**VIDEOTRON**

Master Control Switcher MS-6416HD/SD

# APC Control specifications

2012/3/26

## 1. Protocol

1. Communications Signal
   a) Asynchronous bit serial, word serial
   b) Conforms to EIA RS-422
   c) Full duplex communications channel
   d) Transfer rate: 38400bps

2. Bit configuration
   a) 1 start bit (space)
   b) 8 data bit
   c) 1 parity bit (odd)
   d) 1 stop bit (mark)
   e) Byte time = 0.286 ms

## 2. Packet structure

1) A COMMAND packet is composed with from 2 to 256 Bytes.
2) Byte 0: STX, Start of Transmission Code, 0x02 is given.
3) Byte 1 – 2: BC, Byte Count, count number from Byte 3 to Byte m, the number is binary format and Byte 1 is the most significant byte.
4) Byte 3: MID, Machine ID Code, 0x51 is given for the master control switcher.
5) Byte 4: CMD-1, Command code-1, is composed with two nibbles; a command type nibble and a unit address nibble, which defines the address of a subsystem in a device. The unit address will not be used by the system.
6) Byte 5: CMD-2 identifies the syntax of the data.
7) Byte 6 – m: DATA, the number of data bytes is determined by the command. The value of DATA is given with ASCII code.
8) Byte m+1: Checksum, summing data from MID to DATA n and logical products of 0x7F. Refer Appendix for an example.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | m | m+1 |
|---|---|---|---|---|---|---|---|---|---|
| STX (0x02) | BC-1 (MSB) | BC-2 (LSB) | MID (0x51) | CMD -1 | CMD -2 | DATA 1 | DATA 2 | DATA n | Checksum |

## 3. COMMAND Execution

1) The switcher should respond the command within 6msec after received it.
2) The controller should not request the status within the frame interval (16msec) after command was issued.
3) The controller should request the status, if the switcher does not respond the command within 100ms.
4) The switcher needs 16ms at least to execute the command, because commands are sampled with VD interval.
5) Refer Appendix 4. Flowchart for Command execution.

# 4. COMMAND Specification

Command Code **20.01** means CMD1=0x20 and CMD2=0x01.

## 1. 20.01; Request Transition/Take.[TAKE]

**Executes Transition as Preset (20.03).***

DATA 1: Execution code.
0, (0x30): On-Air the Preset Channel and reports the Status Change (30.01).**
1, (0x31): Drop the On-Air PGM and PST Over level.
2, (0x32): Drop the On-Air Key level.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-01 | | 30 | 22 |

Note*: TAKE command should be issued more than 8 frame (>266msec) after PRESET command was issued.

**Return (20.81)**: OK ('O' = 0x4f ) or Not OK ('N' = 0x4e )

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-81 | | 4F | 41 |

Note**: TAKE execute with transition, the switcher should report Status Change at timing of transition. Refer appendix 'Timing of Status Change'.

## 2. 20.02; Request Direct Program Channel Change.[PGM]

**Change the Program Source directly as following Channel.**

DATA 1-2: On-Air Video channel number, ex. (0x30. 0x31) ***
DATA 3-4: On-Air Audio Channel number, ex. (0x30. 0x31) ***

Note: All DSK and Audio Over are made Off-air, if DSK and Audio Over are On-air insides when this command is executed.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | CS |
| 02 | 00 | 07 | 51 | 20-02 | | 30-31 | | 30-31 | | 35 |

**Return (20.82)**: OK ('O') or Not OK ('N')

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-82 | | 4F | 42 |

Note***: Data for channel number is described in Appendix.

## 3. 20.03; Request Preset.[PST]

**Preset the Preset Bus, Transition Type, Transition Rate.**

DATA 1-2: Preset Video channel* or DSK channel** number, ex (0x30. 0x46)
DATA 3-4: Preset Audio channel* or DSK channel** number, ex (0x30. 0x46)
DATA 5: Transition Type.
- T, (0x54): Cut-out and cut-in.
- M, (0x4d): Dissolve or Mix.
- F, (0x46): Fade-out and Fade-in.
- >, (0x3e): Fade-out and Cut-in.
- <, (0x3c): Cut-out and Fade-in.
- W, (0x57): Wipe.
- K, (0x4b): Select DSK channel as DATA 1-2 **

DATA 6: Transition Rate.
- C, (0x43): Cut.
- F, (0x46): Fast transition rate.
- M, (0x4d): Middle transition rate.
- S, (0x53): Slow transition rate.

Note *: Set the same channel number for Video and Audio, because the switcher does not have breakaway function.
Note **: If 'K' was selected in DATA5, DATA1-2 should be DSK channel, and set the same channel number for DATA3-4.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | DT5 | DT6 | CS |
| 02 | 00 | 09 | 51 | 20-03 | | 30-46 | | 30-46 | | 46 | 43 | 69 |

**Return (20.83)**: OK ('O') or Not OK ('N')

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-83 | | 4F | 43 |

## 4. 20.04; Request Over Direct In/Out.[OVER]

**Execute Over In or Out directly and reports the Status Change (30.01).**

DATA 1: Over In or out.
0, (0x30): Over in
1, (0x31): Over out
DATA 2-3: Over Channel number.
1, (0x30·0x31): Channel 1
2, (0x30·0x32): Channel 2
DATA 4: Transition Type, must be 'O' only. (0x4f)
DATA 5: PST Over or PGM Over.
0, (0x30): PST over
1, (0x31): PGM over

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | DT5 | CS |
| 02 | 00 | 08 | 51 | 20-04 | | 30 | 30-31 | | 4F | 30 | 1B |

**Return (20.84)**: OK ('O') or Not OK ('N')

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-84 | | 4F | 44 |

## 5. 20.05; Request Key Direct In/Out.[DSK]

**Execute Key In or Key Out directly and reports the Status Change (30.01).**

DATA 1: Key In or Out
0, (0x30): Key In.
2, (0x32): Key Out.
DATA 2-3: Key Channel number.
1, (0x30·0x31): Key 1
2, (0x30·0x32): Key 2
3, (0x30·0x33): Key 3
DATA 4: Transition Type, must be 'K' only. (0x4b)
DATA 5 contains Transition Rate.
F, (0x46): Fast transition rate.
C, (0x43): Cut In or Cut out.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | DT5 | CS |
| 02 | 00 | 08 | 51 | 20-05 | | 30 | 30-31 | | 4B | 46 | 18 |

**Return (20.85)**: OK ('O') or Not OK ('N')

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-85 | | 4F | 45 |

## 6. 20.06; Request Audio Output Assign.

**Assign Output Channel for Audio.**

DATA 1-2: Channel number of input.
DATA 3-4: Output channel (or Track) number of Audio.
DATA 5-6: Input channel (or Track) number of Audio.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | DT5 | DT6 | CS |
| 02 | 00 | 09 | 51 | 20-06 | | 30 | 31 | 30 | 31 | 30 | 31 | 1A |

**Return (20.86)**: OK ('O') or Not OK ('N')
(Communication Error status [40.01,xx])

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-86 | | 4F | 46 |

## 7. 20.10; Request Machine Status.[STATUS]

**Send the Machine Status.**

DATA 1: Request type.
0, (0x30): Send All Status of On-Air and Preset.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-10 | | 30 | 31 |

**Return (20.90)**; **Report Machine Status.**

DATA 1-2: On-Air Video Channel number, ex. (0x30.0x31)
DATA 3-4: On-Air Audio Channel number, ex. (0x30.0x31)
DATA 5-6: DSK Key In Channel number.
0, (0x36 0x33): All DSK are Key Out.
1, (0x30 0x31): DSK1 is Key In.
2, (0x30 0x32): DSK2 is Key In.
3, (0x30 0x33): DSK3 is Key In.
4, (0x30 0x34): DSK1 and 2 are Key In.
5, (0x30 0x35): DSK1 and 3 are Key In.
6, (0x30 0x36): DSK2 and 3 are Key In.
7, (0x30 0x37): DSK1, 2 and 3 are Key In.
DATA 7-8: Audio Over Channel number.
0, (0x36 0x33): All Over are off.
1, (0x30 0x31): PST EXT1 Audio Over.
2, (0x30 0x32): PST EXT2 Audio Over.
3, (0x30 0x33): PGM EXT1 Audio Over.
4, (0x30 0x34): PGM EXT2 Audio Over.
5, (0x30 0x35): PST EXT1 and PGM EXT1 are Audio Over.(Reserved)
6, (0x30 0x36): PST EXT1 and PGM EXT2 are Audio Over.(Reserved)
7, (0x30 0x37): PST EXT2 and PGM EXT1 are Audio Over.(Reserved)
8, (0x30 0x38): PST EXT2 and PGM EXT2 are Audio Over.(Reserved)
DATA 9-10: Preset Video channel or DSK channel number, ex. (0x30.0x46)

DATA 11-12: Preset Audio channel or DSK channel number, ex. (0x30.0x46)
DATA 13: Preset Transition Type.
T, (0x54): Cut-out and cut-in.
M, (0x4d): Dissolve or Mix.
F, (0x46): Fade-out and Fade-in.
>, (0x3e): Fade-out and Cut-in.
<, (0x3c): Cut-out and Fade-in.
W, (0x57): Wipe.
K, (0x4b): DSK channel is selected as DATA 9-10.
DATA 14: Transition Rate.
C, (0x43): Cut.
F, (0x46): Fast transition rate.
M, (0x4d): Middle transition rate.
S, (0x53): Slow transition rate.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Continue next page |
|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | |
| 02 | 00 | 11 | 51 | 20-90 | | 30-31 | | 30-31 | | |

| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| DT5 | DT6 | DT7 | DT8 | DT9 | DT10 | DT11 | DT12 | DT13 | DT14 | CS |
| 30-37 | | 36-33 | | 30-46 | | 30-46 | | 54 | 46 | 19 |

**Notify)**
Enable the field DATA 15 to set the APC Mode when Add APC MODE STATE of SYSTEM CUSTOMIZE PAGE 2-6 in main menu is ON.

DATA 15: APC Mode
0x30: APC Mode is Auto/Manual Mode.
0x31: APC Mode is Auto Mode.
0x32: APC Mode is Manual Mode.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Continue next page |
|---|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | DT4 | |
| 02 | 00 | 12 | 51 | 20-90 | | 30-31 | | 30-31 | | |

| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DT5 | DT6 | DT7 | DT8 | DT9 | DT10 | DT11 | DT12 | DT13 | DT14 | DT15 | CS |
| 30-37 | | 36-33 | | 30-46 | | 30-46 | | 54 | 46 | 30 | 49 |

## 8. 20.11; Request Take Synchronization.

**Execute Take Operation for both switchers of Main and Sub at the same time. And return status of it.**
Notify: This function is valid when both TAKE INTERLOCK in SYSTEM CUSTOMIZE PAGE 3-1 and MS INTERLOCK in PAGE 2-2 on menu are ON.

DATA 1: Assign Take Synchronization.
0x30: Take Synchronization is ON.
0x31: Take Synchronization is OFF.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-11 | | 31 | 33 |

**Return (20.91)**: OK ('O') or Not OK ('N')
(Communication Error status [40.01,xx])

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-91 | | 4F | 51 |

## 9. 20.12; Request Audio Remapping.

**Execute Audio Remapping. And return status of it.**
Notify: This function is valid when AUDIO REMAPPING in SYSTEM CUSTOMIZE PAGE 3-3 is ON.

DATA 1: Assign Audio Remapping.
0x30: Audio Remapping is ON.
0x31: Audio Remapping is OFF.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-12 | | 31 | 34 |

**Return (20.92)**: OK ('O') or Not OK ('N')
(Communication Error status [40.01,xx])

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 20-92 | | 4F | 52 |

## 10. 30.01; Report Status Change.[CHANGE]

**The Switcher should report the Status when Interrupt is occurred.**

DATA 1: Show Interrupt, AUTO TRANSITION starts. Show is occurred.
0, (0x30): No Change.
1, (0x31): Show Interrupt is occurred.
DATA 2: End of Transition Interrupt, End of AUTO TRANSITION, completion of DIRECT PROGRAM CHANGE.
0, (0x30): No Change. Completion of DSK TAKE and OVER TAKE
1, (0x31): End of Transition Interrupt is occurred.
DATA 3: Button Interrupt, Switch button of PGM row is pressed.
0, (0x30): No Change.
1, (0x31): Button Interrupt is occurred.
Note: Button Interrupt occurring switches are following,
PGM row - black,1～16,back color/color bar
OVER group - ext1, ext2, fade, cut
DSK group - fade, cut, take of each DSK

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | DT2 | DT3 | CS |
| 02 | 00 | 06 | 51 | 30-01 | | 30 | 31 | 30 | 63 |

## 11.40.01; Communication Error Status.[ERROR]

**The Switcher should report the Status when communication error is occurred.**

DATA 1: Communication error.

1, (0x01): STX error; could not find STX code in the received word.
2, (0x02): Checksum error; received checksum is not coincide with calculated checksum.
4, (0x04): Data error; received data is not defined or over value etc.
8, (0x08): Counter error; received data in byte count is zero.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| STX | BC1 | BC2 | MID | CMD1 | CMD2 | DT1 | CS |
| 02 | 00 | 04 | 51 | 40-01 | | 01 | 13 |

# Appendix

## 1. Command Code List

| Index | Request/ Report | Command Code | Action | Data | Return Code | Return Data |
|---|---|---|---|---|---|---|
| 1 | Request | **20.01** | TAKE | DT1 | **20.81** | DT1 |
| 2 | Request | **20.02** | PGM | DT1 – 4 | **20.82** | DT1 |
| 3 | Request | **20.03** | PST | DT1 – 6 | **20.83** | DT1 |
| 4 | Request | **20.04** | OVER | DT1 – 5 | **20.84** | DT1 |
| 5 | Request | **20.05** | DSK | DT1 – 5 | **20.85** | DT1 |
| 6 | Request | **20.06** | – | DT1 – 6 | **20.86** | DT1 |
| 7 | Request | **20.10** | STATUS | DT1 | Report* | – |
| | Report* | **20.90** | STATUS | DT1 – 14 | – | – |
| 8 | Request | **20.11** | – | DT1 | **20.91** | DT1 |
| 9 | Request | **20.12** | – | DT1 | **20.92** | DT1 |
| 10 | Report | **30.01** | CHANGE | DT1 – 3 | – | – |
| 11 | Report | **40.01** | ERROR | DT1 | – | – |

Command Code **20.01** means CMD1=0x20 and CMD2=0x01

## 2. Data for Channel Number

Video/Audio channel number is indicating in two Hexadecimal digits. (CH8=0x30,0x38)
00 (0x30,0x30) :black video
01 (0x30,0x31)～16 (0x31,0x30) :input channel number
17 (0x31,0x31) :back color or color bar video

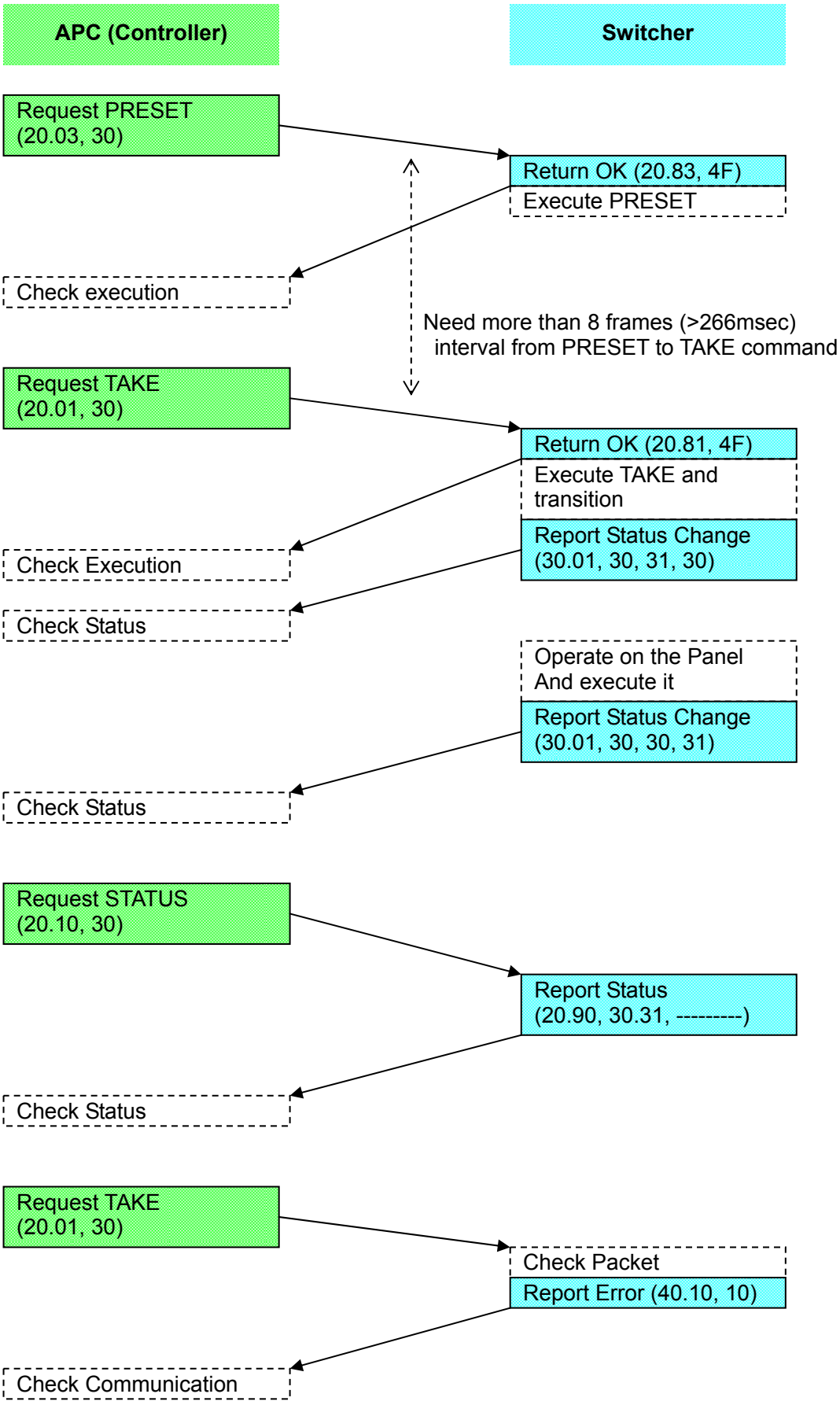
| CH | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| DT1 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 |
| DT2 | 0x30 | 0x31 | 0x32 | 0x33 | 0x34 | 0x35 | 0x36 | 0x37 | 0x38 |

| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|
| 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x30 | 0x31 | 0x31 |
| 0x39 | 0x41 | 0x42 | 0x43 | 0x44 | 0x45 | 0x46 | 0x30 | 0x31 |

## 3. Checksum calculation

For example, in case of the command 20.01,
Summation from MID to DATA 1, 0x51+0x20+0x01+0x30=0xA2
Logical Production for the checksum, 0xA2 AND 0x7F = 0x22
0x22 is the checksum.

## 4. Flowchart

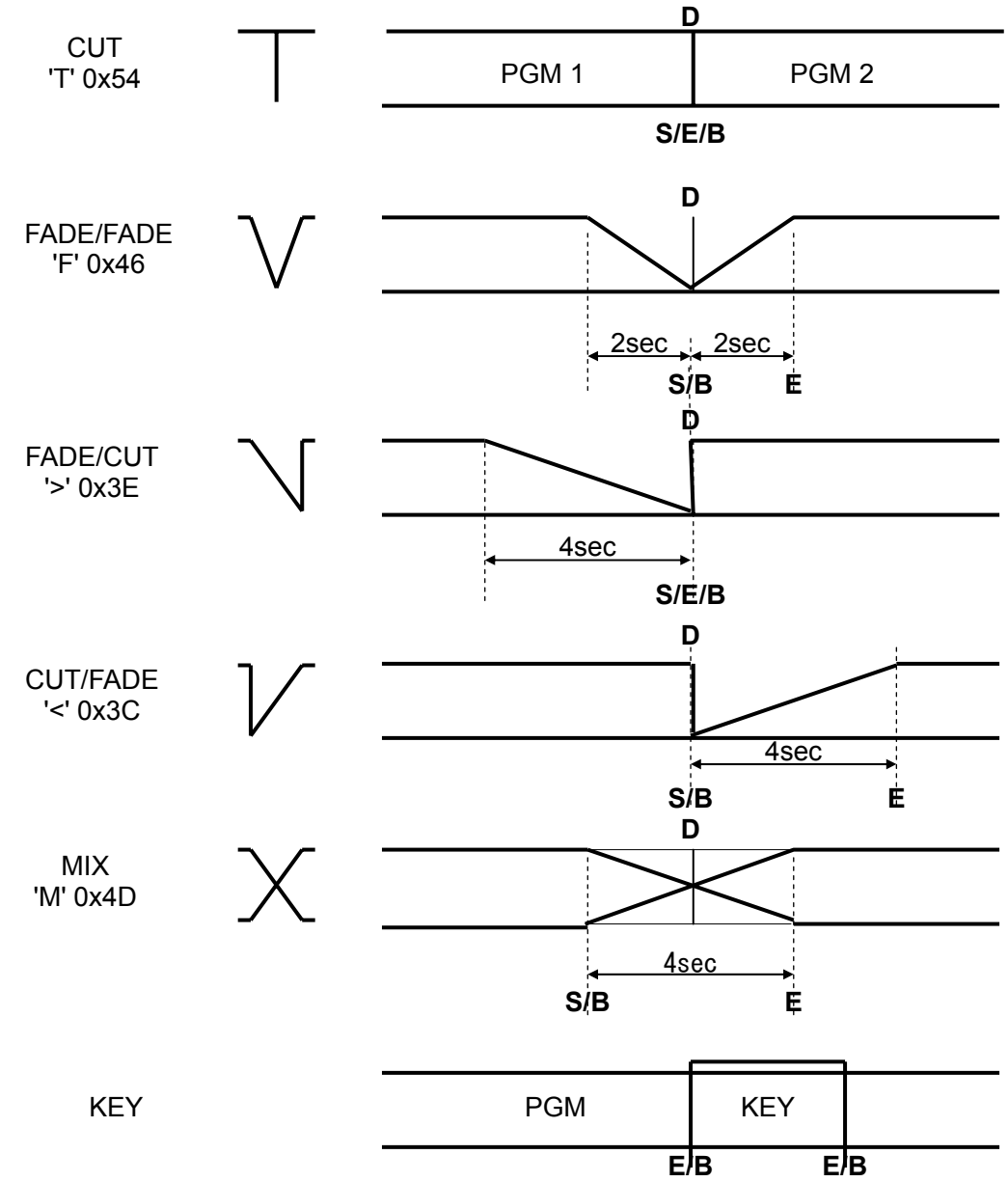

APC (Controller)
Switcher
Request PRESET
(20.03, 30)
Return OK (20.83, 4F)
Execute PRESET
Check execution
Need more than 8 frames (>266msec)
interval from PRESET to TAKE command
Request TAKE
(20.01, 30)
Return OK (20.81, 4F)
Execute TAKE and
transition
Report Status Change
(30.01, 30, 31, 30)
Check Execution
Check Status
Operate on the Panel
And execute it
Report Status Change
(30.01, 30, 30, 31)
Check Status
Request STATUS
(20.10, 30)
Report Status
(20.90, 30.31, ---------)
Check Status
Request TAKE
(20.01, 30)
Check Packet
Report Error (40.10, 10)
Check Communication

## 5. Timing of Status Change

Switcher should report the Status Chang at following timing.

**S**: Show Interrupt
**E**: End of Transition Interrupt
**B**: Button Interrupt, from operation panel

Transition Type
Symbol and code data




Note: Transition time of 4 seconds is an example.
'**D**' is changing point of LED display on operation panel.