selection.

## Table I – Module water & light exchange pattern

|  |  |  |
| --- | --- | --- |
| ***sum*** | ***EXCHANGE of configuration specified in ADDR*** | ***A/B*** |
| 00 | STOP Motion | 00 |
| 01 | Effect the WATER settings – W1-W6 & W8 only | 01 |
| 02 | Effect the LIGHT settings | 02 |
| 16 | Place “A” configurations into “B” | 10 |
| 32 | Place “B” configurations into “A” | 20 |

Note- combine bits above to EXCHANGE A & B for Water and/or Lights

1. ***Table J – Sweep to Limit or Between Limits***

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1. ***Table K – LED Color Select***

|  |  |  |
| --- | --- | --- |
| ***select*** | ***Color Palette #*** | ***A/B*** |
| 000 | LED OFF | - |
| x01-x32 | Color Palette 1-32 where X = Intensity (0-9) | - |
|  | Where X @ 0=100%, 1=10% 🡪 9=90% Intensity |  |
| NOTE | COLORS 1-15 MUST MATCH TABLE C1 |  |

1. ***Table L – FADE***

|  |  |  |
| --- | --- | --- |
| ***select*** | ***Time interval in .01 secs*** | ***A/B*** |
| xxx | 0.10 - 9.99 secs. | - |

Note – FADE FCW must be immediately followed by a Color & Intensity FCW for the SAME fixture/group address to specify the Color and Intensity to FADE UP or FADE DOWN to. A new color in the following FCW will cause a CROSS FADE to occur.

Example – 601 100 501 520, FADES LED fixture 1 from the current Color and Intensity to color palette #20 at intensity 50%.

1. ***Table M – Maintenance Data (not choreography use)***

|  |  |  |
| --- | --- | --- |
| ***select*** | ***Selected Creations for ADDR*** | ***A/B*** |
| na | All maintenance functions OFF | 00 |
| 97 | Reset ALL water & PLC functions | - |
| 98 | Disables ALL Outputs for Testing | - |
| 99 | Enable Mode for 97 or 98 Data | - |

# PROGRAM EXAMPLE

Following is an excerpt from a program contained in the standard library.

11:30.5006­049 050­010 049­012

11:31.7009­016 049­004 050­002 049­006 050­010

11:33.5099­000 099­000

11:34.5054­001 054­001

11:54.0005­021 004­020 002­019 005­033 004­033 002­033

11:55.0008­020 008­033 049­004 050­001

11:56.0005­064 004­064 002­064 008­064 049­006 050­005

11:56.2054­000 054­000

11:57.0005­000 004­000 002­000 008­000 049­001 050­003

11:58.0005­064 004­064 002­064 008­064 049­006 050­005

11:59.0005­000 004­000 002­000 008­000 049­001 050­003

12:00.0005­064 004­064 002­064 008­064 049­006 050­005

12:03.0006­051 052­008 000­002

12:06.2101­888 104­025 106­889 107­024

12:06.4122­888 123­025 125­889 128­024

12:06.6181­050 182­050 183­050 184­050 185­050 186­050 187­050 188­150

12:06.9032­001 000­003

It is inserted here as an exercise for the novice programmer. Use the example and the specification for a learning exercise.

# REVISION HISTORY

2.7.14 FCL-03.00.01 REV3 – Initial Final Draft Document

2.9.14 FCL-03.00.04 – Added LED modules [100-255] addresses & data table M – Color Select, Removed A/B Data value for LED lights. Added second Data Function Table of new FCW commands. Added Fade & Strobe FCW.

2.11.14 FCL-03.00.05 – Added ADDRESSES 252, 253, 254 – Fade & Strobe ALL LEDs

2.12.14 FCL-03.00.06 – Added Reorder some LED FCW addresses

2.15.14 FCL-03.00.07 – Added LED fixture references L1-L40 and water references W1- W9 to correlate with fountain layout drawing

2.24.14 FCL-03.00.08 – Modified description of Address 048d and Table A data “1-5” and “64”. Added level “6” for “Wedding Cake” for address 048d.

3.19.14 FCL-03.00.09 – Added Addresses 038 & 039 and Data Table D2 to control Sweep speeds independently for left & right sweeps.

3.20.14 FCL-03.00.10 – Reversed Bytes in Data in Tables D1 & D2 for Sweep Speed & Distance.

3.28.14 FCL-03.00.11 – Added Address 040 and Table D3 for new Sweep Mode. Added footnote to Table A for “Wedding Cake” water heights.

4.4.14 FCL-03.00.12 – Added Address 047 for new Multi-Mode. Effects water valves W1-W6. Added Table A2 to support this address.

4.4.14 FCL-03.00.13 – Changed references to Sweeps as Left and Right and deleted A & B Sweep references to avoid confusion with A & B water modules. Changed Mode references for Addresses 033 & 034 from A & B to T = Sync Together and O = Sync Opposed for the same reason.

4.5.14 FCL-03.00.14 - Changed Address 040 to 042. Added Address 040 for change both sweep speeds at same time.

9.4.14 FCL-03.00.15 – Readdressed most new LED FCW & simplified numbering. Removed Strobing. Updated Data Tables. Expanded Color Table K to include INTENSITY. Added rule for Fade UP. See Table L.

10.14.14 FCL-03.00.16 – Added 127 & 227, Peacock Light Group A & B Fade Up & Fade Down, 027 will be used to control Peacock Lights Color & Intensity selection. Individual Peacock Light Groups A (025) & B (026) will not be supported.

10.28.14 FCL-03.00.17 – Added 149-150 & 249-250, Module A &B LEDS Fade Up & Fade Down. 049 & 050 will be used to control Module A & B lights Color & Intensity.

11.03.14 FCL-03.00.18 – Eliminated FADE DOWN FCWs. FADE command is now one FCW and FADE UP or FADE DOWN is determined by the FCW immediately following the FADE FCW. The immediately following FCW must be for the same LED fixture or group. The FADE will occur UP or DOWN depending on the current intensity and the new intensity specified by the immediately following FCW. A new color may be specified in the immediately following FCW which will cause a cross fade to occur.