GRAND HAVEN MUSICAL FOUNTAIN
FOUNTAIN COMMAND LANGUAGE [FCL]
FOUNTAIN COMMAND WORD [FCW]
REFERENCE

Version 4.05

07/01/2023

Table of Contents

I. 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 and in the tables that follow.

Command lines begin with a time signature followed by FCW 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 AAA-DDD 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 “Data” 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 the reference Tables A thru O.

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 the 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 “BCD” 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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II. Table 1 - Addresses for physical devices

ADDR	Data Table	Description of fountain action / location	BCD	Added
001	A1	W1 - Module Outside Ring Water with 10 foot diameter	01	<2013
002	A1	W2 – 2A Helix, 2B WAVE supply (2nd ring water 7' dia. Repurposed 2017)	02	2018
003	A1	W3 - Module Third ring Water with 4-foot diameter	03	<2013
004	A1	W4 - Module Inner ring Water with 2-foot diameter	04	<2013
005	A1	W5 - Module Center water – Single Spout	05	<2013
006	A1	W6 - Sweep water on left and right of module	06	<2013
007	A1	W7 - A=Bazooka, B =Tall water center spout (VOICE)	07	<2013
008	A1	W8 - Candelabra water in front of module	08	<2013
009	B1	W9 - Front (A) / WAVE (B) Water	09	2017
010	B2	W10 – Peacock (direct FCW. Data 0-5 only. Bypass removed.)	0A	2017
011	B2	W11 – Helix (direct FCW. Data 0-5 only)	0B	2017
012	B2	W12 – WAVE water control (direct FCW. Data 0-5 only)	0C	2017
013	B2	W13 – Dove Tail water control (direct FCW, Data 0-5 only)		
016	E	Selected Lights from the table	10	2015
017	C1/K	Module #1 Lights (left end as viewed from river)	-	<2013
018	C1/K	Module #2 Lights	-	<2013
019	C1/K	Module #3 Lights	-	<2013
020	C1/K	Module #4 Lights	-	<2013
021	C1/K	Module #5 Lights	-	<2013
022	C1/K	Module #6 Lights	-	<2013
023	C1/K	Module #7 Lights (right end as viewed from river)	-	<2013
024	C2	Back Curtain Lights (Green & Yellow only)	-	<2013
025	C1/K	Peacock Light Group A	-	<2013
026	C1/K	Peacock Light Group B	-	<2013
027	C1/K	Peacock Light Group A + B	-	<2013
033	D1	Sweep motion in T mode – Left and Right Sync TOGETHER	21	<2013
034	D1	Sweep motion in O mode – Left and Right Sync OPPOSED	22	<2013
035	J	Sweep to Limit – Both Left & Right Sweeps	23	2014
036	J	Sweep to Limit – Left Sweep	24	2014
037	J	Sweep to Limit – Right Sweep	25	2014
038	D2	Sweep Speed – Left Sweep	26	2014
039	D2	Sweep Speed – Right Sweep	27	2014
040	D2	Sweep Speed – Both Left & Right Sweeps	28	2014
041	C1/K	*Peacock Light Group B [041 = Legacy for Playback Only]	-	<2013
042	D3	Sweep Mode (Left & Right) – Independent, Together or Opposed	2A	2014

ADDR	Data Table	Description of fountain action / location	BCD	Added
047	A2	Multi-Valve – W1-W6 progressive level to Wedding Cake	2F	2014
048	A1	Water Modules W1-W6 & Wedding Cake formation	30	<2013
049	C1/K	Module A lights (ODD 1, 3, 5, 7, modules)	-	<2013
050	C1/K	Module B lights (EVEN 2. 4. 6, modules)	-	<2013
051/052	C1/K	Module A and B lights [052 = Legacy for Playback Only]	-	<2013
053	C1/K	LEGACY reserved – [ALL LIGHTS}	-	<2013
054	F	Automatic LEGACY cataloged formations [Voice water & light]	36	<2013
055	K	Center Spout LED (VOICE) – ALL COLORS	-	2014
056	K	Front Curtain LEDs – EXCLUDES Back & Center Module Spots	-	2014
057	K	Back Curtain LEDs - INCLUDES ALL COLORS	-	2014
069	*H	Repeat JUMP level (Pulse) Sweep Water @ 0.5 sec. **OBSOLETE**	45	<2013
080	*I	Interchange A & B module formations of water & light. **OBSOLETE**	50	<2013
085	*G	Shift/Rotate Module 1-7 lights–Uses Address 086 **OBSOLETE**	-	<2013
086	Time	Set LIGHT shift timer interval – in 0.01 secs. [025-255] **OBSOLETE**	-	<2013
087	Time	T1 interval for WAVE sol alternator. 0-9.99 secs.	57	2017
088	Time	T2 interval for WAVE sol alternator. 0-9.99 secs.	58	2017
089	Time	T3 firework on time. 0-.999 secs.	59	2017
090	Time	S – WAVE sol sequence time. 0-9.99 secs.	5A	
091	Int	R – Random max number of nozzles per interval. 1-9.	5B	
099	M	TURN OFF everything and reset to idle condition – Data = 00	63	<2013
117	L	MODULE 1 (017) ALL LEDs – FADE UP OR DOWN	-	2014
118	L	MODULE 2 (018) ALL LEDs – FADE UP OR DOWN	-	2014
119	L	MODULE 3 (019) ALL LEDs – FADE UP OR DOWN	-	2014
120	L	MODULE 4 (020) ALL LEDs – FADE UP OR DOWN	-	2014
121	L	MODULE 5 (021) ALL LEDs – FADE UP OR DOWN	-	2014
122	L	MODULE 6 (022) ALL LEDs – FADE UP OR DOWN	-	2014
123	L	MODULE 7 (023) ALL LEDs – FADE UP OR DOWN	-	2014
127	L	PEACOCK LED GROUP A & B (027) – FADE UP OR DOWN	-	2014
149	L	MODULE A LEDS (049) – FADE UP or DOWN	-	2014
150	L	MODULE B LEDS (050) – FADE UP or DOWN	-	2014
155	L	CENTER SPOUT LEDs (VOICE/055) – FADE UP or DOWN	-	2014
156	L	FRONT CURTAIN LEDs (056) – FADE UP OR DOWN	-	2014
157	L	BACK CURTAIN LEDs (057) – FADE UP OR DOWN	-	2014

ADDR	Data Table	Description of fountain action / location	BCD	Added
217	N	Module 1 WAVE Sols 0-6		2017
218	N	Module 2 WAVE Sols 7-13		2017
219	N	Module 3 WAVE Sols 14-20		2017
220	N	Module 4 WAVE Sols 21-28		2017
221	N	Module 5 WAVE Sols 29-35		2017
222	N	Module 6 WAVE Sols 36-42		2017
223	N	Module 7 WAVE Sols 43-49		2017
249	N	Module A WAVE Sols		2017
250	N	Module B WAVE Sols		2017
251	N	Left WAVE Sols: 0-24		2017
252	N	Right WAVE Sols: 25-49		2017
253	N	Odd WAVE Sols: 1,3,5,7,….49		2017
254	N	Even WAVE Sols: 0, 2,4,6,8,….48		2017
255	N	ALL WAVE Sols		
501-545	K	LED FIXTURE 1- 45 Color Select. Ex. 501 = Module 1	-	2014
601-645	L	LED FIXTURE 1- 45 FADE UP OR DOWN. Ex. 601 = Module 1	-	2014
700-749	N	WAVE Sols 0-49		2017
750-896	N	Reserved for WAVE Sols 50-196		2017
900-999	R	Custom FCW, Raw Data sent through with Address to DMX & PLC		2018

*OBSOLETE FUNCTIONS

III. DATA / FUNCTIONS

A. Table A1 – Module water level - Legacy

sum	*Selected water height*	*BCD*
0	Water level off and bypass valve closed	0
1-5	*Water level setting – height from 1 to 5	1-5
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

*** **NOTE** – Bypass valves connecting A to B modules disconnected 2014.
**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*	*BCD*
0	Water level off and bypass valve closed	0
1-5	*Water level height from 1 to 5 progressive	1-5
6	**Wedding Cake – (047d only)	6
16	Module A water valves (odd numbered) only	10
32	Module B water valves (even numbered) only	20

**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.

B. Table B1 – Front Curtain, WAVE, and Peacock water level

sum	*Selected water height*	*BCD*
0	Water level off	0
1-5	Water level setting – Select a height from 1 to 5	1-5
16	Front Curtain water valves only	10
32	WAVE water valves only	20
96	*Peacock ON / Back Curtain OFF - Bypass valve	40

Data 32 & 96 are mutually exclusive. All others may sum.
***NOTE** – JULY 2015: Back Curtain & Bypass removed. Legacy programs that call for Back Curtain with or without Bypass will cause Peacock to activate.

Table B2 – Water Level only. Helix added 2017.

sum	*Selected water height (non - water module)*	*BCD*
0	Water level off	0
1-5	Water level setting – Select a height from 1 to 5	1-5

C. Table C1 – Legacy Light colors

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

D. Sweep Tables D1 – D2 – D3

Table D1 – Sweep speed, Legacy command pre-2014

sum	*Selected motion for sweep mode*	*BCD*
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
112	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 (sum) Data = 8 to Pause and any other Data value to resume.

Table D2 – Sweep speed, new command 2014

Data	*Selected motion for sweep mode*	*BCD*
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
112	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)*	*BCD*
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.

E. Table E – Selected special lights

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

F. Table F – Cataloged configurations

Data	*Selected Creations or groups*	*BCD*
0	All OFF	0
1	Voice of the Fountain water and lights ON	1

G. Table G – Module light shifting. OBSOLETE

sum	*Selected Module light shifting actions*	*BCD*
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	-

NOTE – 01/02 & 16/32 are mutually exclusive. OBSOLETE since lighting moved to PC in 2014.

H. *Table H – Module water JUMP data. OBSOLETE*

sum	*AUTO-JUMP type selection for water*	*BCD*
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. Phase 0 by default.

I. *Table I – Module water & light exchange pattern. OBSOLETE*

sum	*EXCHANGE of configuration specified in ADDR*	*BCD*
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. 16/32 mutually exclusive. Exchange pattern use is OBSOLETE since lighting removed from PLC (2014).

J. Table J – Sweep to Limit or Between Limits

ADDRESS	DESCRIPTION	DATA	DESCRIPTION	DATA	DESCRIPTION
		SWEEP TO LIMITS		HOLD AT LIMIT	
35	SET LIMITS BOTH SWEEPS	19	RIGHT LONG TO RIGHT VERY SHORT	17	HOLD AT RIGHT LONG
36	SET LIMITS LEFT SWEEP	20	RIGHT LONG TO CENTER	34	HOLD AT RIGHT SHORT
37	SET LIMITS RIGHT SWEEP	21	RIGHT LONG TO LEFT VERY SHORT	51	HOLD AT RIGHT VERY SHORT
Sweep from Right Water Limit to Left Water Limit If Right = Left Limit, Hold at Limit <u>NOTE:</u> These water commands are opposite of sweep cylinder motions and are with respect to sweep water motions.		22	RIGHT LONG TO LEFT SHORT	00/68	HOLD AT CENTER
		*23	RIGHT LONG TO LEFT LONG	85	HOLD AT LEFT VERY SHORT
		36	RIGHT SHORT TO CENTER	102	HOLD AT LEFT SHORT
		37	RIGHT SHORT TO LEFT VERY SHORT	119	HOLD AT LEFT LONG
		*38	RIGHT SHORT TO LEFT SHORT	OSCILLATE AT LIMIT	
		39	RIGHT SHORT TO LEFT LONG	18	@ RIGHT LONG (1<->2)
		54	RIGHT VERY SHORT TO LEFT SHORT	35	@ RIGHT SHORT (2<->3)
		55	RIGHT VERY SHORT TO LEFT LONG	52	@ RIGHT VERY SHORT (3<->4)
		70	CENTER TO LEFT SHORT	53	@ CENTER (3<->5)
		71	CENTER TO LEFT LONG	69	@ LEFT VERY SHORT (4<->5)
		87	LEFT VERY SHORT TO LEFT LONG	86	@LEFT SHORT (5<->6)
		* Legacy Distances		103	@ LEFT LONG (6<->7)

NOTE – Address & Data shown in decimal format only.

K. Table K – LED Color Select

Data	*Color Palette #*	*BCD*
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 1,2,4,& 8 MUST MATCH TABLE C1	
01	Red	
02	Blue	
03	Violet	
04	Yellow (Amber)	
05	Orange	
06	Green	
07	Magenta	
08	White	
09	Pink	
10	Lt. Blue	
11	Lt. Violet	
12	Lt. Yellow	
13	Lt. Orange	
14	Lt. Green	
15	Cyan	

L. Table L – LED FADE

Data	*Time interval in .01 secs*	*BCD*
xxx	0.1 - 99.9 secs. (1-999)	-

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 – 601 101 501 520, FADES LED fixture 1 from the color palette #1 (Red) and Intensity 100% to color palette #20 at intensity 50% over 10 seconds.

M. Table M – Maintenance Data (not for choreography use except 99-00)

Data	*Selected Functions for ADDR*	*BCD*
00	All water levels to zero and All LEDs OFF	-
01-05	All water to level of data	-
77	Skip lighting LED reset at start of next song	-
90	PV screen control – return to Main screen	
91	PV screen control – Pot Feedback screen	
92	PV screen control – FCW display screen (countdown)	
93	PV screen control – WAVE screen	
97	Reset ALL water & PLC Maintenance Functions	-
98	Disables ALL Outputs for Maintenance Testing	-
99	Enable Maintenance Mode for 97 or 98 Data. Exposes PV+ access on Maintenance screen.	-

N. Table N – WAVE Solenoid Operation

COMMAND	DATA		
	L2R	R2L	X-Over
OFF	0		
ON (continuous)	1		
FIREWORK (One shot. Use T3 for ON)	2		
PULSE T1(4) or T3(6) ON & T2 OFF	4/6		
PULSE T2(8) or T3(10) ON & T1 OFF	8/10		
WAVE (using T1 for ON)	16	32	48
WAVE (with FIREWORK)	18	34	50
WAVE (Stay ON) assumes OFF at start	80	96	112
WAVE (Turn OFF) assumes ON at start	145	161	177
WAVE (@INTERVAL Time)	272	288	304
*Random – defines # of modules on	512		

NOTES – Set T1 & T2 for "Alternate/Pulsing" ON/OFF with addresses 87 & 88 respectively. Set T3 for FIREWORK effect with address 89. Set S time with address 90 for the duration of a WAVE sequence from start to end. Valve on time "INTERVAL" is calculated by S time divided by the number of solenoids in the sequence. Data selections "16-304" are not applicable for individual WAVE solenoid addresses 700-892. L2R = Left to Right R2L = Right to Left X-Over = Cross-Over (both L2R & R2L, i.e. starts at both ends). *Random only applies to ALL (255). Set maximum random nozzles with address 91.

IV. PROGRAM EXAMPLE

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

```
11:30.5 006-049 050-010 049-012
11:31.7 009-016 049-004 050-002 049-006 050-010
11:33.5 099-000
11:34.5 054-001 054-001
11:54.0 005-021 004-020 002-019 005-033 004-033 002-033
11:55.0 008-020 008-033 049-004 050-001
11:56.0 005-064 004-064 002-064 008-064 049-006 050-005
11:56.2 054-000
11:57.0 005-000 004-000 002-000 008-000 049-001 050-003
11:58.0 005-064 004-064 002-064 008-064 049-006 050-005
11:59.0 005-000 004-000 002-000 008-000 049-001 050-003
12:00.0 005-064 004-064 002-064 008-064 049-006 050-005
12:03.0 006-051 052-008 000-002
12:06.2 101-888 104-025 106-889 107-024
12:06.4 122-888 123-025 125-889 128-024
12:06.6 181-050 182-050 183-050 184-050 185-050 186-050 187-050 188-150
12:06.9 032-001
```

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

V. 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 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 – Changed FADE UP & 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.

8.10.15 FCL-03.00.19 – Documented FCW address 010 for Peacock programming direct. Bypass and Back Curtain removed (July 2015). Updated Presto to address 112 instead of 102.
2.25.16 FCL-03.00.20 - Changed table L to be in .1 sec increments instead of .01 to match Playback Software and .1 sec ticks in Choreography Software.
6.1.17 FCL-03.00.21 – Formatting updates.
6.3.17 FCL-04.00.01 – WAVE Sol FCWs added. Added Table N. Helix FCW added. Formatting improvements.
7.9.17 FCL-04.00.02 – Expanded Table N. for Helix FCW. Added Data 064-512. Address 12 added for WAVE flow control.
7.22.17 FCL-04.00.03 – Expanded Table K to show color pallet.
8.23.17 FCL-04.00.04 – Clarified Table N and Notes below.
2.10.18 FCL-04.00.04 R2 – Added Random to Table N (Future feature)
5.12.18 FCL-04.00.04 R3 – Updated Address 2 description for new Helix & WAVE
6.21.18 FCL-04.00.05 R1 – Added Custom FCW 900-999 to support custom codes to DMX
5.13.21 FCL-04.00.05 R2 – Updated descriptions & markings of **OBSOLETE** functions
3.29.22 FCL-04.00.05 R3/R4 – Added Dove FCW 013
5.28.23 FCL-04.00.05 R5 – updated Table M for 99-xx codes.
7.1.23 Fountain Command Language Rev 4.05 – renamed file for clarity.

CS Help Notes

Color Cross Fade –

- Left click on start color
- Right click on new color
- Shift click and drag area of cross fade
- Type ‘x’ or right click/cross fade

Programming the “DOVE” – added in 2022.

The DOVE water level slider works like all others with the following exceptions:

1) If you want the DOVE to rotate, go directly from level zero to level 5. The simulator does not currently show rotation.
2) If you want the DOVE to stay stationary, go from level zero to any level other than 5. Example – if you want level 5 stationary, go to level 4 first, and then .1 sec. later you may go to level 5.
3) If the DOVE is rotating, go to level zero to catch it to the stationary position. The sequence to catch the DOVE takes several seconds. Leave the DOVE off for 5 seconds to allow the catch sequence to complete before using it again.

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WAVE PROGRAMMING PRIMER

GENERAL DESCRIPTION – The "WAVE" refers to the 50 valves located along the back 200 ft. of the fountain – one every 4 feet. They are numbered 0-49 (left to right as viewed by the audience) and can be controlled individually or in defined groups. They actuate at very high speed and can be used to "hit" individual notes of the music. There are over 500 possible "WAVE" valve command combinations.

PROGRAMMING TIP - Most of the WAVE commands are supported by the Choreography Software (CS) under the "WAVE Setup" parameter dialog box. Other commands can be entered using the "Manual FCW Input" function (FCW – Function Command Word). Right click on the Water timeline and select "Manual FCW Input". Type in the address-code. Multiple commands are accepted. A space is required in between each command with a dash between the address and the data. A full list of FCW commands is available in the document entitled "Fountain Command Language Rev x.xx", available on request.

GROUPS – WAVE valves are arranged in the following groups for programming convenience:

MOD 1: WAVE valves behind water module 1. i.e. valves 0-6. Address 217.

MOD 2: WAVE valves behind water module 2. i.e. valves 7-13. Address 218.

MOD 3: WAVE valves behind water module 3. i.e. valves 14-20. Address 219.

MOD 4: WAVE valves behind water module 4. i.e. valves 21-28. Address 220.

MOD 5: WAVE valves behind water module 5. i.e. valves 29-35. Address 221.

MOD 6: WAVE valves behind water module 6. i.e. valves 36-42. Address 222.

MOD 7: WAVE valves behind water module 7. i.e. valves 42-49. Address 223.

MOD A: WAVE valves behind odd water modules. i.e. modules 1,3,5,7. Address 249.

MOD B: WAVE valves behind even water modules. i.e. modules 2,4,6. Address 250.

LEFT: WAVE valves on the left side of the fountain. i.e. valves 0-24. Address 251.

RIGHT: WAVE valves on right side of the fountain. i.e. valves 25-49. Address 252.

ODD: Odd numbered WAVE valves. i.e. valves 1,3,5, through…..47, 49. Address 253.

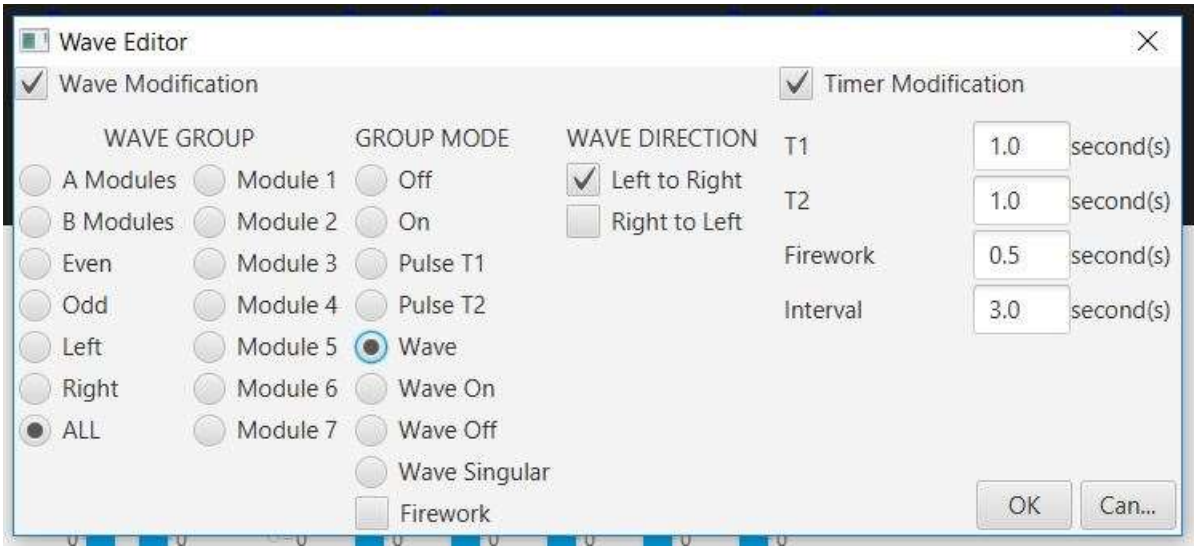
EVEN: Even numbered WAVE valves. i.e. valves 2,4,6, through…..46, 48. Address 254.

ALL: All the WAVE valves. i.e. 0-49. Address 255.

WAVE groups may be turned ON or OFF using the "On" / "Off" buttons in the "WAVE Setup" parameter dialog box. Click "WAVE Setup / Wave Modification / Select Group / On or Off.

PROGRAMMING TIP - You may program multiple WAVE FCW at the same time stamp IF they affect different WAVE valves. This may require multiple "WAVE Setup" entries. **EXAMPLE** – Left and Right or Even and Odd.

WAVE VALVE FEATURES – Any WAVE group may be programmed with many different features supported in the Choreography Software using the "WAVE Setup"/ "WAVE Editor". These features include many types of "WAVE" and "Pulsing" modes.



WAVE MODES – A "WAVE" is a sequence of WAVE valves by group. This could be any of the groups listed above. Multiple WAVEs can occur at the same time BUT only if they do not affect each other. In other words, starting a second WAVE command that affects the same WAVE valves will immediately terminate the prior FCW operation on valves in common with the two groups, BUT groups which do not contain the same WAVE valves may have simultaneous WAVE commands.

PROGRAMMING TIP – Start the "Left" WAVE group with a "Left to Right" "WAVE DIRECTION" and the "Right" WAVE group with a "Right to Left" "WAVE DIRECTION" and they will meet in the middle and crossover. This may require two "WAVE Setup" configurations at the same time stamp on the music timeline. Any two groups which are mutually exclusive (they don't share any of the same valve numbers) may be programmed this way.

WAVE SEQUENCES - WAVE sequences may proceed left to right, right to left, or cross-over in the center of the group. A cross-over starts from each end of the group simultaneously and meets/crosses-over in the middle and proceeds to each end of the group. To select a "Cross-over" WAVE, you simply select both "Left to Right" and "Right to Left" for "WAVE DIRECTION". These WAVE sequences are well simulated in the CS to give a general impression of the effect on the fountain. The exact appearance of course will be quite different on the fountain, but the simulation will help you visualize what is expected to happen. The timing will be quite close to how it is simulated.

A "normal" WAVE sequence is selected with the "WAVE" setting under the "Group Mode" within the "WAVE Setup" parameter dialog box. The "normal" WAVE is why the feature is called the "WAVE". It looks like a crowd of spectators at a sporting event doing "the WAVE". You must select a direction for the WAVE. "Left to Right" or "Right to Left" or both (causing a cross-over).

A "**WAVE ON**" sequence assumes the WAVE valves in the chosen group are OFF at the beginning of the WAVE sequence. During the WAVE sequence, the WAVE valves in the sequence will cycle ON one at a time. At the end of the WAVE sequence, all the WAVE valves in the chosen group will stay ON.

PROGRAMMING TIP – A WAVE ON sequence might normally be followed by a WAVE OFF sequence, although it would be equally acceptable to simple turn the chosen group OFF later by using a simple group OFF command for the same group.

A "**WAVE OFF**" sequence assumes that the WAVE valves in the chosen group are ON at the beginning of the WAVE sequence. During the WAVE sequence, the WAVE valves in the chosen group will be cycled OFF in sequence. At the end of the WAVE sequence all the WAVE valves in the chosen group will be OFF.

PROGRAMMING TIP - A "WAVE OFF" might normally be proceeded with a "WAVE ON", although it would be equally acceptable to use simply turn the chosen group ON at an earlier time using a simple group ON command for the same group.

A "**WAVE Singular**" sequence will cycle the WAVE valves in the chosen group <u>one at a time</u>. The ON time for each valve in the group will be determined by dividing the total sequence time ("Interval") by the number of valves in the chosen sequence group.

WAVE SEQUENCE TIMERS - The amount of time that each WAVE valve stays on during the "WAVE" sequence depends on the "Timer Modification" settings in the "WAVE Setup". In general, the default ON time is controlled by timer T1. This timer is adjusted in the CS "WAVE Setup" by checking the box for "Timer Modification" and adjusting the time setting for T1. Optionally, if the setting for "Firework" is checked in the "Group Mode", then the "Firework" timer will be used to control the ON time. The intent is for the "Firework" timer to be used as a short time which will give a quick burst from the chosen group WAVE valves resembling a firework display.

PROGRAMMING TIP – The "Firework" feature can be selected in the Group Mode with "ON" or "WAVE". When used with the "ON" mode, the valves in the chosen group will all turn ON at the same time, but they will only be ON for the length of time specified by the "Firework" timer. When used with the "WAVE" mode, the valves in the chosen group will turn on in WAVE sequence, but they will only be ON for the length of time specified by the "Firework" timer. Typically, .5 sec is a good setting for a firework effect.

The "**Interval**" timer controls the entire length of time for the WAVE to sequence from start to finish, not including the ON time of the last valves in the group to complete their cycle.

PROGRAMMING TIP – Adjust the "Interval" time to equate to one stanza or riff of music, so that the music and the WAVE finish together.

Timer T2 is not used for WAVE sequences and will be described in the following section on "Pulsing" modes.

PULSING MODES – There are two pulsing modes, "Pulse T1" and "Pulse T2". The purpose of the "Pulsing" modes is typically to alternate opposing groups. **EXAMPLES** – Left vs Right, or Even vs Odd, or Mod A vs Mod B. "Pulsing" stays active until another WAVE code affecting the same WAVE valves commands them to do something else. This can eliminate a lot of programming by allowing a dramatic visual effect for many stanzas with only a couple of commands.

In the "Pulse T1" Group Mode, the valves ON time is set by the T1 timer, and the valves OFF time is set by the T2 timer.

In the "Pulse T2" Group Mode, the valves ON time is set by the T2 timer, and the valves OFF time is set by the T1 timer.

PROGRAMMING TIP – Set the T1 and the T2 times the same and equal to the beat time of the music. Set one WAVE group as "Pulse T1" and an opposing group as "Pulse T2". **EXAMPLE** – Set "WAVE Group" "Left" to "Pulse T1" in the "Group Mode" AND "WAVE Group" "Right" to "Pulse T2" in the "Group Mode". This will require two separate entries in the "WAVE Setup" BUT can be made at the same time stamp and therefore executing both commands simultaneously.

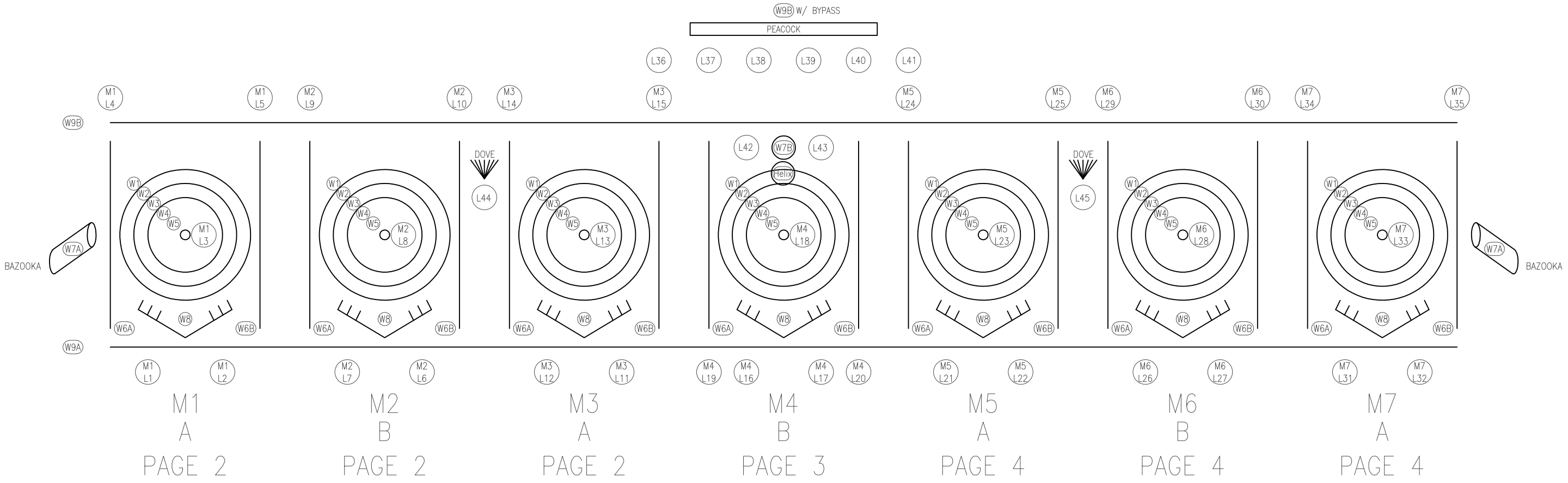
If "Firework" is selected with either of these Group Modes, then the ON time is controlled by the "Firework" timer instead of corresponding T1 or T2 timers but the interval between on times should still be controlled by T1 and T2.

INDIVIDUAL WAVE VALVES – Individual WAVE valves can be turned ON or OFF using codes 7xx, where xx is the valve #. Data is 001 for ON and 000 for OFF. Example: 705-001 turns ON the WAVE valve 5. 705-000 turns OFF the WAVE valve 5. Use the "Manual FCW Entry" feature. A fountain layout map is available on request. (Fountain Layout Drawing R23.pdf)

PROGRAMMING TIP – Programming of individual WAVE valves will not be highly visible by the audience. Consider using WAVE Groups instead (Mod 1 through Mod 7 for example). Individual WAVE valves must be programmed using the "Manual FCW Input" feature. However, WAVE groups are supported in the Choreography Software/WAVE Setup (CS).

GENERAL TIPS –

- The WAVE streams are not as prominent on the fountain as it is on the simulator.
- Be careful about putting water in front of the WAVE. The WAVE is in the very back of the fountain, so all other water features are in front of it. It is quite visible with Water module Rings 5 or 4 on, but you will find Rings 1 and 3 of the Water Modules will effectively visibly block the audience's view of the WAVE streams. The same is true with the sweeps. Keep a low water level or they will obscure the WAVE streams.
- One strategy that works well with the WAVE is to put up the A Modules as desired and leave the B modules off. Then use the space of the B Modules for WAVE effects. Vice versa with the A off and the B on.
- Minimum time for WAVE on (T1, T2, or Firework) should be .4 secs. Less than that is not enough time for the water to escape the valve and create a stream. One half second is probably the optimal time for the "Firework" effect.
- Minimum time for a WAVE interval should be 1 second or more. Set this interval time equal to a riff or sequence in the music for maximum effect.
- If you turn the back LEDs on to backlight the WAVE using Manual FCW, they will stay the programmed color until you turn them back off, using Manual FCW input.
- One WAVE command will abort a prior WAVE command and start the new one if the same WAVE valves are involved in both commands. In other words, make sure you don't start one WAVE until the last WAVE has time to finish. The amount of time to finish is the Interval time plus the T1 (or Firework time if that is selected) on time.



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title: WATER AND LIGHTING LAYOUT

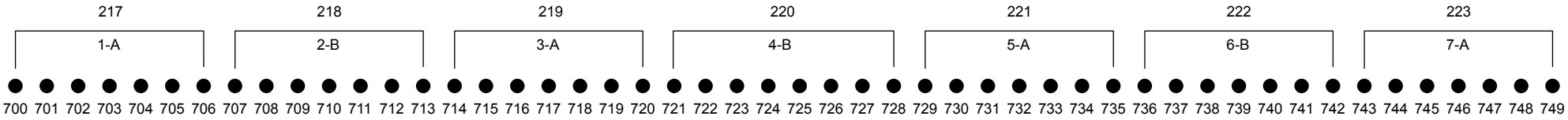
GRAND HAVEN MUSICAL FOUNTAIN

designed by	date	description	project
TLS	5/14/15	FULLDIAGRAM	XXXX
drawn by	date	filename	no. shts / sht no.
CTG	8/10/22	01FULLDIAGRAM.DWG	8 / 1

APEX Controls Project #8373 File: 01FULLDIAGRAM.DWG – Last Revised 5/14/2015 (3:19:51 PM)

GHMF Wave Vales

Individual Valve Control



7xx-001 = On

7xx-000 = Off

Example: Open the first and last vale of Module 3.

1. In the software, go to the time marker you want the vales to turn on, then tap W
2. Enter the valve number like this: 714-001, 720-001

When controlling individual valves, you are responsible for turning them on and off. If you have individual vales on, and then call a normal wave function, the individual valves will be canceled out.

If you have several vales up and quickly want to turn them all off, use the All - Off function in the Wave Setup rather than entering several individual off commands.