Title: Technical Specification Requirement for Digital Video Control Unit

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Revision Instructions
1. Method of revision will be through the issue of new document.
2. Revision No. will be advanced by one letter.
3. Change Description and Reason(s) for Change to be recorded.

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1 INTRODUCTION

The Digital Video Control Unit (DVCU) is designed mainly for All Round Surveillance System (ARSS) and Close Hatch Driving (CHD).

1.1 CLOSE HATCH DRIVING (CHD)

Provide selection of real-time video images from cameras to the intelligent Driver Display Panel (iDDP) with minimal video latency introduced.

1.2 ALL ROUND SURVEILLANCE SYSTEM (ARSS)

Provide a selection of video images to achieve up to 360 degree view around the vehicle and independently send the images to the devices terminals.

2 OBJECTIVE

This Technical Specification (TSP) provides the information and technical requirements for the design, built and qualification of the Digital Video Control Unit.

The technical requirements includes configuration management, functional, performance, interface control, EMI/EMC, environment, safety, reliability & maintainability (R&M) and integrated logistics support (ILS) and acceptance requirements for the Digital Video Control Unit (DVCU).

3 REFERENCES

Document No.	Title
MIL-STD-461E	Requirements for the control of Electromagnetic Interference Emissions and Susceptibility.
MIL-STD-810E	Test Method standard for Environmental Engineering Consideration and Laboratory Tests.
MIL-STD-1472D	Human Engineering Design Criteria for Military System, Equipment and Facilities and Material.
IEC 61000-4-2	Electrostatic Discharge Immunity Test
IEC 60529	Degrees of Protection Provided by Enclosures
MIL-STD-1275B	Characteristics of 28 Volt DC Electrical Systems in Military Vehicles
FED-STD-595-C	Colors used in Government Procurement

It is assumed that the latest revisions of the mentioned standards are referred to, unless specifically stated.

In cases where non-military standards and specifications are used in lieu of the above, details of such standards and specifications shall be submitted to ST Kinetics for approval.

4 DEFINITIONS

Abbreviation	Definition
ARSS	All Round Surveillance System
BMS	Battle Management System
CHD	Closed Hatch Driving
CVBS	Composite Video Baseband Signal (Analog Video)
DC	Direct Current
DVCU	Digital Video Control Unit
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Induction
GigE	Gigabit Ethernet
HD	High Definition
ICS	Independent Commander Sight
iDDP	Intelligent Driver Display Panel
NUC	Non-Uniformity Correction
PAL	Phase Alternating Line
SD	Standard Definition
SDI	Serial Digital Interface (Digital Video)
TI	Thermal Image
VC	Vehicle Commander
TC	Trooper Commander
AVR	Audio Video Recorder
YCbCr	Digital Component Video
NTSC	National Television System Committee
GSU	Gun-Sight Unit

5 TECHNICAL SPECIFICATION

This section states in detail and define the various aspect of the technical specification of the DVCU.

5.1 DESIGN REFERENCES

- Video Streaming and Device Control Over Ethernet Standard Version 2.0.
- STANAG 2895 Extreme climatic and derived conditions for use in design/test criteria for NATO force.
- MIL-STD-810E Test Method standard for Environmental Engineering Considerations and laboratory test.
- MIL-STD-961D Department of Defence Standard Practice, Defence Specification.
- MIL-STD-461E Electromagnetic Emission and Susceptibility Requirements for control of Electromagnetic Interference.
- MIL-STD-1472D Human Engineering Design Criteria for Military System, Equipment and Facilities.
- MIL-HDBK-454 General Guideline for Electronic equipments.
- ISO-9001 Quality System Model for Quality Assurance in Design, Development, Production, Installation and Servicing.
- MIL-HDBK-217 Reliability Prediction for Electronic System.
- MIL-HDBK-338 Reliability Handbook.
- MIL-STD-1629 FMECA Handbook.
- MIL-STD-882D Department of defence standard practice, system safety.
- MIL-STD-498 Software development and documentation

5.2 PRODUCT QUALITY REQUIREMENT

The following requirements shall apply to the DVCU, referred to as the system in this section, where applicable.

5.2.1 GENERAL QUALITY REQUIREMENTS (GQR)

The following governing document shall be provided to contractor to meet the relevant quality standards for the fabrication, design, manufacturing and development of the DVCU.

Document No.	Title
M-SQ-002	Supplier Quality Requirements Rev.02

5.2.1.1 Electrical/Electronic Components/Assemblies

5.2.1.1.1 Jumper Wire

No jumper wires shall be used on any printed wiring assembly without prior approval from ST Kinetics. Components shall not be stacked up on printed wiring assembly. Written approval shall be obtained from ST Kinetics for each modification on any printed wiring board.

5.2.1.1.2 Conformal Coating

Conformal Coating shall be required for printed wiring and multi-layer boards in accordance with best practices. MIL-HDBK-454 or equivalent shall be used as a reference for conformal coating. Connectors and fastening devices shall be of high corrosion resistance grade to resist the environment that the Article may encounter as specified in the environmental requirements section.

5.2.1.1.3 Cable / Wire

Cable / Wire shall be of adequate design to prevent damage due to normal military operation. In particular, the joints between connectors and the cable shall be of a design that is strong enough to take the regular flexing and tension as well as keep out any moisture that may be expected during its use. Cable / Wire should be routed away from high temperature or moving parts. Cable / Wire shall not pass under / over sharp edges or points without suitable protection.

5.2.1.1.4 Supports

All parts weighing more than 7.1 grams per lead shall be supported by clamps or other mechanical means which defines mounting techniques for electronic components. Cables, harnesses or individual wires shall be supported by clamps located at sufficient spacing to eliminate sag or allow proper routing. For abrasion protection at points of contact, synthetic rubber stripping shall be used between wires and clamp.

5.2.1.1.5 Mounting of Axial and Non-axial Leaded Component

Axial and non-axial leaded components shall only be mounted on one side of PCB. Surface mount devices may be mounted on both sides of PCB. On mixed technology boards, through-hole components are preferred to be mounted only on one side.

5.2.1.1.6 Strain relief

Wires exiting from connectors shall be strain-relieved.

5.2.1.2 Mechanical Parts

5.2.1.2.1 Surface Defects

All parts shall be free from cracks and fractures. Surfaces shall be free from visible irregularities or defects. Conditions of acceptance and rejection of surface defects shall be defined in inspection plans

5.2.1.3 Workmanship Standards

The Contractor shall state the military or commercial workmanship standards applicable for production and re-work. The workmanship standards shall depict clearly the conditions of acceptance and rejection for characteristics requiring visual inspection

5.3 PRODUCT DESCRIPTION

The DVCU is a ruggedized enclosure unit that has multi-channel video (CVBS/SDI) receiver with multiple video outputs for CHD and ARSS displays. Using control interfaces like RS422, GigE Vision Control and Discrete I/O to select the required video input to be viewed on each display. RS422 interface can also be used to control the cameras if required.

The features shall include:

- 16x channel CVBS (PAL/NTSC)
- 18x channels SD-SDI input videos
- 6x channels HD-SDI inputs videos (Up to 1920x1080P)
- 3x CVBS low video latency output with multiplexer
- 4x GigE Vision interface each with independent selectable video matrix configuration
- 1x duplicates GigE Vision
- 5x RS422 control ports
- 8x Discrete I/O (24V/0V)
- Video deinterlacer and scaler.
- Emergency mode for the CVBS output to bypass internal video processing of CVBS inputs.
- Video image processing (Image stitching, Image Fusion and Heat Detection(Optonal))
- DC-DC convertor to provide 12V for cameras.
- DVCU BIT via GigE (BIT Protocol to be provided by OEM)

Figure 1 shows how the DVCU shall be connected to the various external devices.

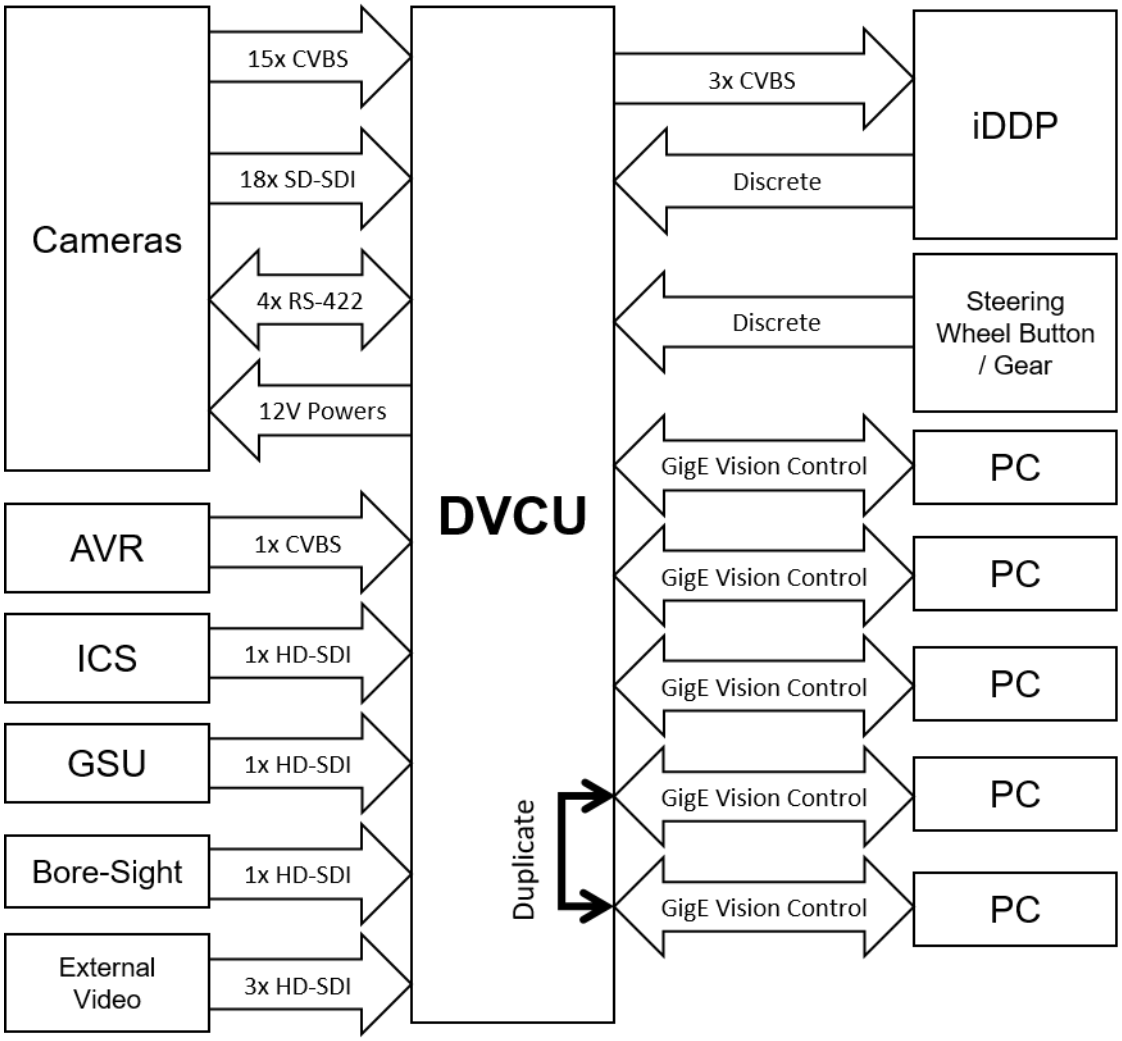
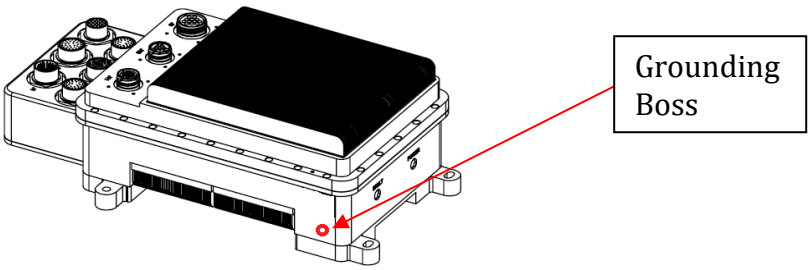


Figure 1: System Overview Interface to External Devices

5.4 DESIGN REQUIREMENT

The DVCU shall meet the following design specification and requirements.

No.	Description	Requirements	
5.4.1	Operating Power	Nominal Voltage:	28V DC
		Input Voltage Range:	18V to 32V
		Fuse	Resettable
		Reverse Polarity Protection	The system shall not operate with reverse polarity power input. Condition may last indefinitely and the unit shall not be damaged
5.4.2	Output Power for camera power	Nominal Voltage	12V DC
		No. of outputs (500mA)	9
		No. of outputs (700mA)	8
		Fuse	Resettable fuse for each output
5.4.3	Video Interface	CVBS Inputs	16x PAL
		CVBS Outputs (Driving)	3x PAL
		CVBS Outputs (Duplicate Driving)	3x PAL
		Ethernet (GigE Vision 2.0)	5x (1024x768 25Hz)
5.4.4	Control Interface	RS-422	5
		Discrete	8
		Ethernet	4
		Ethernet (Duplicate)	1
5.4.5	Video Latency	CVBS Outputs (Driving)	Typical 1 field (90% confidence level)
5.4.6	Qualification Standards	MIL-STD-461E	
		MIL-STD-1275B (Exclude 6V condition)	
		MIL-STD-810E	
		IP65	
5.4.7	Timestamp and Video Telemetries (Future Growth)	Timestamp and relevant video telemetries (frame's area of interest, FOV and position) shall be embedded into the digital video in accordance to Motion Imagery Standards Board (MISB) 0605.6 standard for uncompressed video to enable subsequent processing and/or exploitation of the video frames.	
5.4.8	Future Growth	Upgradability to increase digital/analog video inputs and outputs	
5.4.9	Start Up Time	Less than 50 Sec	

No.	Description	Requirements
5.4.10	Acoustic Noise Levels	Shall not produce audible noise during operations
5.4.11	Finishing	Black – Color Code: 27038. Reference to FED-STD-595-C Gloss Level between 30%-45% as defined in FED-STD-595-C (Exclude heat sink)
5.4.12	Chassis Connections	An earth boss (M6 thread) must be provided at the left side of the ebox. There shall be no DC connection between the chassis and electronics within the unit. The DC resistance between the DC ground and the earth boss shall be > 1MΩ. 
5.4.13	Environmental Stress Screening (ESS)	Test profiles to be recommended by the OEM and submitted to ST Kinetics for endorsement.
5.4.14	PCB Protection	Conformal Coating required.
5.4.15	Reworks and Jumpers	No manual reworks or jumper wire is allowed.
5.4.16	Connectors	MIL-STD Connectors shall be used All unused connectors shall be protected with a connector dust cover.
5.4.17	Mechanical Dimensions	OEM to submit 3D model and 2D drawings to ST Kinetics for endorsement.
5.4.18	Emergency Mode (CVBS Driving Video)	The system is to monitor CHD video processing module for failures. When a failure is detected, the CVBS input signal is to bypass the CHD video processing module and be directly routed it to the CVBS outputs.
5.4.19	No video input	When no video signal is detected, the output video for that video channels shall display a blue raster image.

No.	Description	Requirements
5.4.20	Health Status (BITS)	The DVCU shall provide system health status via the 5 GigE outputs. The health and utilization status shall include the following:
		• DVCU unique ID (BITS1)
		• Average system CPU load over five (5) minutes (BITS2)
		• Average system Memory Utilization over five (5) minutes (BITS3)
		• System CPU Temperature (BITS4)
		• Health Status data for driving and surveillance cameras as well as their associated Line-Replacement Units (LRUs) (BITS5)
		• Continuous BIT status of DVCU, driving and surveillance cameras (BITS6)

5.4.21 Heat Detection (Optional)

The DVCU shall be able to detect heat and highlight the hot object (up to 4 channels) as shown in **Figure 2**. Detailed functionality and requirements of heat detection shall be further defined and agreed upon between ST Engineering Land Systems and the OEM.

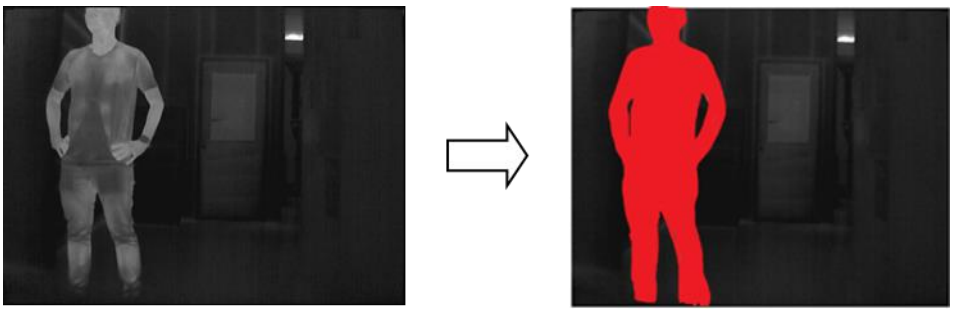


Figure 2: Heat Detection

5.5 SELECTION MATRIX

5.5.1 CAMERA VIEW ABBREVIATION

The table below and Figure 3 show the various camera positions, video formats and the corresponding abbreviation.

Cam ID	Camera Position	Abbreviation	Video Format
1	Front Left	FL	SD-SDI
2	Front Center	FC	SD-SDI
3	Front Right	FR	SD-SDI
4	Left Side Rear-A	LSR	PAL
5	Right Side Rear-A	RSR	PAL
6	Left Side Front	LSF	SD-SDI
7	Right Side Front	RSF	SD-SDI
8	ICS / Left FLS Cam (MCEV)	ICS	HD-SDI (1920x1080P)
9	Front Center TI	FCTI	SD-SDI
10	AVR	AVR	PAL
11	Left Side Center- A	LSC	PAL
12	Right Side Center- A	RSC	PAL
13	Rear Left-A	BL	PAL
14	Rear Center-A	BC	PAL
15	Rear Right-A	BR	PAL
16	Rear Near-A	BN	PAL
17	BVS-A (AVLB)	BVS	PAL
18	Bridge TOP DAY (AVLB)	BT	SD-SDI
19	Left Side Front TI	LFTI	SD-SDI
20	Right Side Front TI	RFTI	SD-SDI
21	Laying Arm TI (AVLB)	LAYTI	SD-SDI
22	Gun Sight Unit / Right FLS Cam (MCEV)	GS	HD-SDI (1920x1080P)
23	Laying Arm DAY (AVLB)	LAY	SD-SDI
24	Front Left-A	FL	PAL
25	Front Center-A	FC	PAL
26	Front Right-A	FR	PAL
27	Left Side Front-A	LSF	PAL
28	Right Side Front-A	RSF	PAL
29	Bridge TOP TI (AVLB)	BTTI	SD-SDI
30	Rear Left	BL	SD-SDI
31	Rear Center	BC	SD-SDI
32	Rear Right	BR	SD-SDI
33	Bore-Sight	BS	HD-SDI (1920x1080P)
34	Rear Center TI	BCTI	SD-SDI
35	EA Main Cam (MCEV)	EAM	HD-SDI (1920x1080P)
36	EA Stick Cam (MCEV)	EAS	HD-SDI (1920x1080P)
37	Bore-Sight-A	BS	PAL

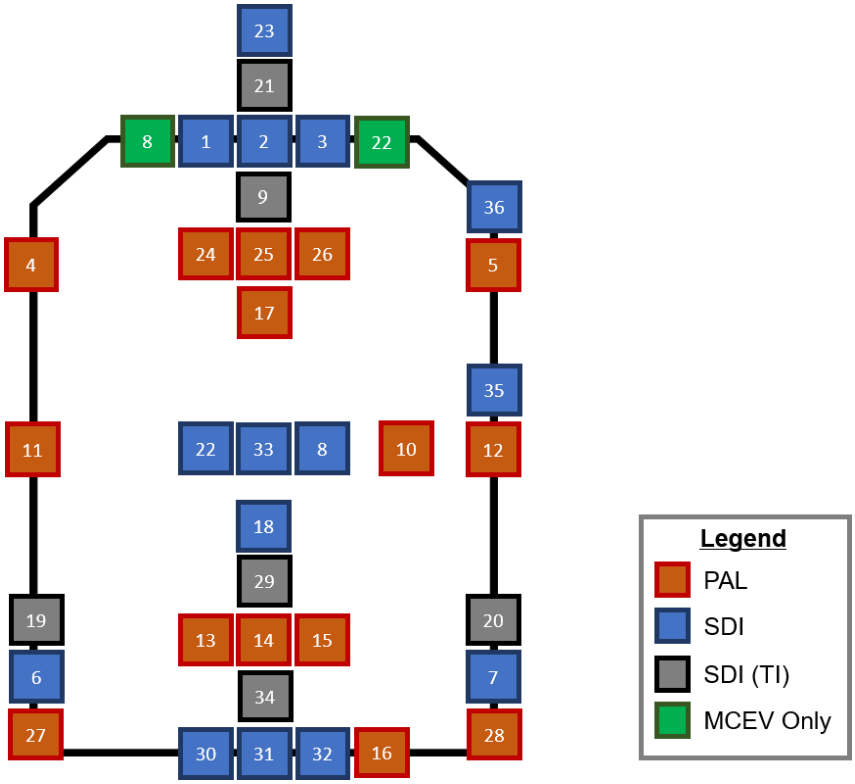


Figure 3: Cameras Positions

5.6 DEFAULT VIEW FOR CHD AND ARSS

After power on, the DVCU shall output the following default views for CHD and ARSS.

5.6.1 CHD

Video Outputs	Camera View
iDDP Left	LSFA (ID:27)
iDDP Center	FCA (ID:25)
iDDP Right	RSFA (ID:28)

5.6.2 ARSS

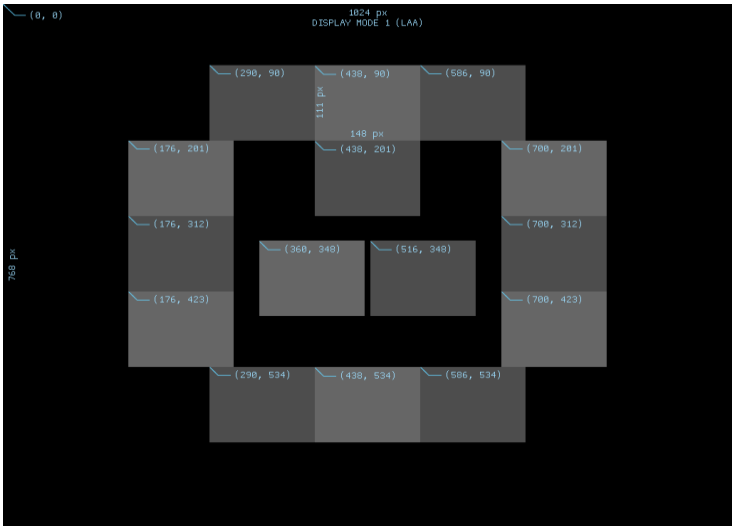
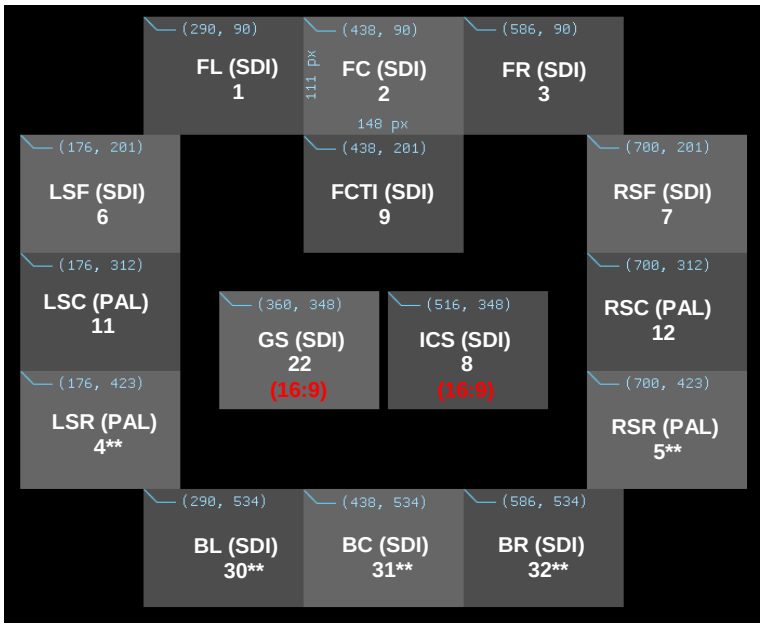
GigE Terminal	View Layout
Driver PC	**Refer to 5.8**
VC PC	
Gunner PC	
Trooper PC	
CCC PC	

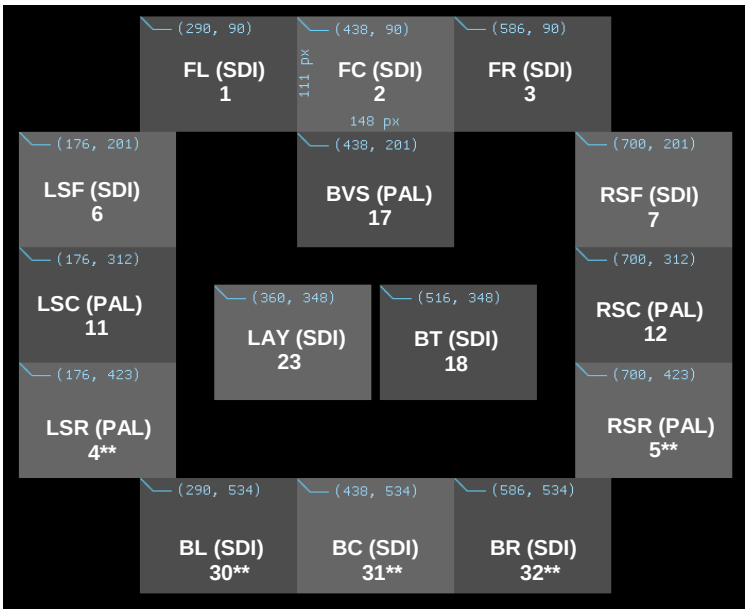
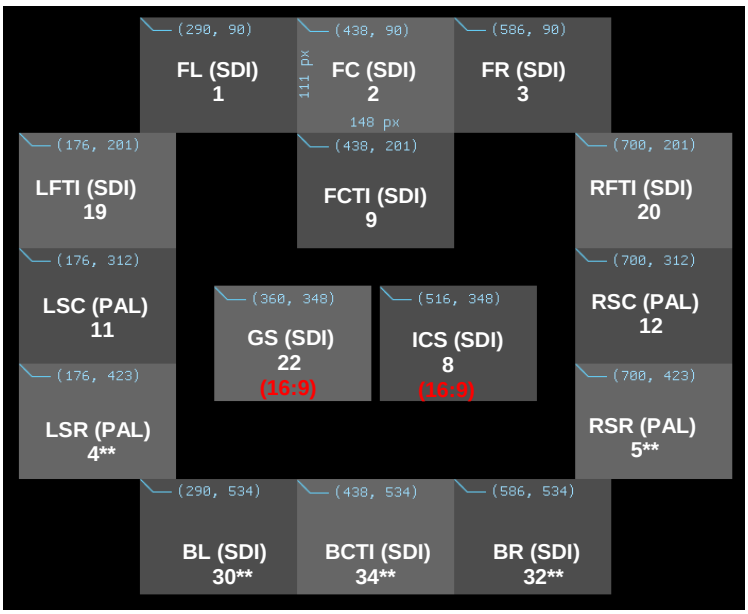
5.7 IP ADDRESS

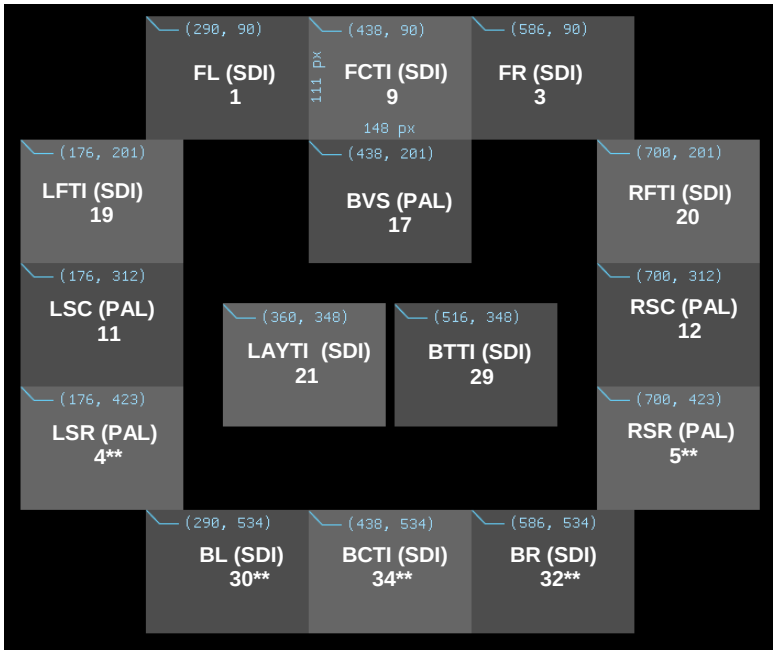
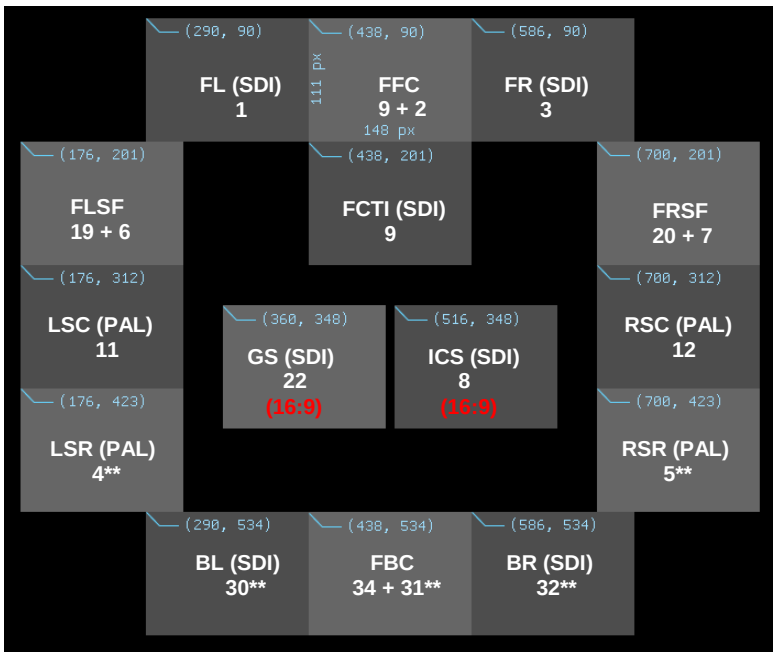
- Driver Terminal: 192.168.6.112
- Gunner Terminal: 192.168.6.113
- Vehicle Commander Terminal: 192.168.6.114
- Trooper Terminal: 192.168.6.115
- Duplicate Terminal: 192.168.6.116

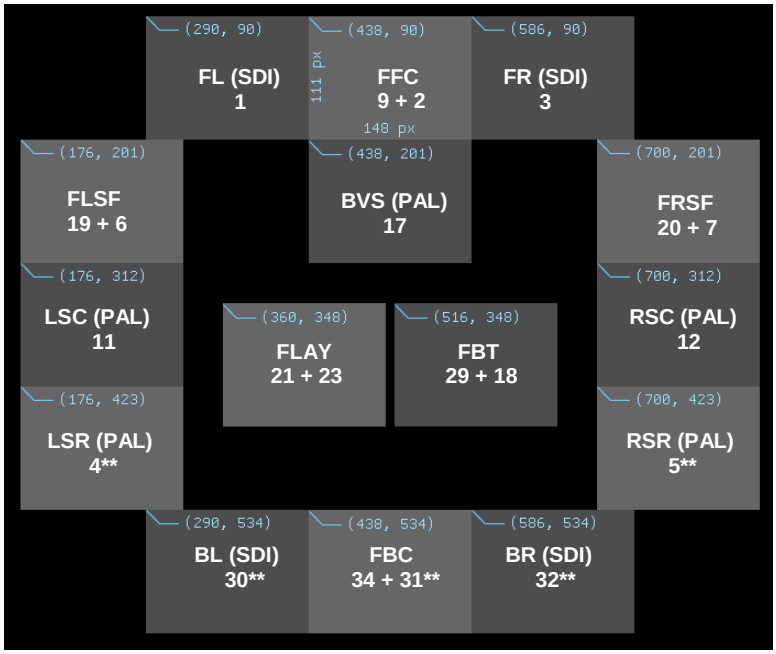
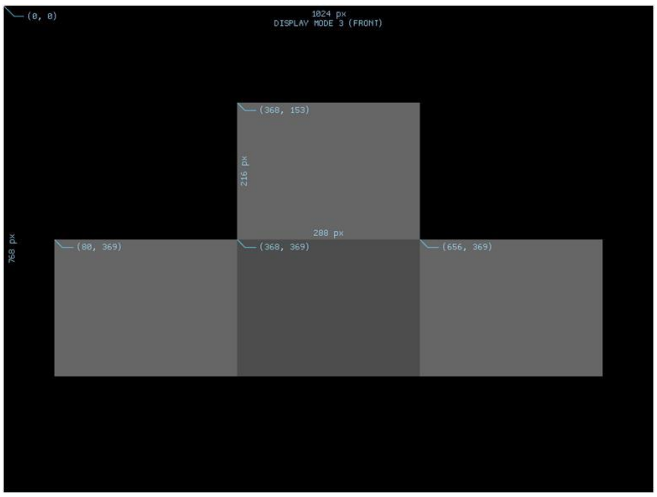
5.8 ARSS LAYOUT VIEW SELECTION PROTOCOL (GIGE VISION)

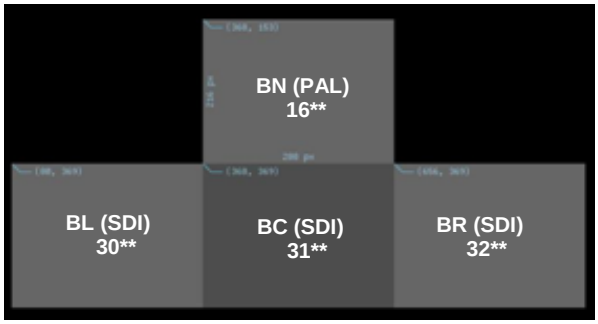
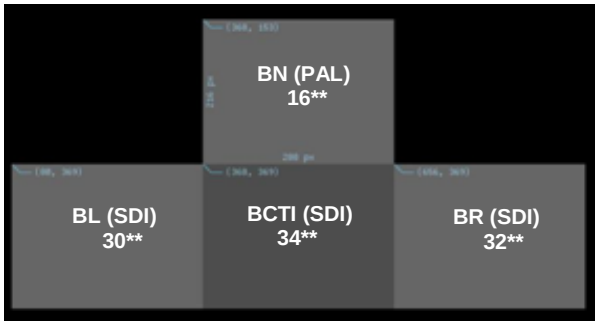
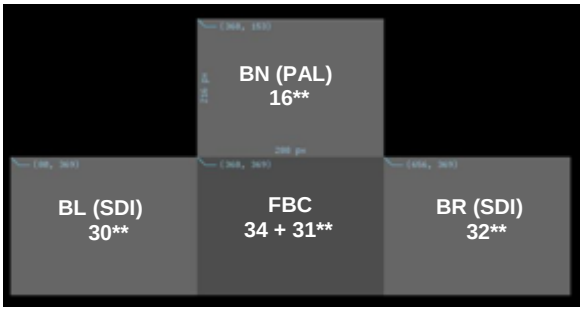
- The ARSS layout view selection shall be done via the GigE Vision Control Command.
- Once command protocol is sent to DVCU, the DVCU shall acknowledge by relying the same command protocol it received to the terminal.
- The ARSS layout views include, but not limited to, the below table.
- All HD-SDI videos shall be displayed in 16:9 format.

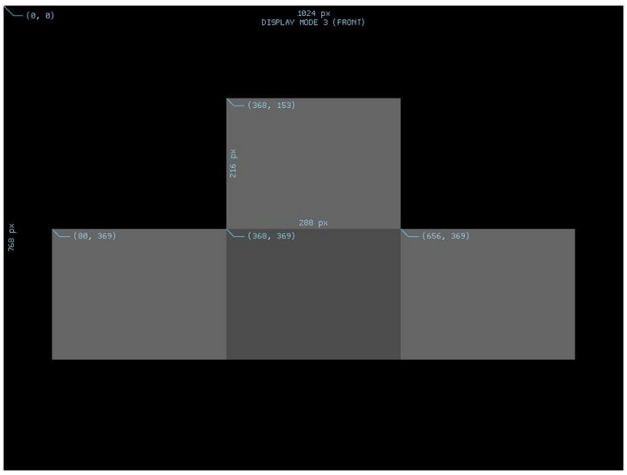
Display Mode	Protocol	Layout and Camera View Display mode pixel location (x,y) (**) Mirrored image
No.1	**All round View**	
No.1.1 Day Mode GCV Only	**0AAC**	

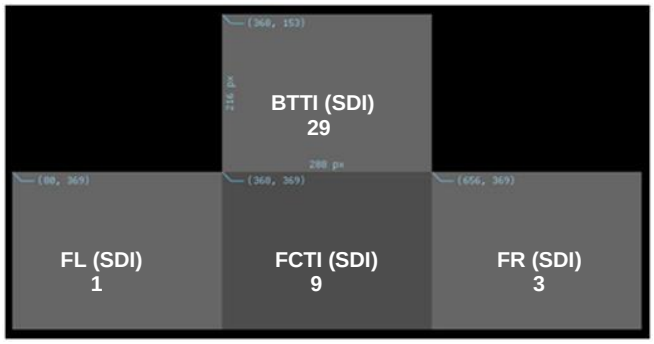
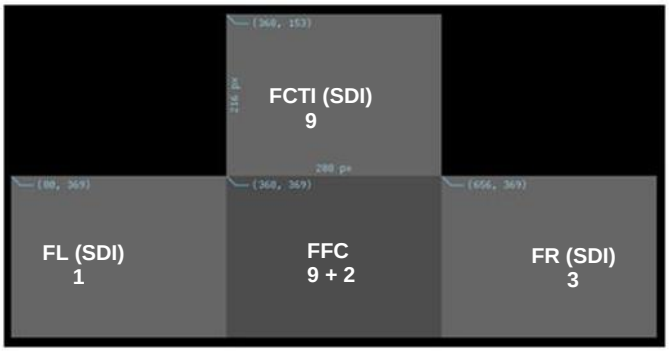
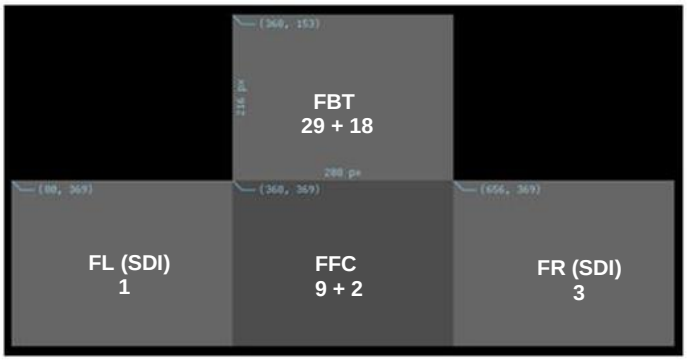
No.1.2 Day Mode AVLB Only	**00AC**	
No.1.3 TI Mode GCV Only	**AIAC**	

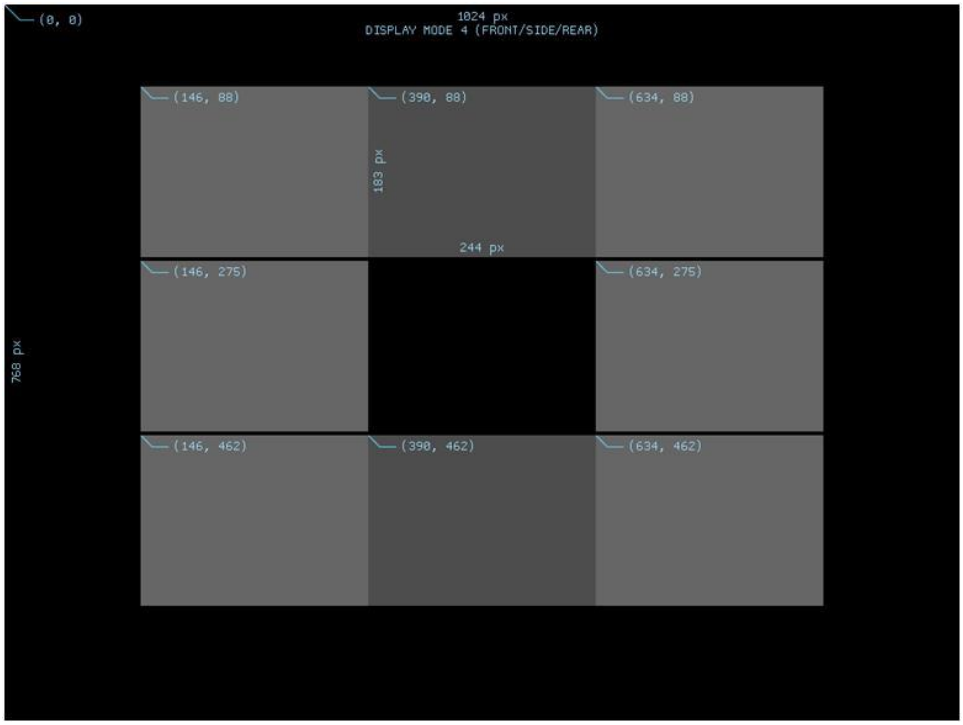
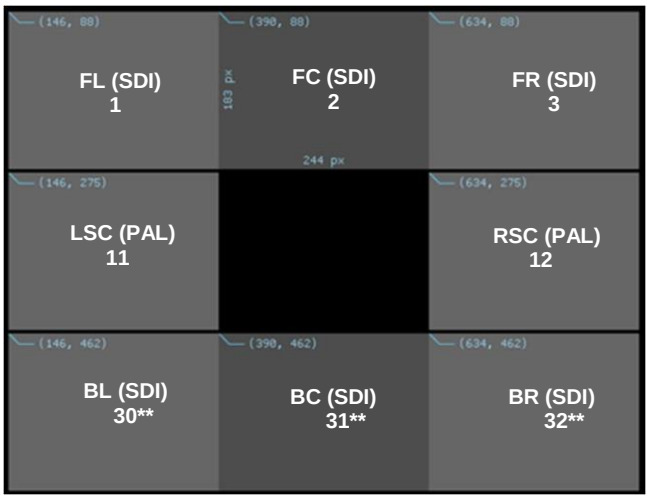
No.1.4 TI Mode AVLB Only	**TIAC**	
No.1.5 Fusion Mode GCV Only	**FFAC**	

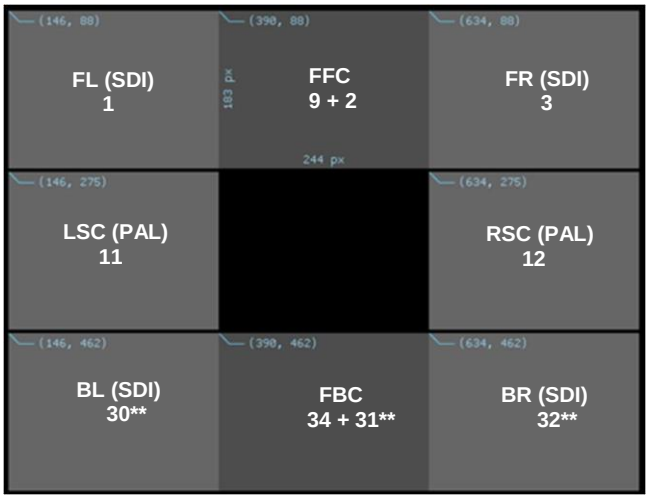
No.1.6 Fusion Mode AVLB Only	**FIAC**	
No.2	**Rear View**	

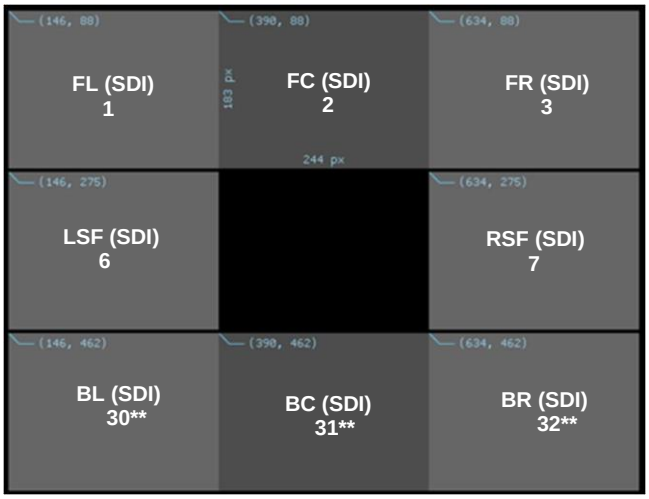
No.2.1 Day Mode	**00AB**	
No.2.2 TI Mode	**TIAB**	
No.2.3 Fusion Mode	**FIAB**	

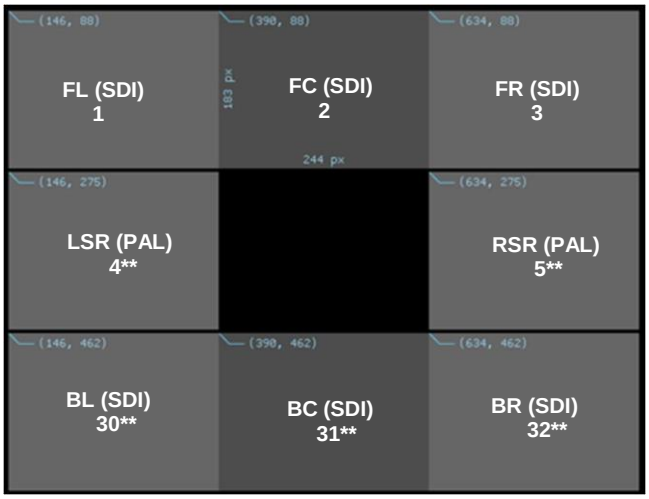
No.3	**Front View**	
No.3.1 Day Mode	**0AAF**	
No.3.2 Day Mode AVLB Only	**00AF**	

No.3.3 TI Mode AVLB Only	**TIAF**	
No.3.4 Fusion Mode	**FAAF**	
No.3.5 Fusion Mode AVLB Only	**FIAF**	

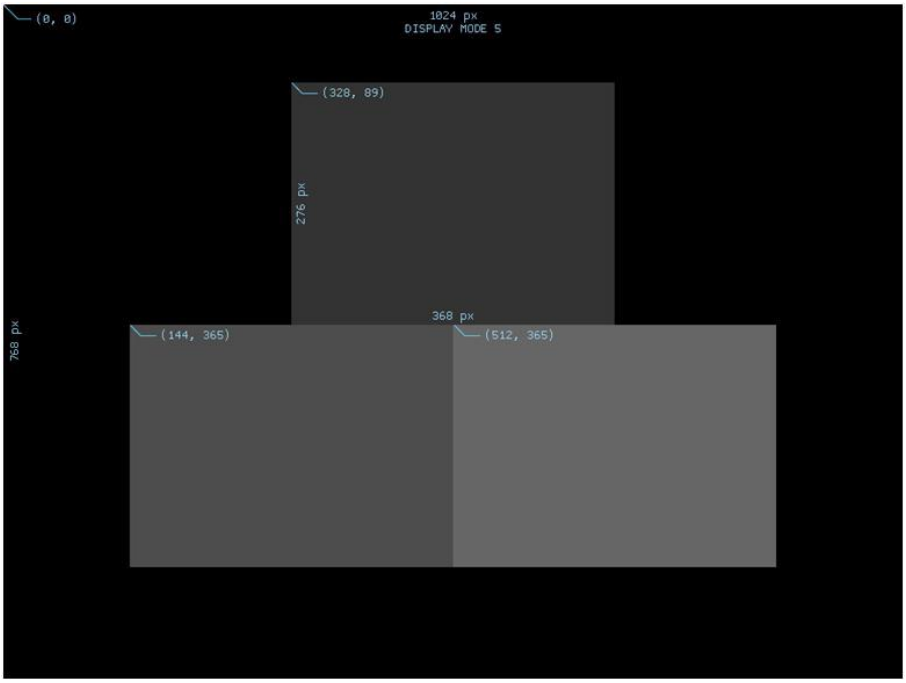
No.4	**Front/ Side/ Rear View**	
No.4.1 Day Mode (Side Center)	**ARIC**	

No.4.2 TI Mode (Side Center)	**TRIC**	
No.4.3 Fusion Mode (Side Center)	**FRIC**	

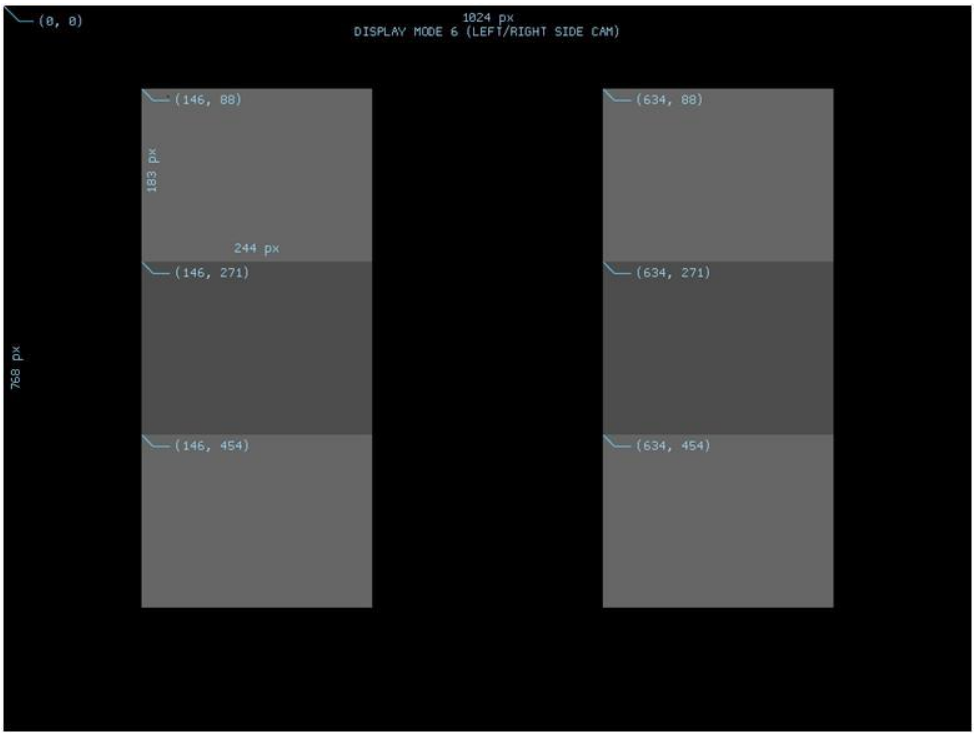
No.4.4 Day Mode (Side Front)	**ARIF**	
No.4.5 TI Mode (Side Front)	**TRIF**	

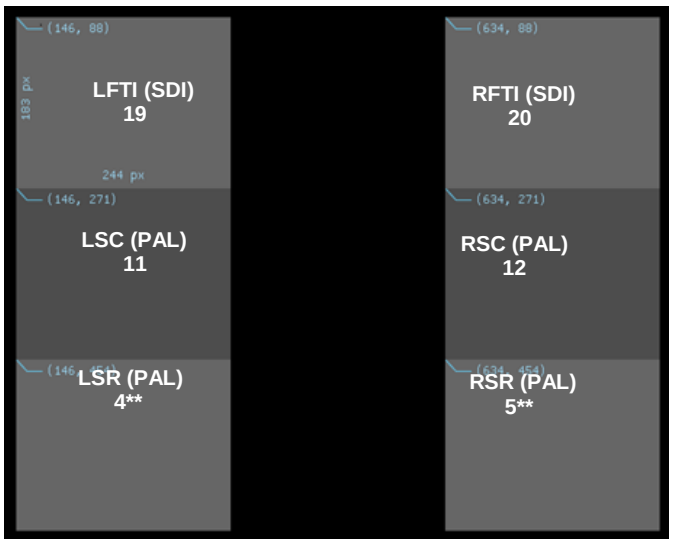
No.4.6 Fusion Mode (Side Front)	**FRIF**	
No.4.7 Day Mode (Side Rear)	**ARIB**	

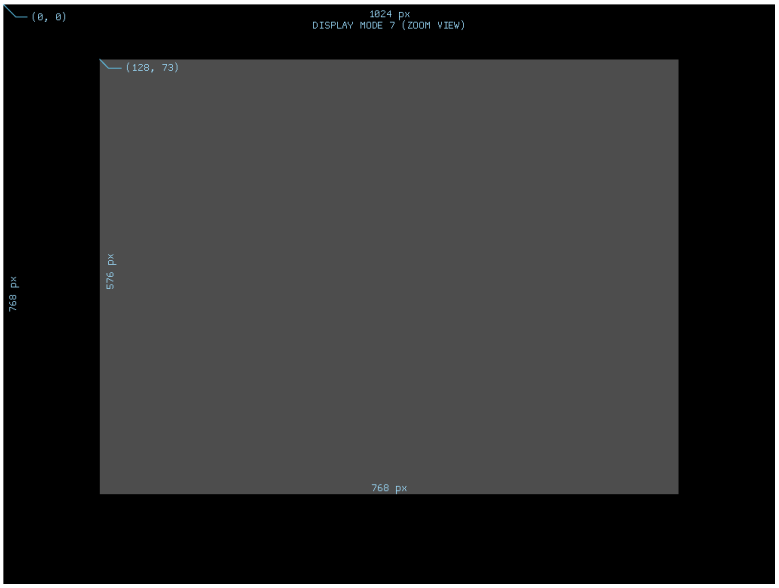
No.4.8 TI Mode (Side Rear) For GCV Only	**TRIB**	
No.4.9 Fusion Mode (Side Rear) For GCV Only	**FRIB**	

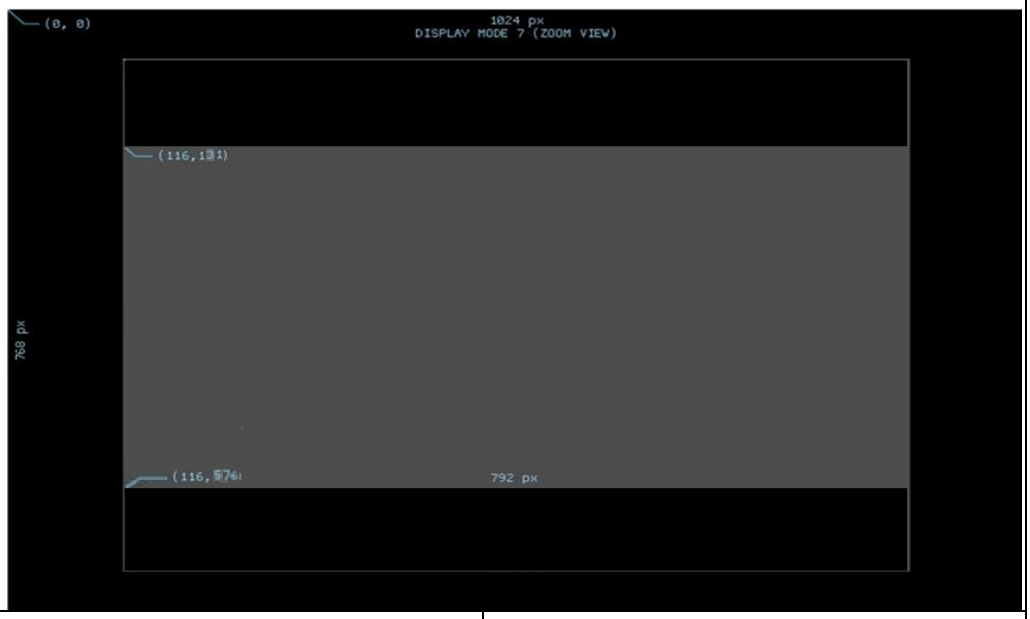
No.5	Weapon View Pls see Appendix B for ICS and GSU image scaling	
No.5.1 GCV Only	**0AAT**	

No.5.2 Day Mode AVLB Only	**00AT**	
No.5.3 TI Mode AVLB Only	**TIAT**	

No.5.4 Fusion Mode AVLB Only	**FIAT**	
No.6	**Side Cam View**	

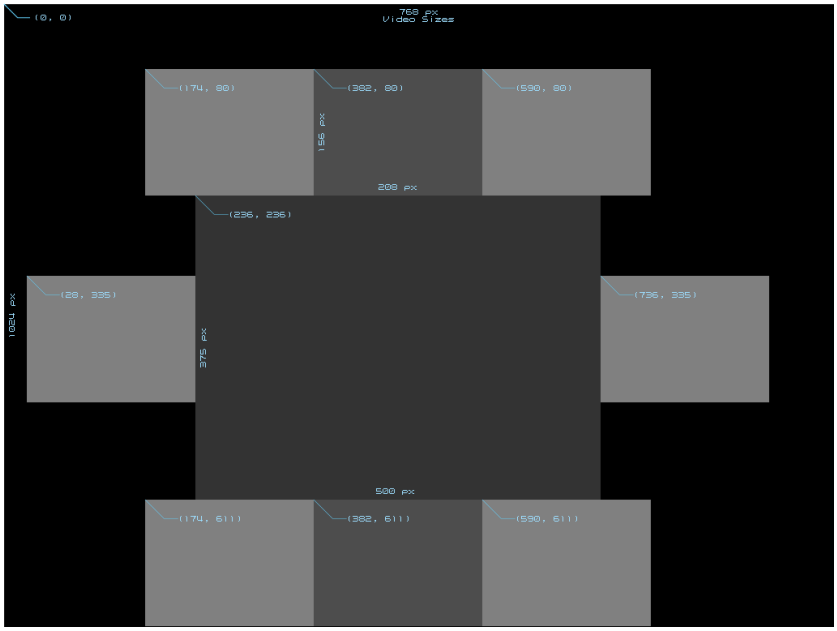
No.6.1 Day Mode	**00SI**	
No.6.2 TI Mode	**TISI**	

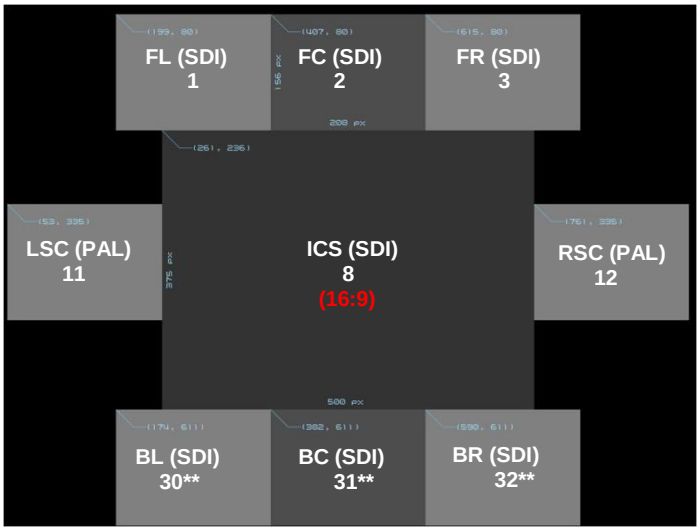
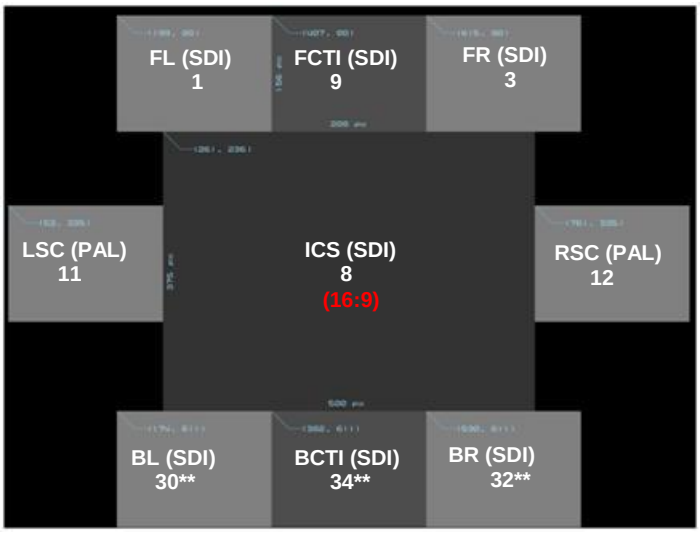
No.6.3 Fusion Mode	**FISI**	
No.7	**Zoom View**	

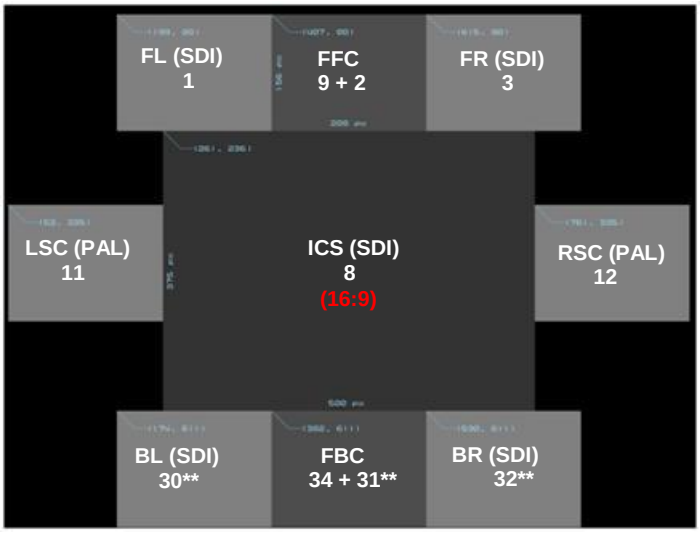
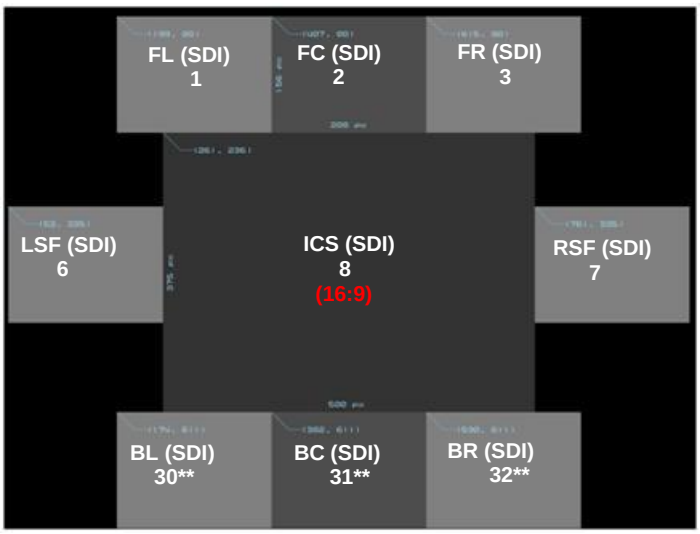
	HD-SDI (16:9)		
No.7.1	0AFL	FL (SDI) Cam ID: 1	Front Left
No.7.2	0AFC	FC (SDI) Cam ID: 2	Front Center
No.7.3	0AFR	FR (SDI) Cam ID: 3	Front Right
No.7.4	0ALF	LSF (SDI) Cam ID: 6	Left Side Front
No.7.5	0ALC	LSC (PAL) Cam ID: 11	Left Side Center
No.7.6	0ALB	LSR (PAL) Cam ID: 4**	Left Side Rear
No.7.7	0ABL	BL (SDI) Cam ID: 30**	Rear Left
No.7.8	0ABC	BC (SDI) Cam ID: 31**	Rear Center
No.7.9	0ABR	BR (SDI) Cam ID: 32**	Rear Right
No.7.10	0ABS	BS (SDI) Cam ID: 33	Bore-Sight
No.7.11	0ABN	BN (PAL) Cam ID: 16**	Rear Near
No.7.12	0ARF	RSF (SDI) Cam ID: 7	Right Side Front
No.7.13	0ARC	RSC (PAL) Cam ID: 12	Right Side Center
No.7.14	0ARB	RSR (PAL) Cam ID: 5**	Right Side Rear
No.7.15	00GS	GS (SDI) Cam ID: 22	Gun Sight
No.7.16	0ABV	BVS (PAL) Cam ID: 17	BVS
No.7.17	0ICS	ICS (SDI) Cam ID: 8	ICS
No.7.18	FCTA	FCTI (SDI) Cam ID: 9	Front Center TI
No.7.19	LFTA	LFTI (SDI) Cam ID: 19	Left Side Front TI
No.7.20	BCTA	BCTI (SDI) Cam ID: 34**	Rear Center TI
No.7.21	RFTA	RFTI (SDI) Cam ID: 20	Right Side Front TI
No.7.22	BTTI	BTTI (SDI) Cam ID: 29	Bridge TOP TI
No.7.23	LATI	LAYTI (SDI) Cam ID: 21	Laying Arm TI
No.7.24	FCFA	2 + 9	Front Center Fusion
No.7.25	LFFA	19 + 6	Left Side Front Fusion

No.7.26	BCFA	31+ 34**	Rear Center Fusion
No.7.27	RFFA	20 + 7	Right Side Front Fusion
No.7.28	BTFI	18 + 29	Bridge TOP Fusion
No.7.29	LAFI	21 + 23	Laying Arm Fusion
No.7.30	0AVR	AVR (PAL) Cam ID: 10	AVR
No.7.31	SP10	Spare SDI Input 1	Spare SDI Input 1
No.7.32	SP20	Spare SDI Input 2	Spare SDI Input 2
No.7.33	SP30	Spare SDI Input 3	Spare SDI Input 3
No.7.34	SP40	Spare SDI Input 4	Spare SDI Input 4
No.7.35	SP50	Spare SDI Input 5	Spare SDI Input 5
No.7.36	SP60	Spare PAL Input 1	Spare PAL Input 1
No.7.37	00BT	BT (SDI) Cam ID: 18	Bridge TOP Day
No.7.38	0LAY	LAY (SDI) Cam ID: 23	Laying Arm DAY
No.7.39	0HOT	Heat Detection (Optional)	Heat Detection activiation (Optional)
No.7.40	EEAM	EAM (SDI) Cam ID: 35	EA Main Camera
No.7.41	EEAS	EAS (SDI) Cam ID: 36	EA Stick Camera
No.7.42	E001	FL (SDI) Cam ID: 1**	Front Left Mirrored
No.7.43	E002	FC (SDI) Cam ID: 2**	Front Center Mirrored
No.7.44	E003	FCTI (SDI) Cam ID: 9**	Front Center TI Mirrored
No.7.45	E004	FFC (SDI) Cam ID: 9 + 2**	Front Center Fusion Mirrored
No.7.46	E005	FR (SDI) Cam ID: 3**	Front Right Mirrored
No.7.47	E006	LSF (SDI) Cam ID: 6**	Left Side Front Mirrored
No.7.48	E007	LFTI (SDI) Cam ID: 19**	Left Side Front TI Mirrored
No.7.49	E008	FLSF (SDI) Cam ID: 19 + 6**	Left Side Front Fusion Mirrored
No.7.50	E009	RSF (SDI) Cam ID: 7**	Right Side Front Mirrored
No.7.51	E010	RFTI (SDI) Cam ID: 20**	Right Side Front TI Mirrored
No.7.52	E011	FRSF (SDI) Cam ID: 20 + 7**	Right Side Front Fusion Mirrored
No.7.53	E012	LSC (PAL) Cam ID: 11**	Left Side Center Mirrored
No.7.54	E013	RSC (PAL) Cam ID: 12**	Right Side Center Mirrored
No.7.55	E014	LSR (PAL) Cam ID: 4	Left Side Rear Unmirrored
No.7.56	E015	RSF (PAL) Cam ID: 5	Right Side Rear Unmirrored
No.7.57	E016	BL (SDI) Cam ID: 30	Rear Left Unmirrored
No.7.58	E017	BC (SDI) Cam ID: 31	Rear Center Unmirrored
No.7.59	E018	BCTI (SDI) Cam ID: 34	Rear Center TI Unmirrored
No.7.60	E019	FBC (SDI) Cam ID: 34 + 31	Rear Center Fusion Unmirrored
No.7.61	E020	BR (SDI) Cam ID: 32	Rear Right Unmirrored
No.7.62	E021	BN (PAL) Cam ID: 16	Rear Near Unmirrored
No.7.63	E022	ICS (SDI) Cam ID: 8**	ICS Mirrored
No.7.64	E023	GS (SDI) Cam ID: 22**	GSU Mirrored
No.7.65	E024	BVS (PAL) Cam ID: 17**	BVS Mirrored
No.7.66	E025	BT (SDI) Cam ID: 18**	Bridge Top Mirrored
No.7.67	E026	BTTI (SDI) Cam ID: 29**	Bridge Top TI Mirrored
No.7.68	E027	FBT (SDI) Cam ID: 18 + 29**	Bridge Top Fusion Mirrored

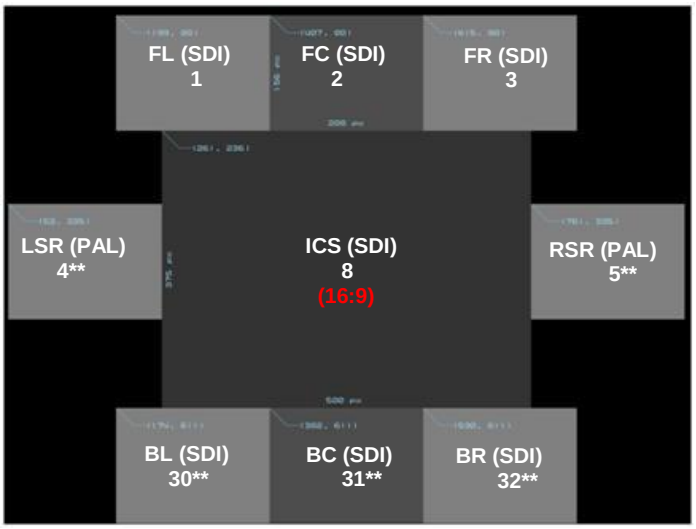
No.7.69	E028	LAY (SDI) Cam ID: 23**	Laying Arm Mirrored
No.7.70	E029	LAYTI (SDI) Cam ID: 21**	Laying Arm TI Mirrored
No.7.71	E030	FLAY (SDI) Cam ID: 21 + 23 **	Laying Arm Fusion Mirrored
No.7.72	E031	EAM (SDI) Cam ID: 35**	EA Main Mirrored
No.7.73	E032	EAS (SDI) Cam ID: 36**	EA Stick Mirrored
No.7.74	E033	BS (SDI) Cam ID: 33**	Bore Sight Mirrored
No.7.75	E034	AVR (PAL) Cam ID: 10**	AVR Mirrored

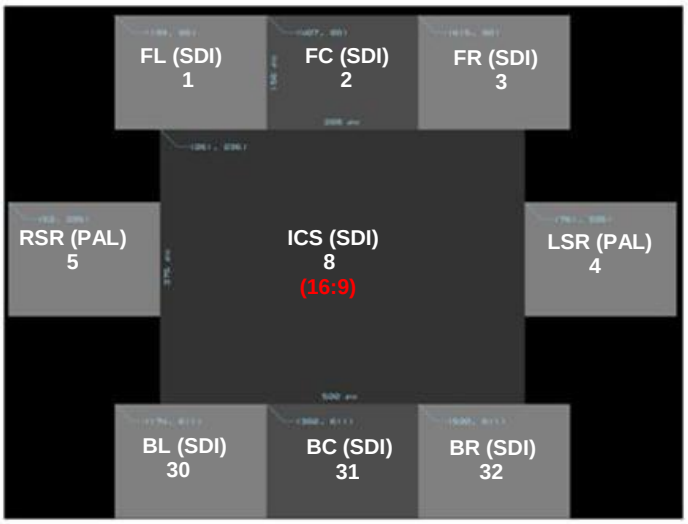
No. 8	**ICS-SA View**	

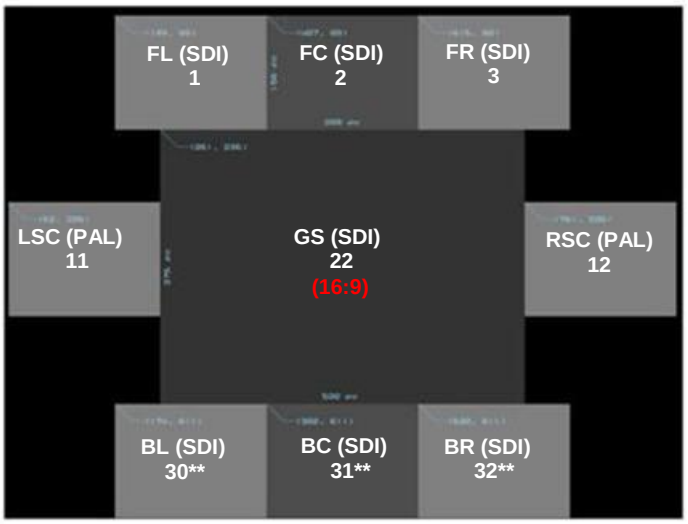
No.8.1 Day Mode (ICS-SA Side Center) GCV only	**CSSC**	
No.8.2 TI Mode (ICS-SA Side Center) GCV only	**TCSC**	

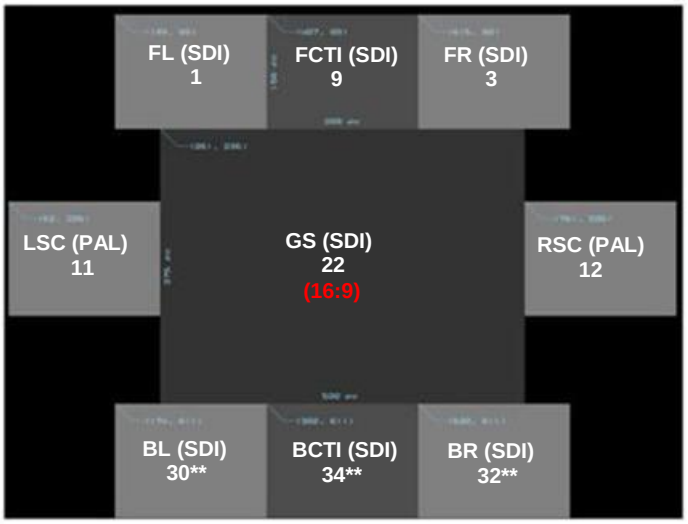
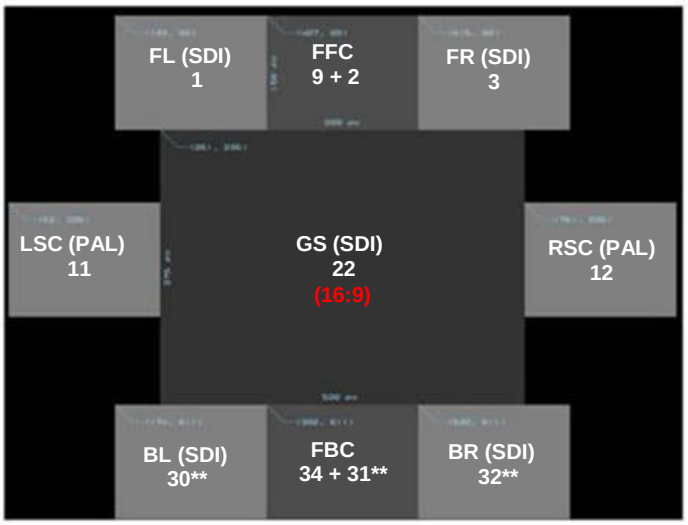
No.8.3 Fusion Mode (ICS-SA Side Center) GCV only	**FCSC**	
No.8.4 Day Mode (ICS-SA Side Front) GCV only	**CSSF**	

No.8.5 TI Mode (ICS-SA Side Front) GCV only	**TCSF**	
No.8.6 Fusion Mode (ICS-SA Side Front) GCV only	**FCSF**	

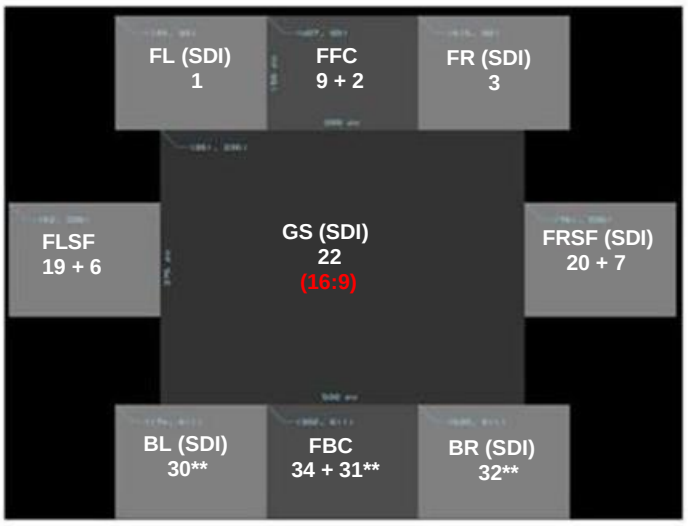
No.8.7 Day Mode (ICS-SA Side Rear) GCV only	**CSSB**	
No.8.8 TI Mode (ICS-SA Side Rear) GCV only	**TCSB**	

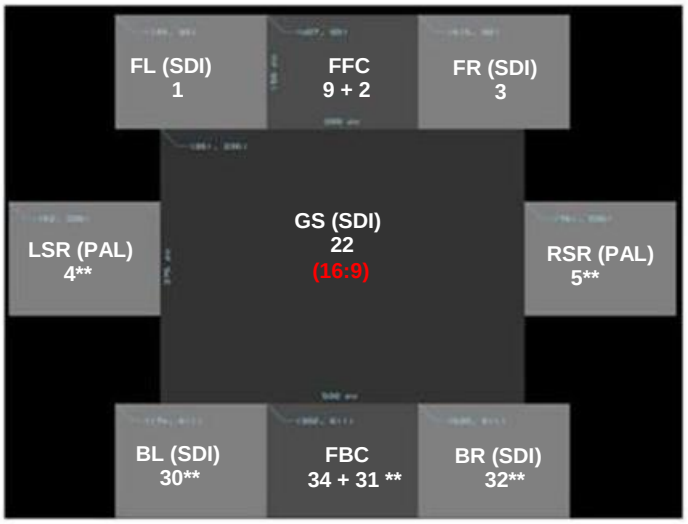
No.8.9 Fusion Mode (ICS-SA Side Rear) GCV only	**FCSB**	
No.8.10 Non Mirror (ICS-SA Side Rear) GCV only	**NMSB**	

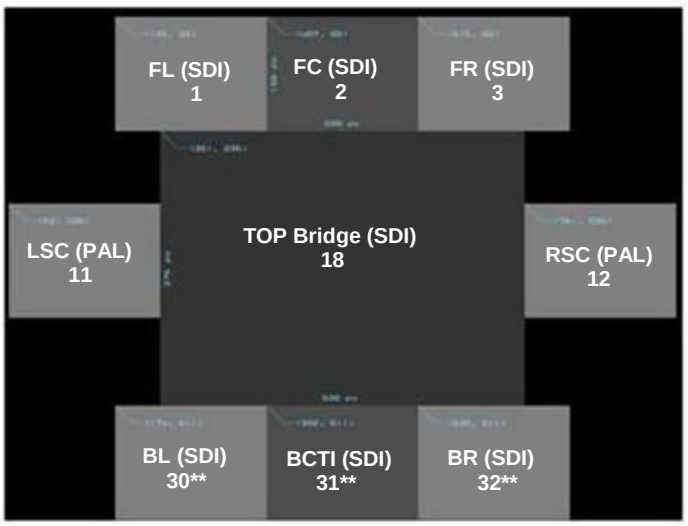
No.9	GS-SA View	
No.9.1 Day Mode (GS-SA Side Center) GCV only	**GSSC**	

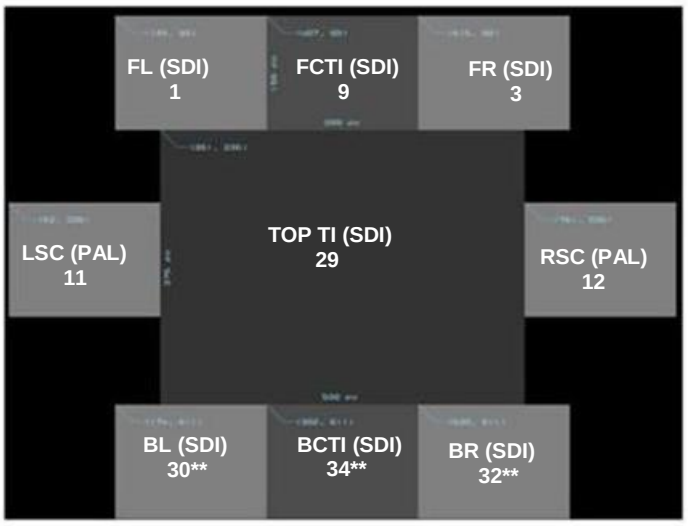
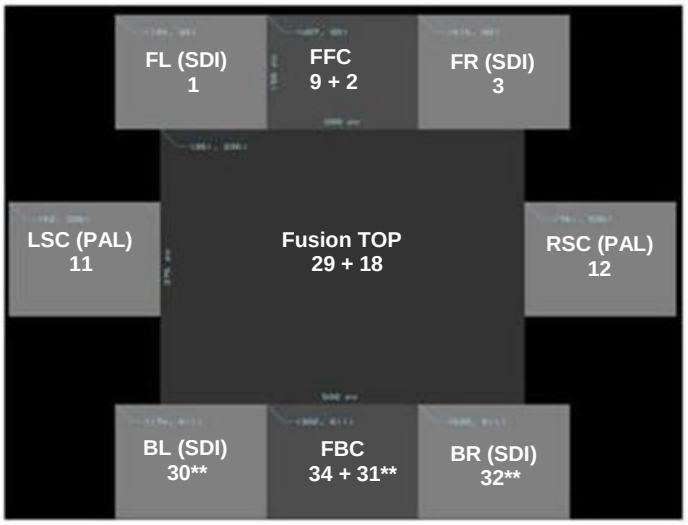
No.9.2 TI Mode (GS-SA Side Center) GCV only	**TGSC**	
No.9.3 Fusion Mode (GS-SA Side Center) GCV only	**FGSC**	

No.9.4 Day Mode (GS-SA Side Front) GCV only	**GSSF**	
No.9.5 TI Mode (GS-SA Side Front) GCV only	**TGSF**	

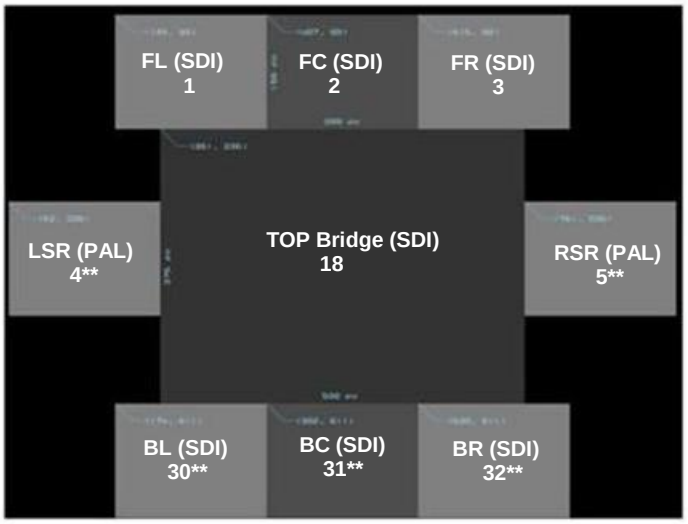
No.9.6 Fusion Mode (GS-SA Side Front) GCV only	**FGSF**	
No.9.7 Day Mode (GS-SA Side Rear) GCV only	**GSSB**	

No.9.8 TI Mode (GS-SA Side Rear) GCV only	**TGSB**	
No.9.9 Fusion Mode (GS-SA Side Rear) GCV only	**FGSB**	

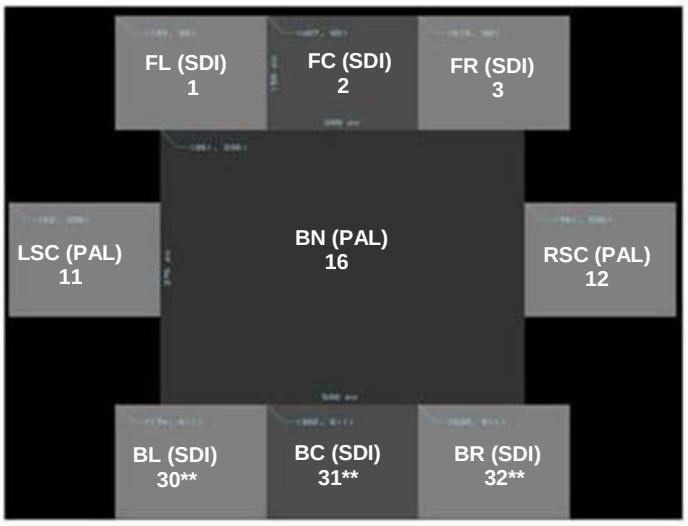
No.9.10 Day Mode (GS-SA Side Rear) Non-Mirror GCV only	**NGSB**	
No.9.11 Day Mode (TOP-SA Side Center) AVLB only	**BVSC**	

No.9.12 TI Mode (TOP-SA Side Center) AVLB only	**TBSC**	
No.9.13 Fusion Mode (TOP-SA Side Center) AVLB only	**FBSC**	

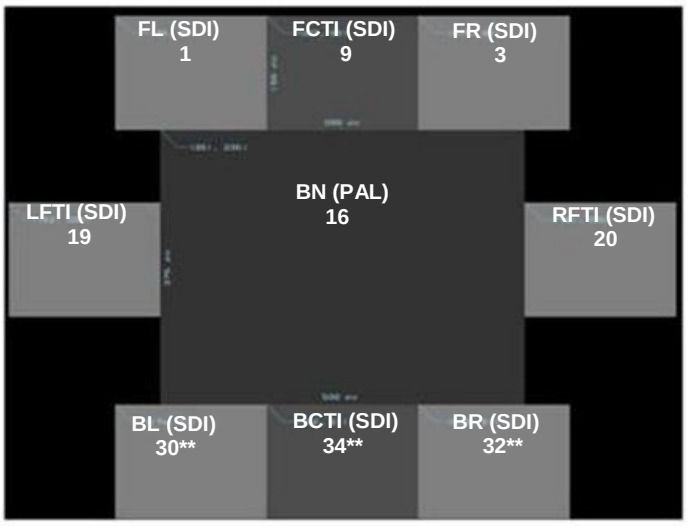
No.9.14 Day Mode (TOP-SA Side Front) AVLB only	**BVSF**	
No.9.15 TI Mode (TOP-SA Side Front) AVLB only	**TBSF**	

No.9.16 Fusion Mode (TOP-SA Side Front) AVLB only	**FBSF**	
No.9.17 Day Mode (TOP-SA Side Rear) AVLB only	**BVSB**	

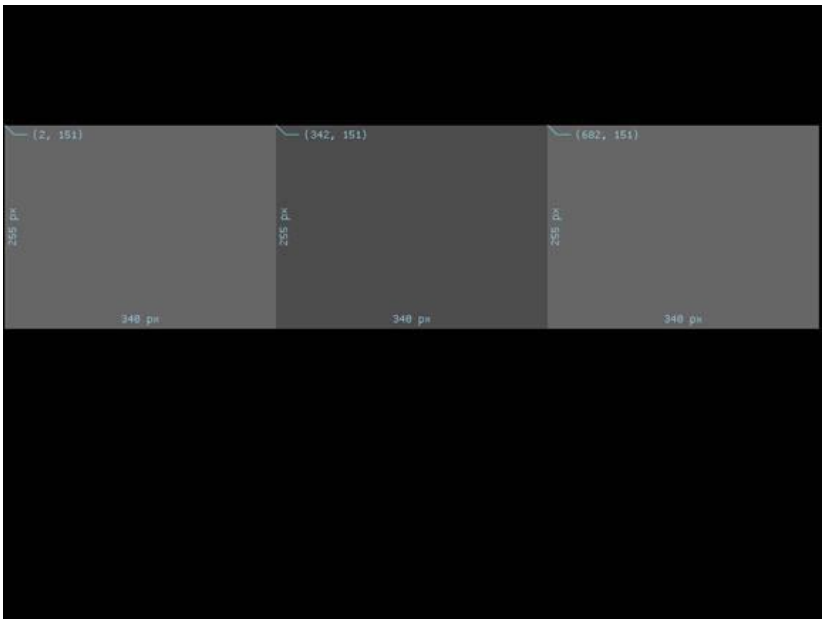
No.9.18 TI Mode (TOP-SA Side Rear) AVLB only	**TBSB**	
No.9.19 Fusion Mode (TOP-SA Side Rear) AVLB only	**FBSB**	

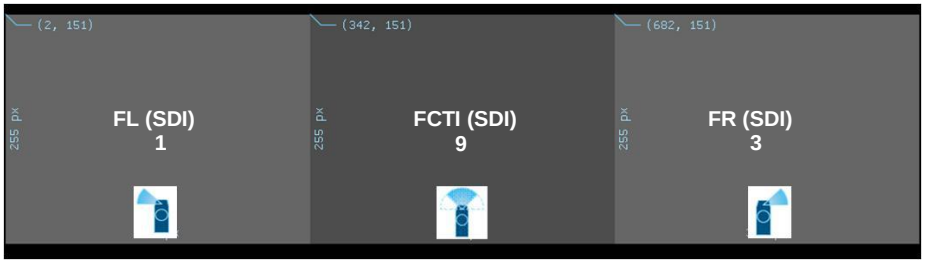
No.9.20 Day Mode (BN-SA Side Center)	**BNSC**	
No.9.21 TI Mode (BN-SA Side Center)	**TNSC**	

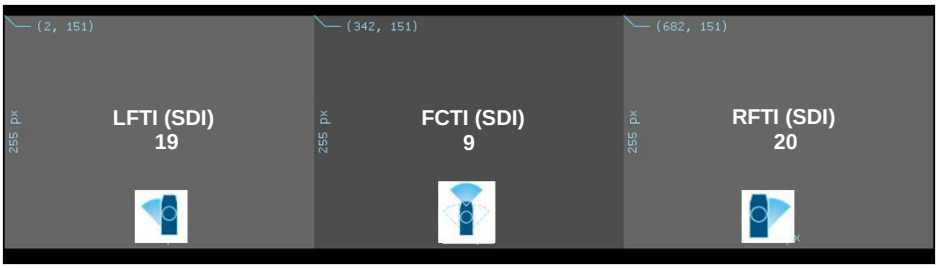
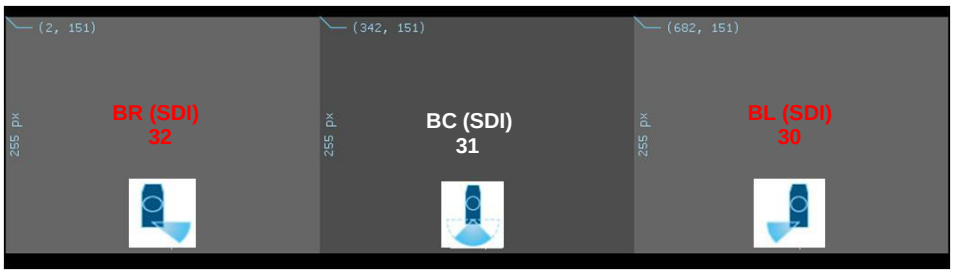
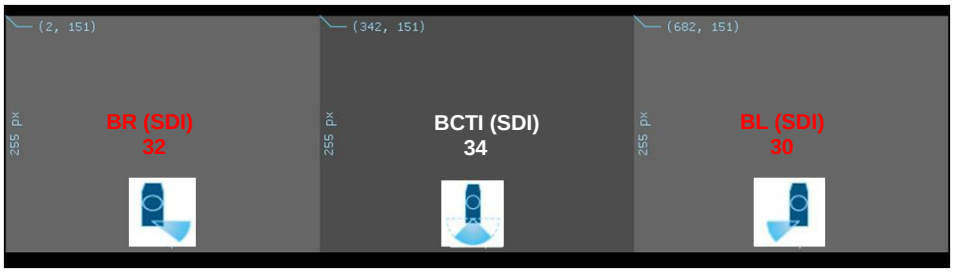
No.9.22 Fusion Mode (BN-SA Side Center)	**FNSC**	
No.9.23 Day Mode (BN-SA Side Front)	**BNSF**	

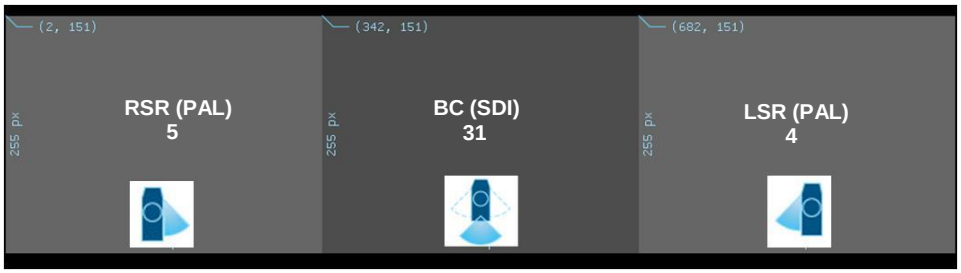
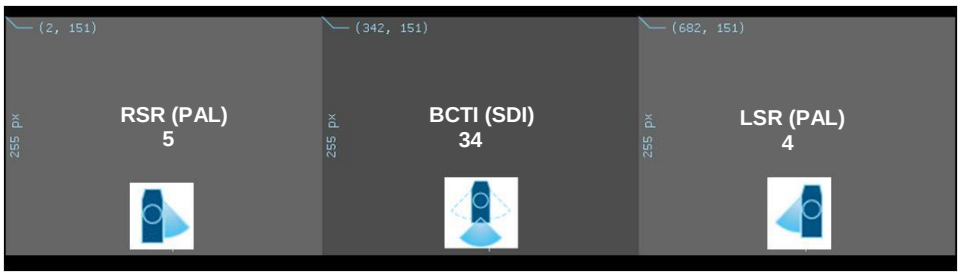
No.9.24 TI Mode (BN-SA Side Front)	**TNSF**	
No.9.25 Fusion Mode (BN-SA Side Front)	**FNSF**	

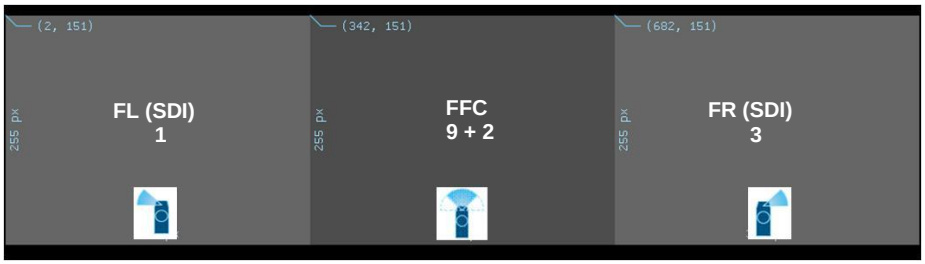
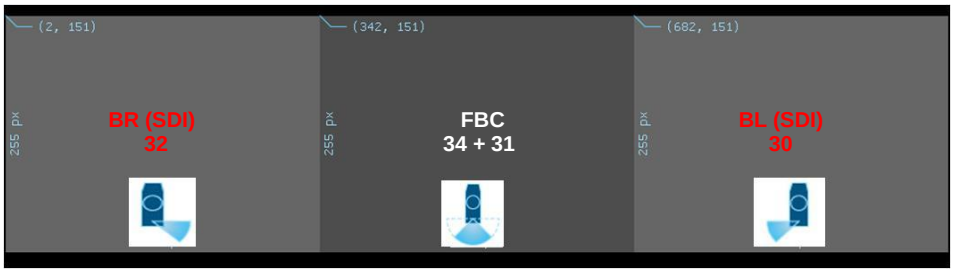
No.9.26 Day Mode (BN-SA Side Rear)	**BNSB**	
No.9.27 TI Mode (BN-SA Side Rear)	**TNSB**	

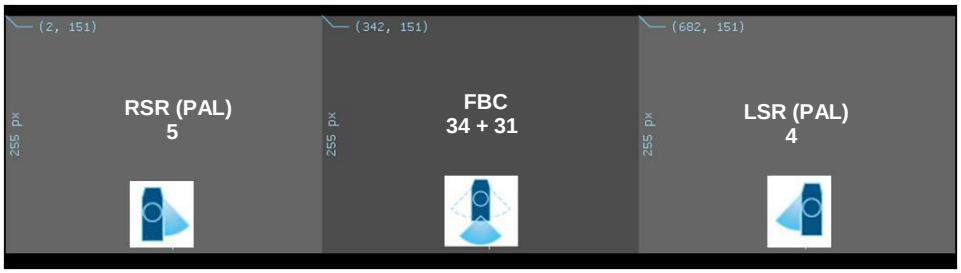
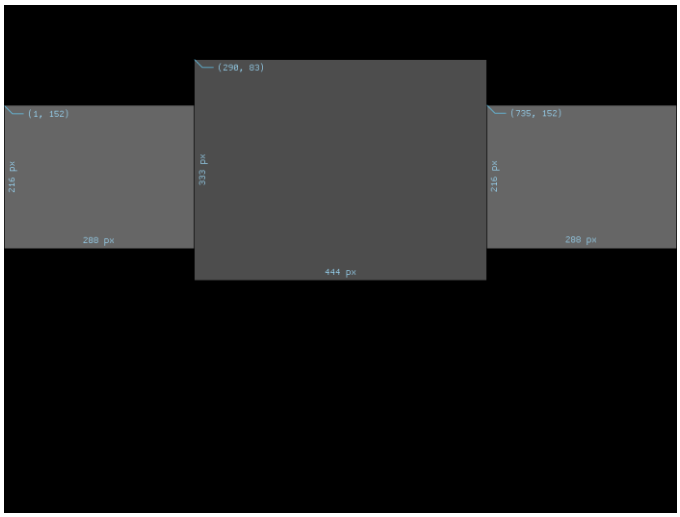
No.9.28 TI Mode (BN-SA Side Rear)	**FNSB**	
No.10	Degraded Driving Mode 1	

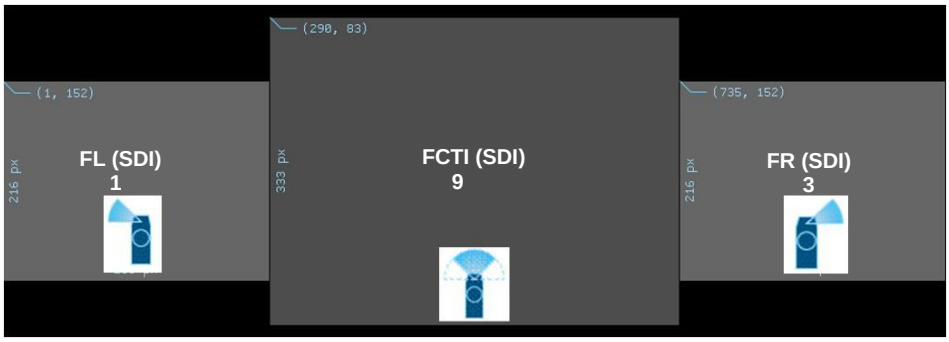
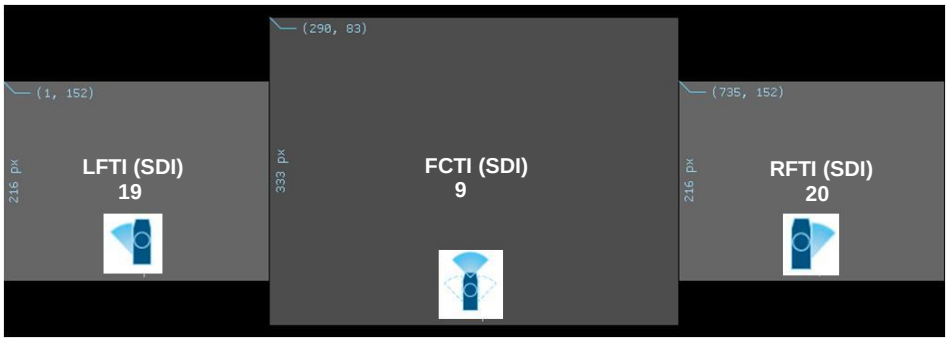
No.10.1 Front 3 Cameras (DAY)	**DDNF**	
No.10.2 Front 3 Cameras (TI)	**DDFT**	
No.10.3 Front + Side Camera	**DDSF**	

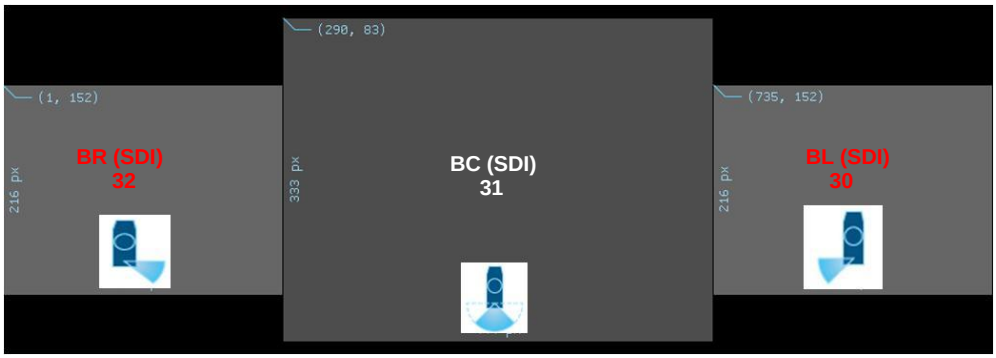
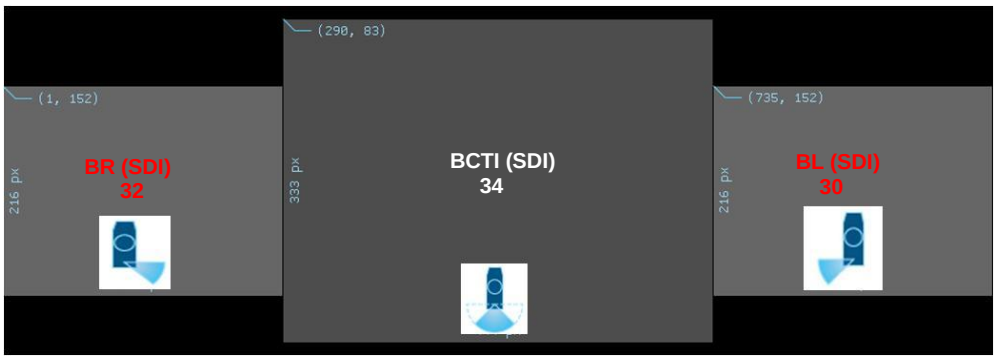
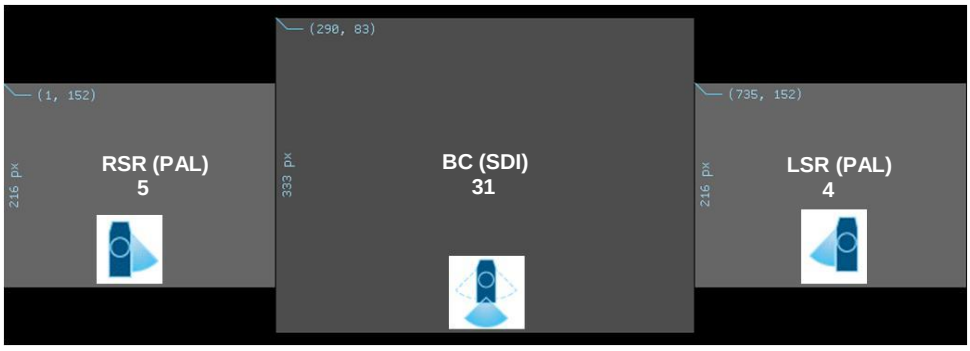
No.10.4 Front + Side Camera (TI)	**DSFT**	
No.10.5 Rear 3 Cameras	**DDNB**	
No.10.6 Rear 3 Cameras (TI)	**DDBT**	

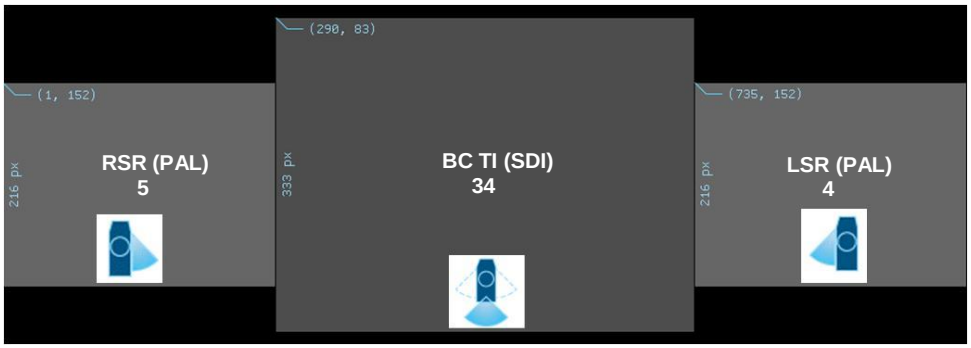
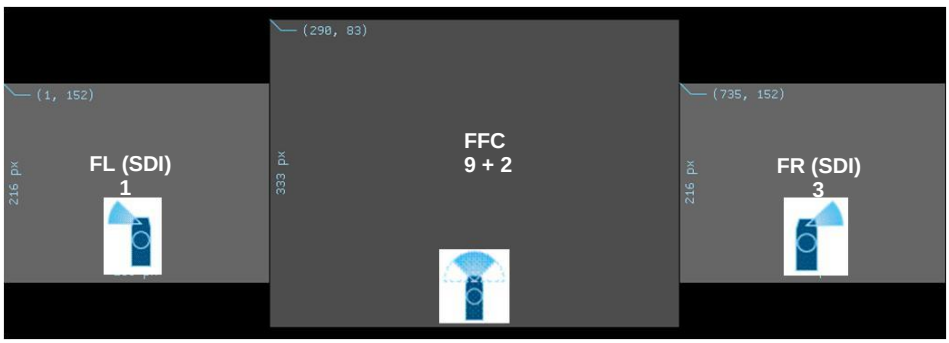
No.10.7 Rear Side Cameras	**DDSB**	
No.10.8 Rear Side Cameras (TI)	**DSBT**	
No.10.9 Back Near	**DDRB**	

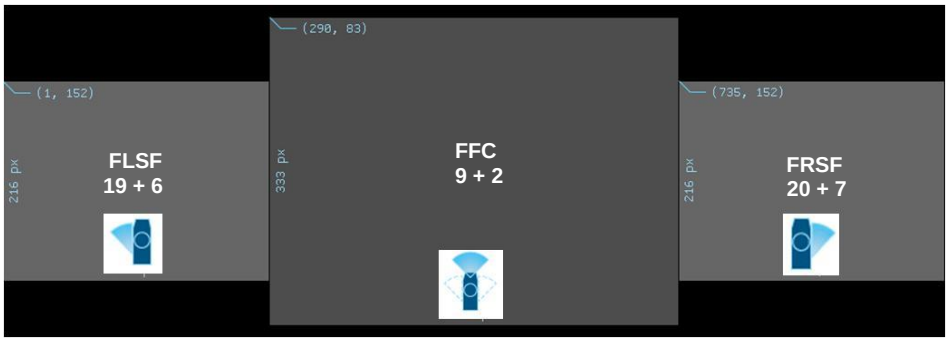
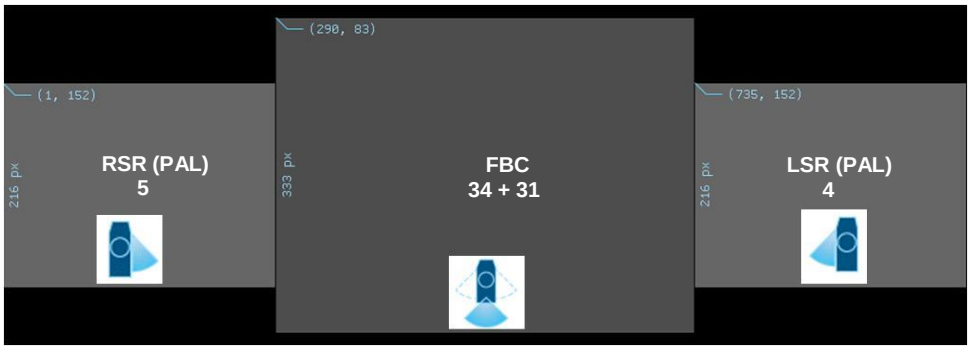
No.10.10 Front 3 Cameras (Fusion)	**DFNF**	
No.10.11 Front + Side Camera (Fusion)	**DFSF**	
No.10.12 Rear 3 Cameras (Fusion)	**DFNB**	

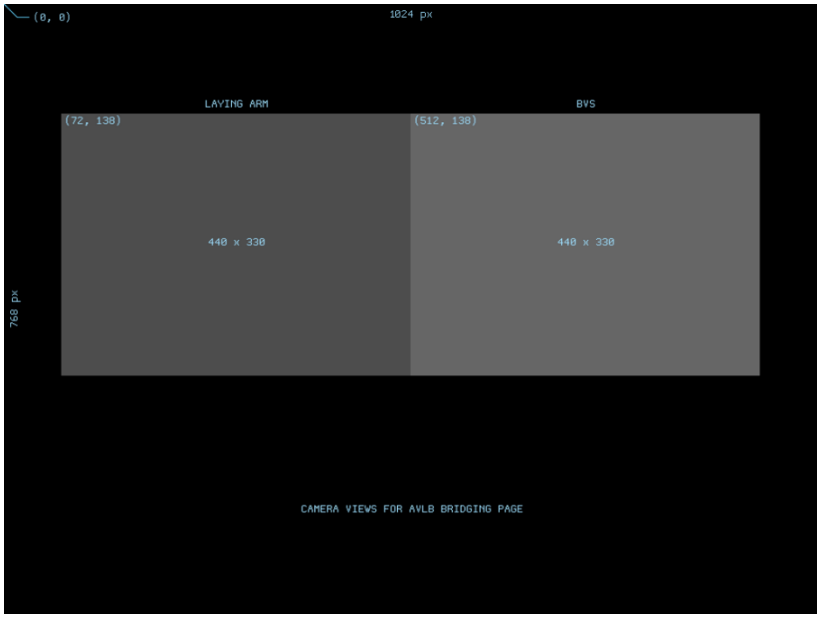
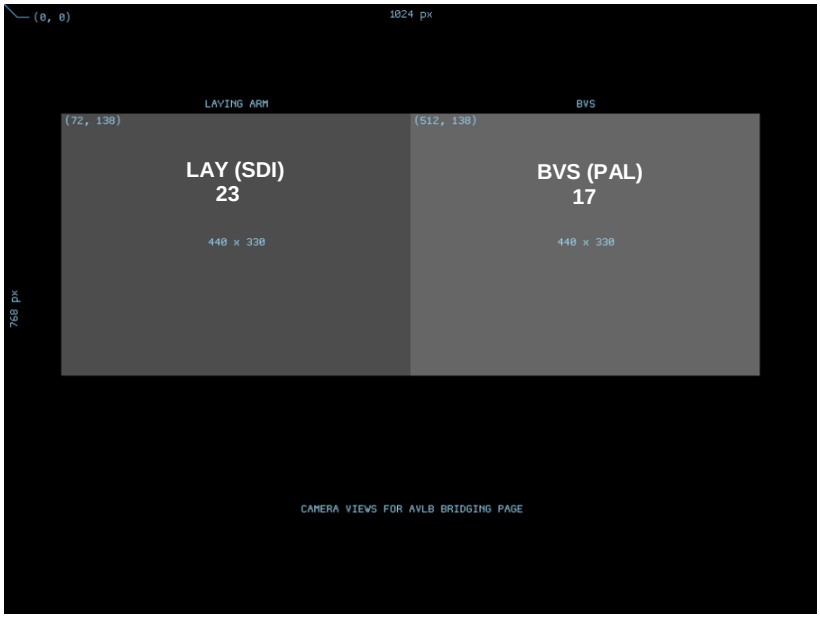
No.10.13 Rear Side Cameras (Fusion)	**DFSB**	
No.11	Degraded Driving Mode 2	
No.11.1 Front Camera	**DZNF**	

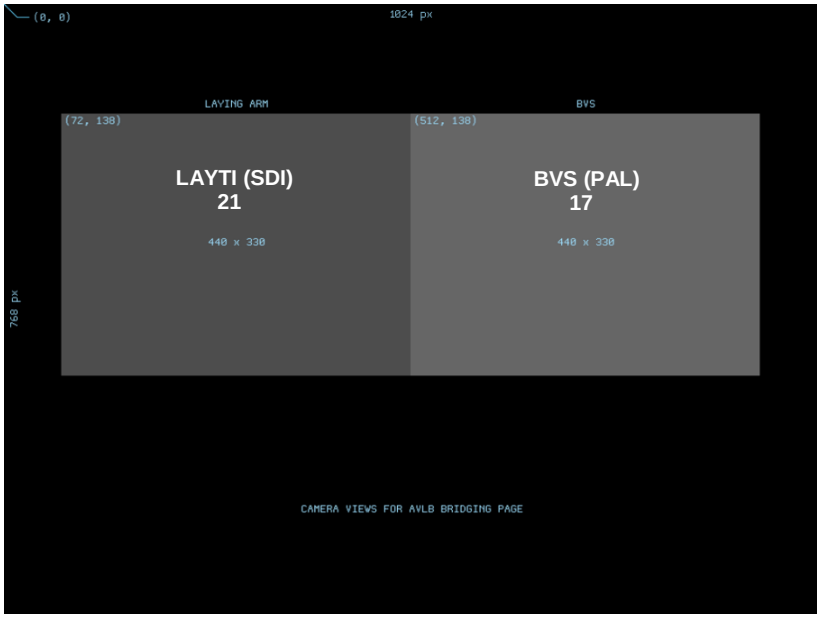
No.11.2 Front Camera (TI)	**DZFT**	
No.11.3 Front + Side Camera	**DZSF**	
No.11.4 Front + Side Camera (TI)	**ZSFT**	

No.11.5 Rear Camera	**DZNB**	
No.11.6 Rear Camera (TI)	**DZBT**	
No.11.7 Rear + Side Camera	**DZSB**	

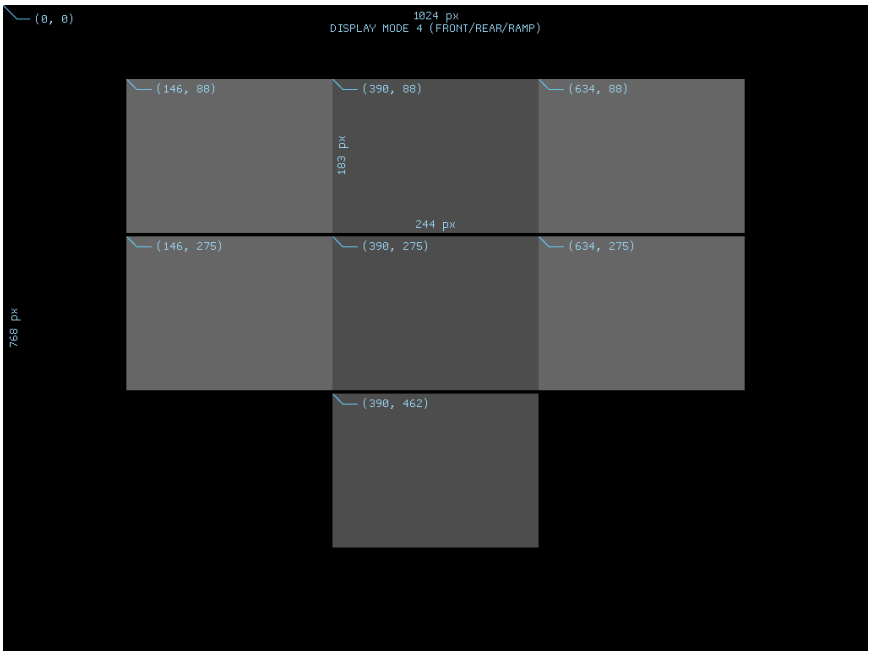
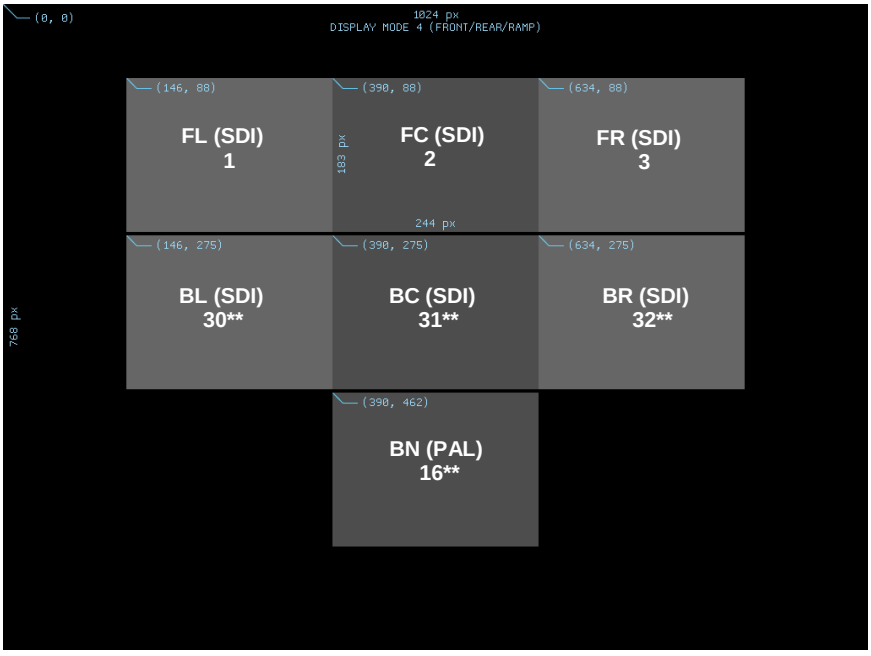
No.11.8 Rear + Side Camera (TI)	**ZSBT**	
No.11.9 Rear + Side Camera (Back Near)	**DZRB**	
No.11.10 Front Camera (Fusion)	**DZFF**	

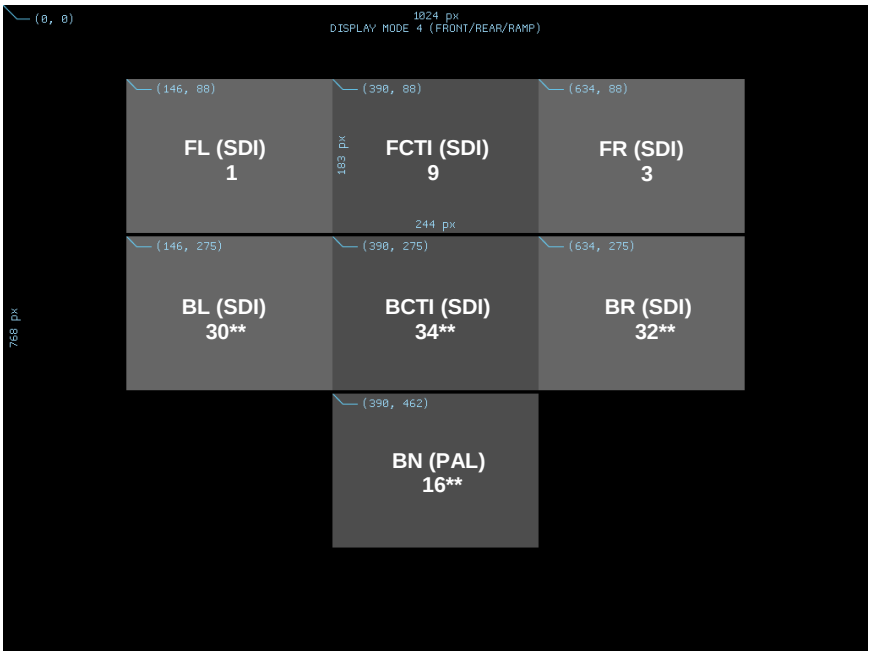
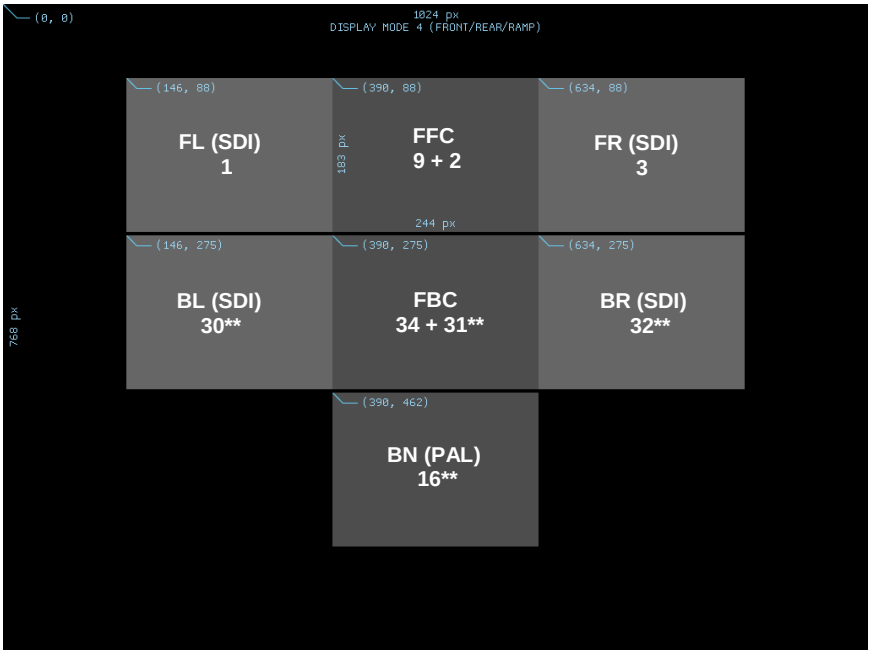
No.11.11 Front + Side Camera (Fusion)	**FZSF**	
No.11.12 Rear Camera (Fusion)	**FZNB**	
No.11.13 Rear + Side Camera (Fusion)	**FZSB**	

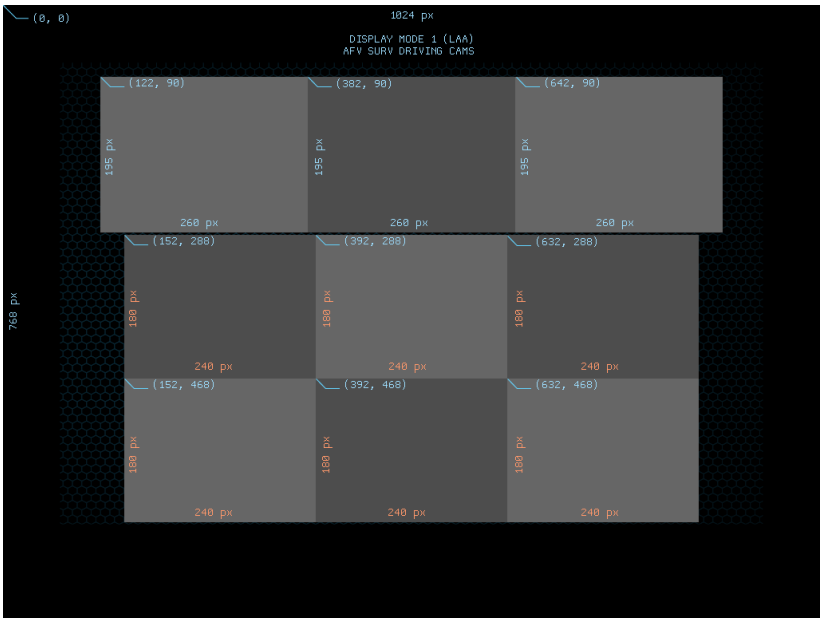
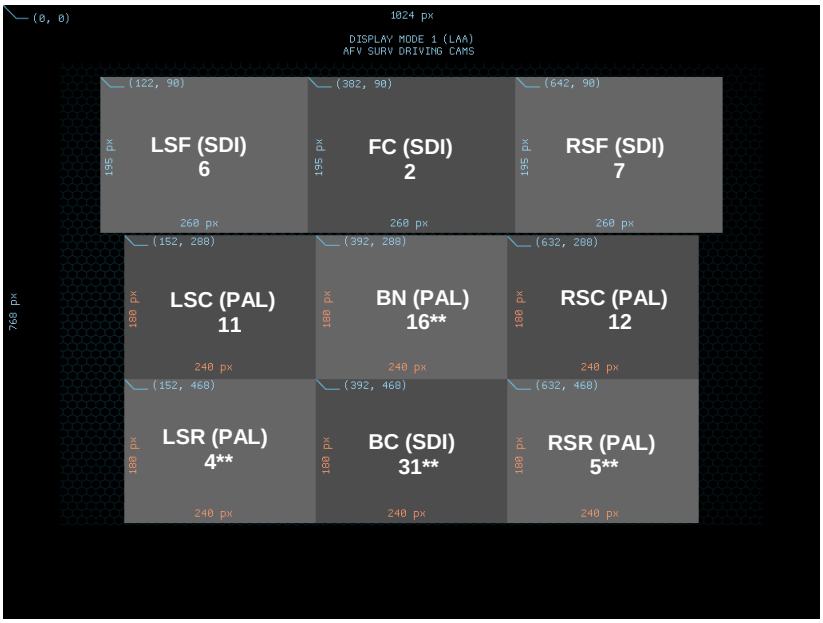
No.12	**Bridging Modes**	
No.12.1 Day Mode Default View	**00BM**	

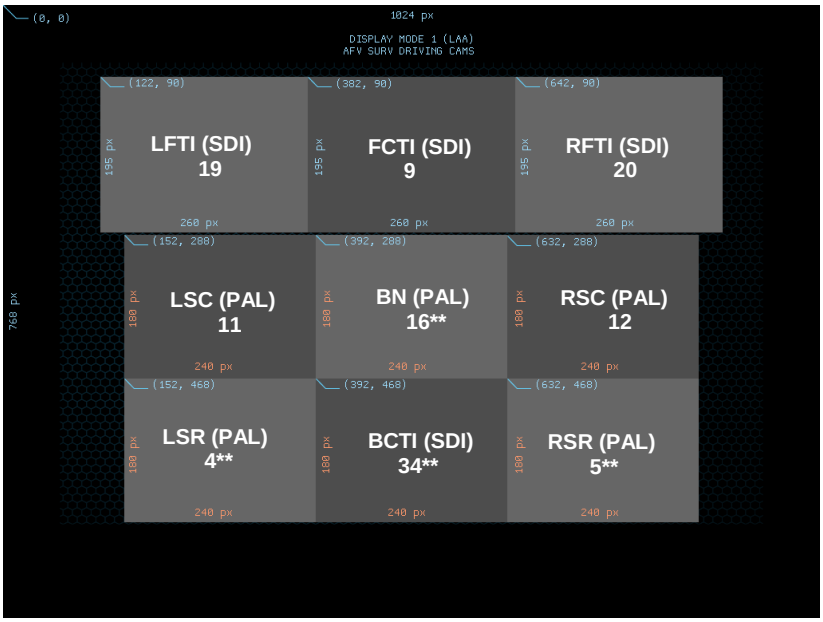
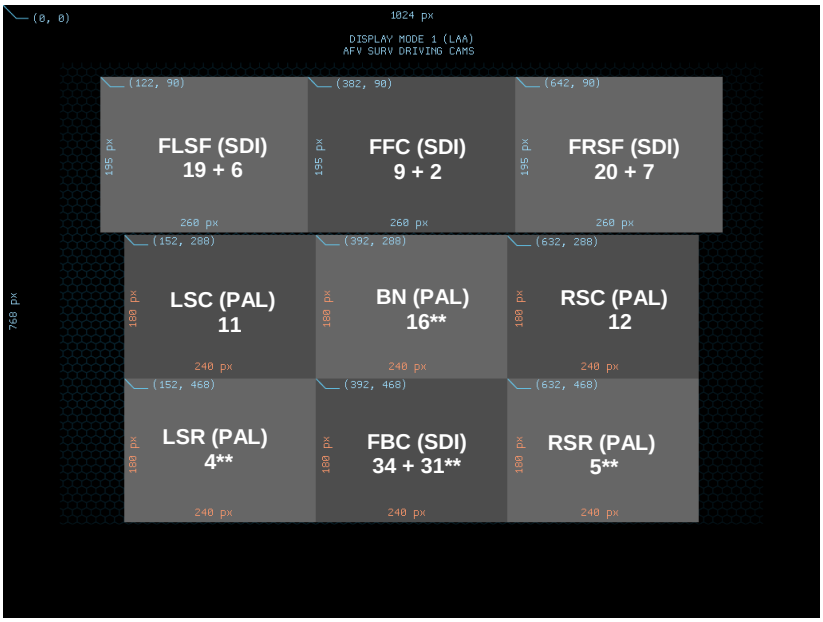
No.12.2 TI Mode Default View	**TIBM**	
No.12.3 Fusion Mode Default View	**FIBM**	

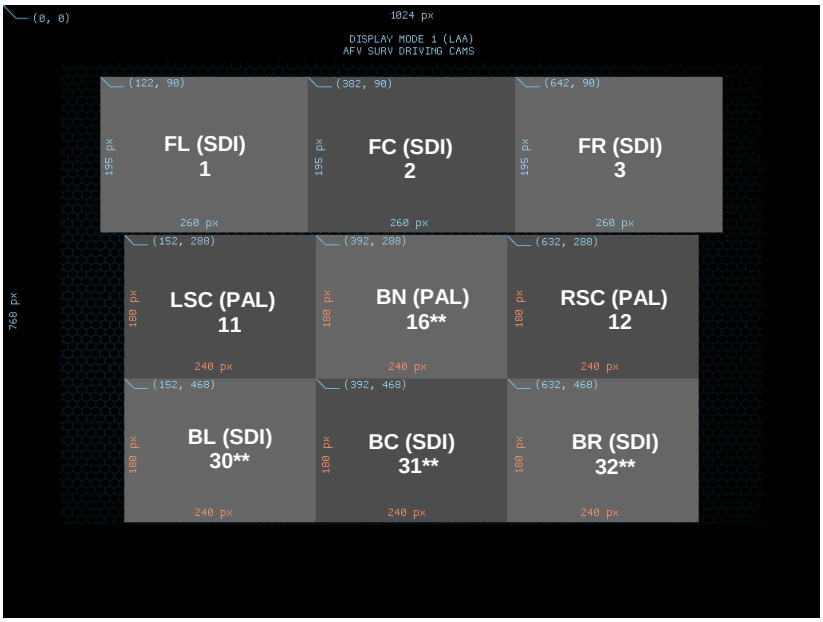
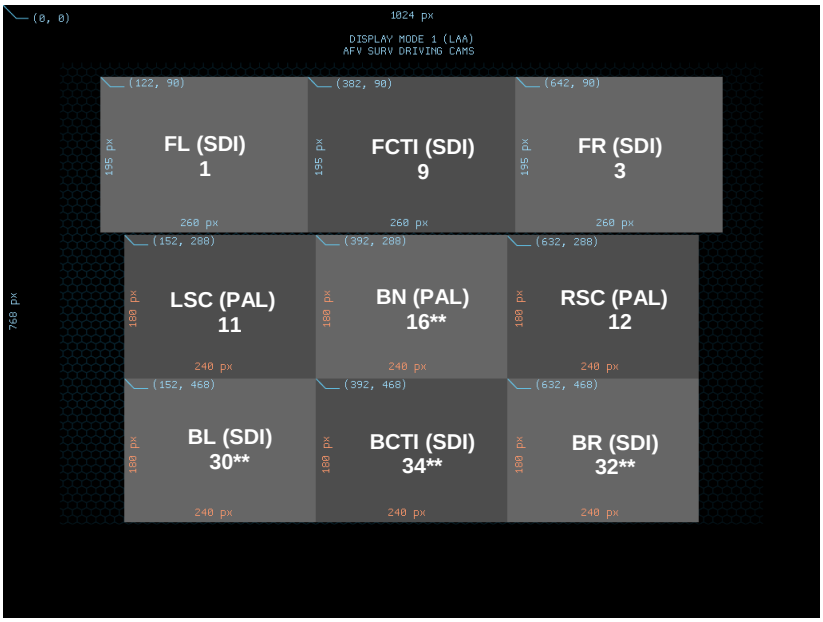
No.13	**AVLB Lasing Mode**	
No.13.1 AVLB Lasing Mode	**BL00**	

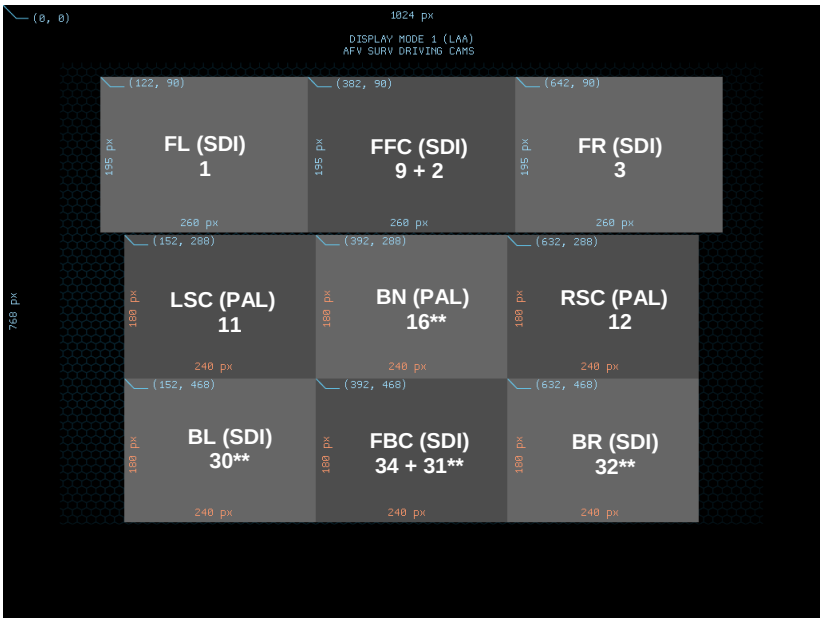
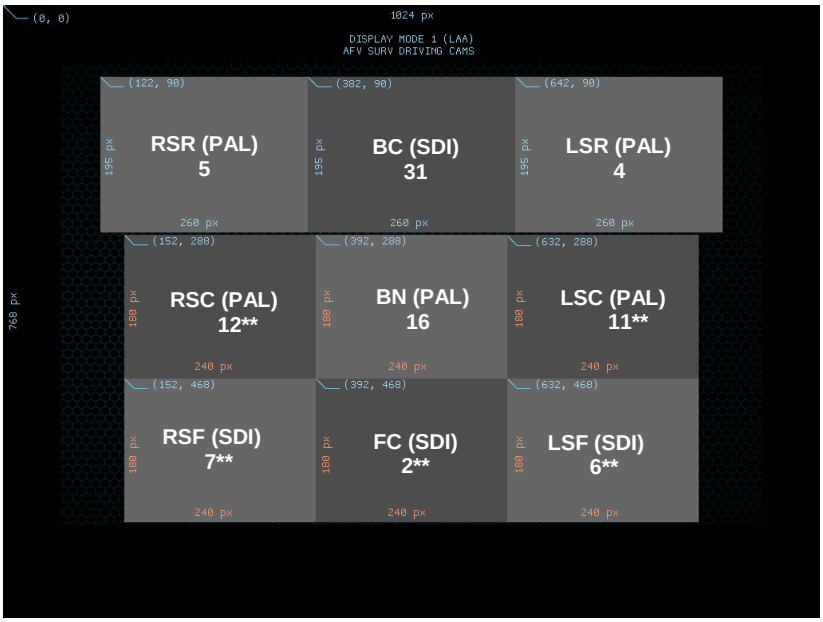
No.14	**Front/ Rear/ Ramp View**	
No.14.1 Day Mode	**0004**	

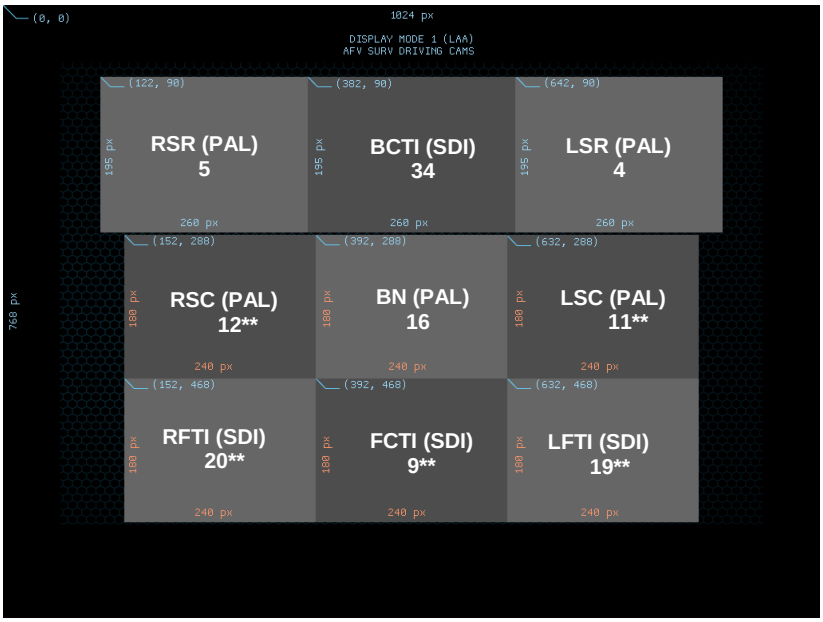
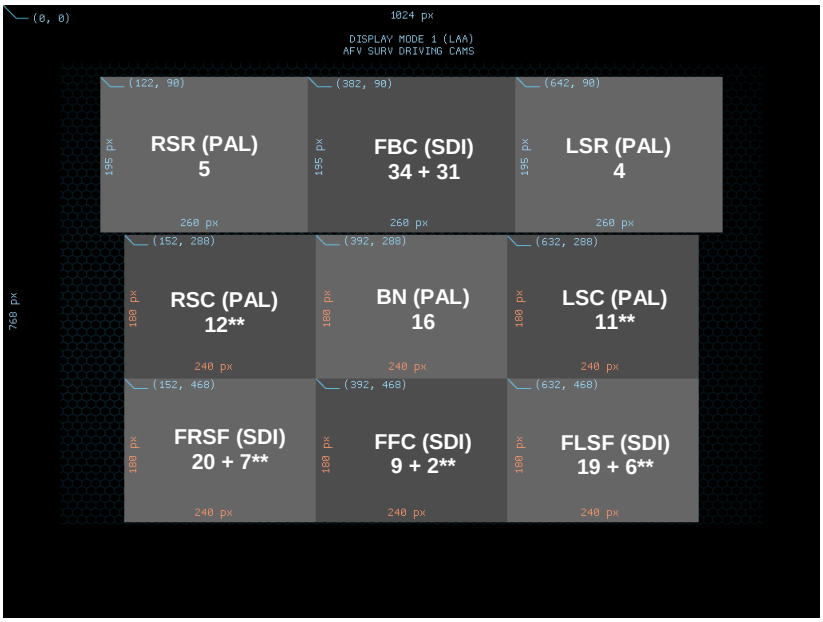
No.14.2 TI Mode	**0005**	
No.14.3 Fusion Mode	**0006**	

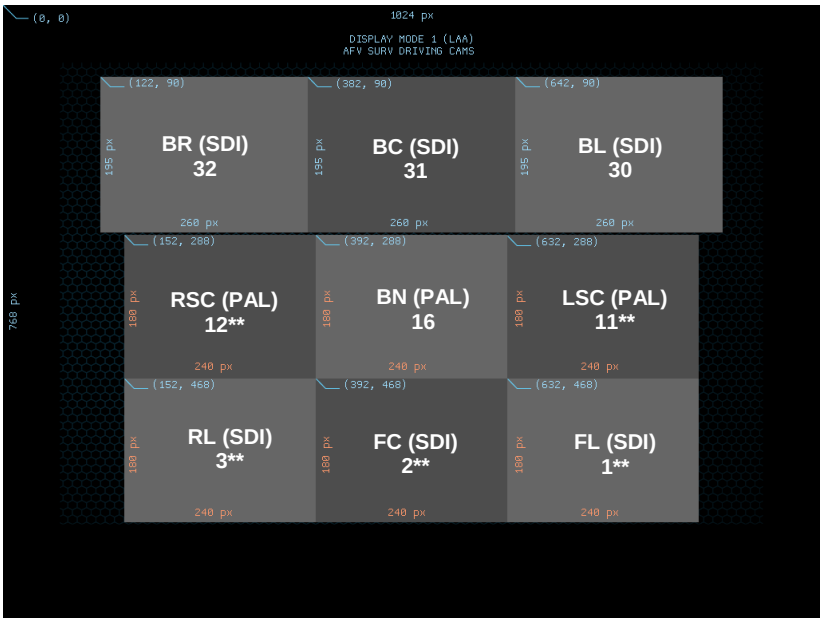
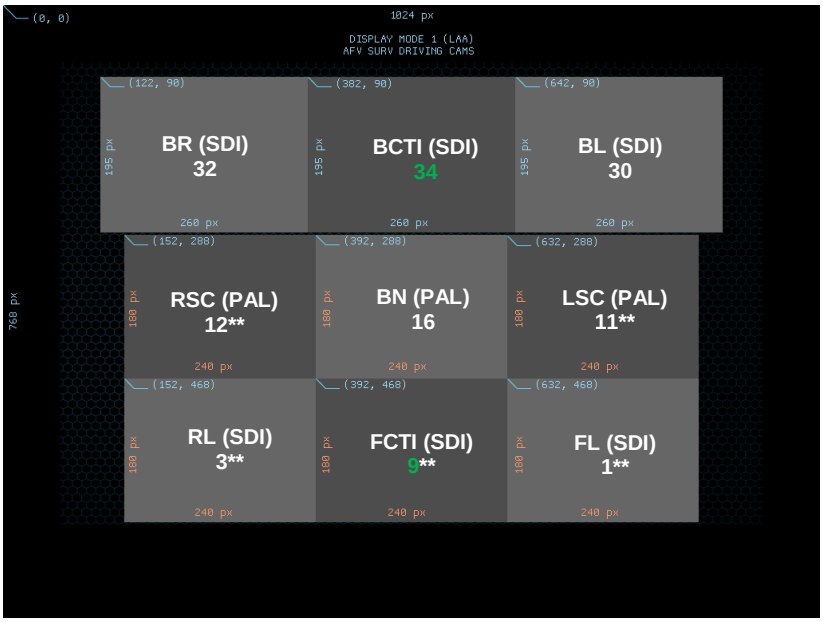
No.15	**Driving Cams**	
No.15.1 Day Mode Default Forward	**D0FD**	

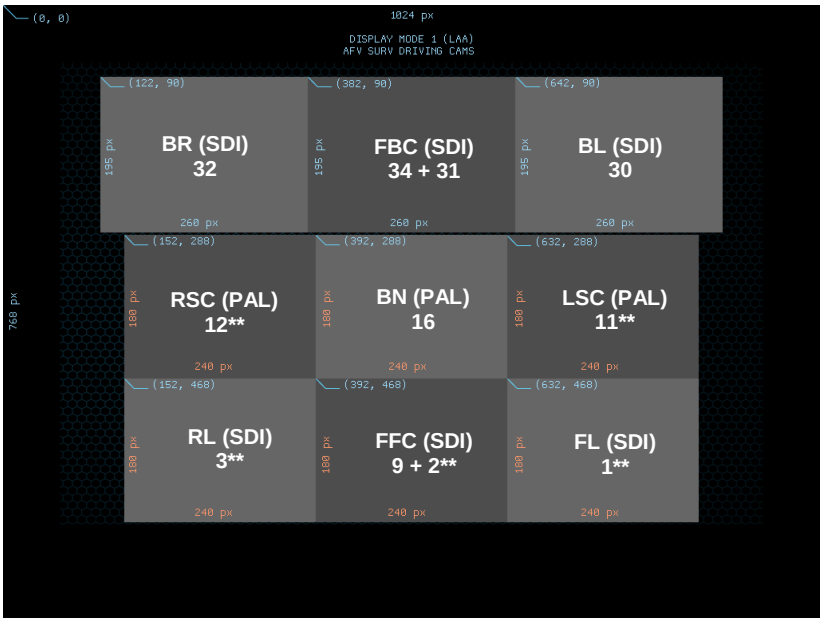
No.15.2 TI Mode Default Forward	**D0FT**	
No.15.3 Fusion Mode Default Forward	**D0FF**	

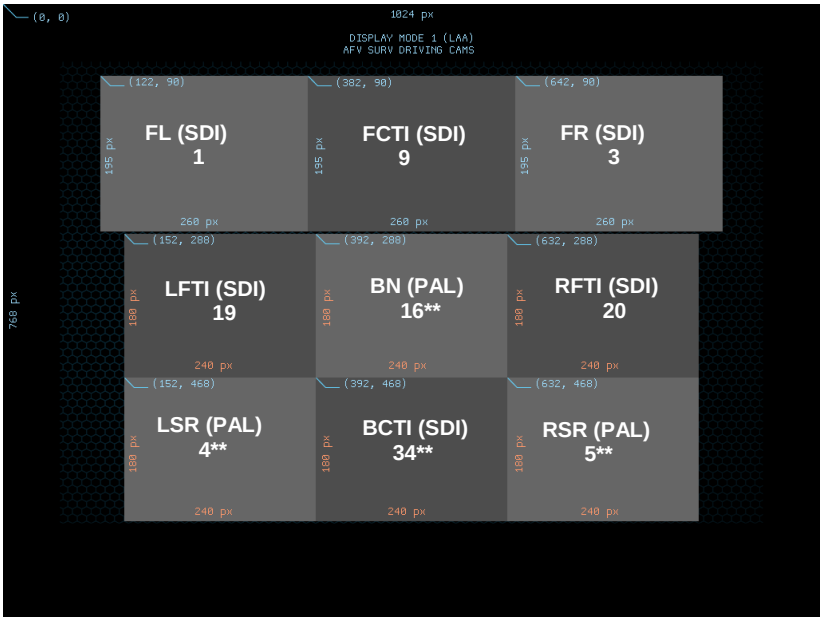
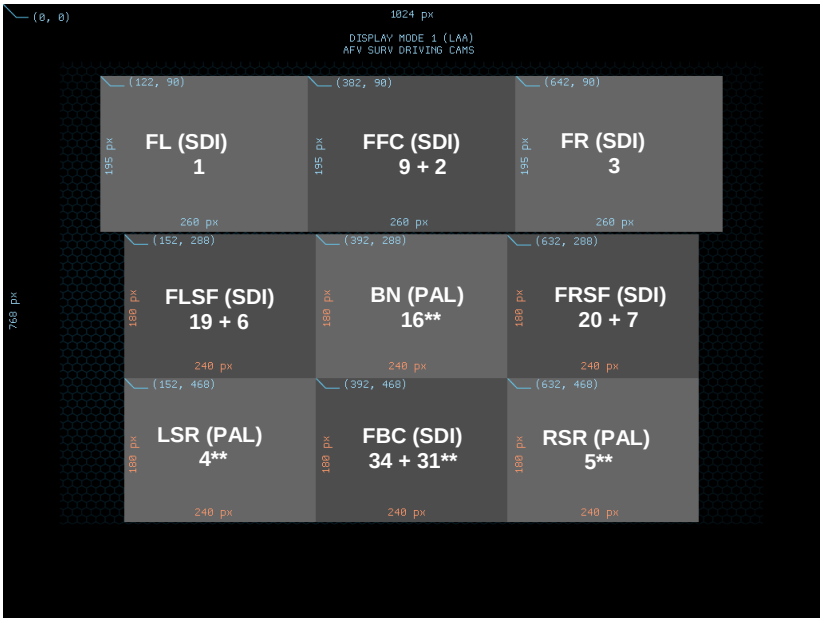
No.15.4 Day Mode Toggled Forward	**DTFD**	
No.15.5 TI Mode Toggled Forward	**DTFT**	

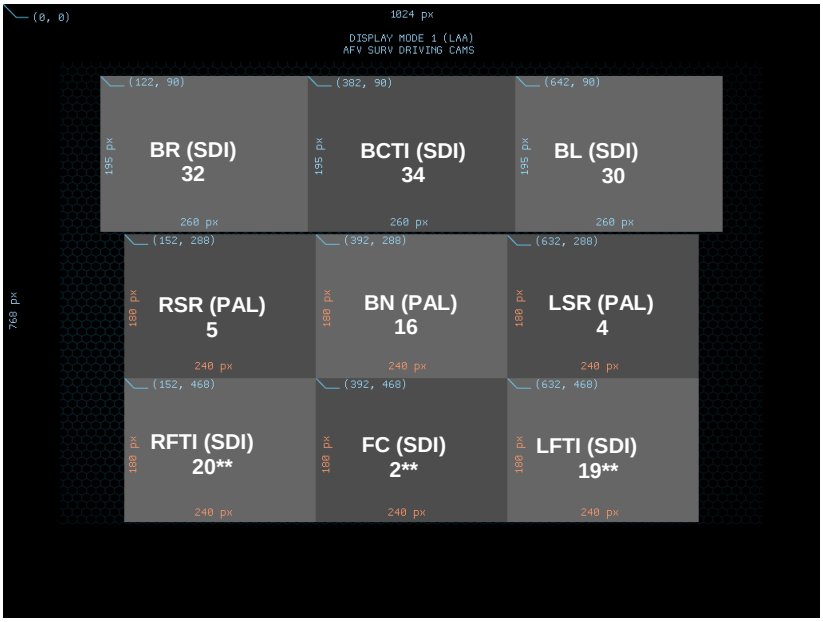
No.15.6 Fusion Mode Toggled Forward	**DTFF**	
No.15.7 Day Mode Default Reverse	**D0RD**	

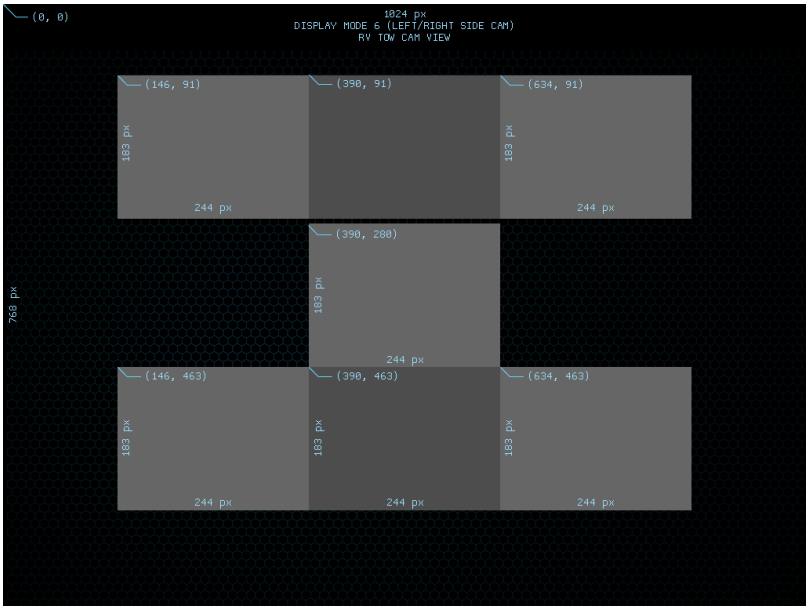
No.15.8 TI Mode Default Reverse	**D0RT**	
No.15.9 Fusion Mode Default Reverse	**D0RF**	

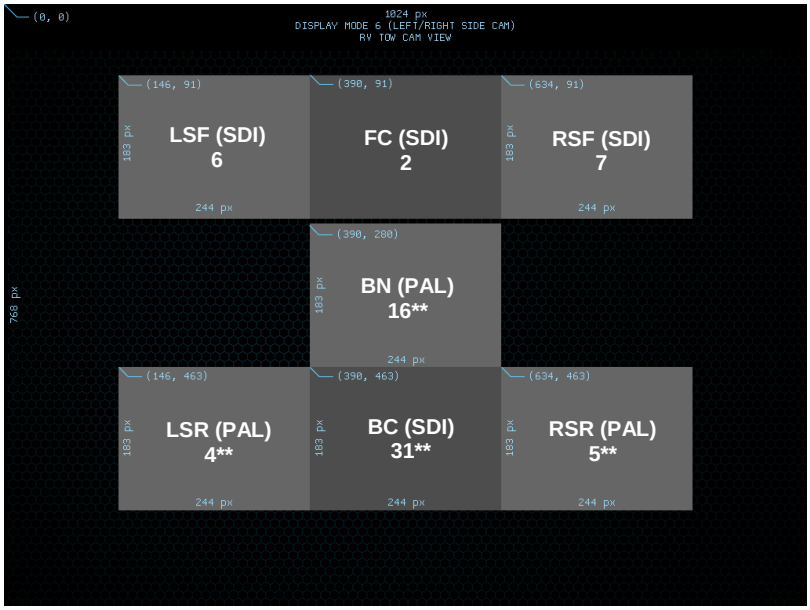
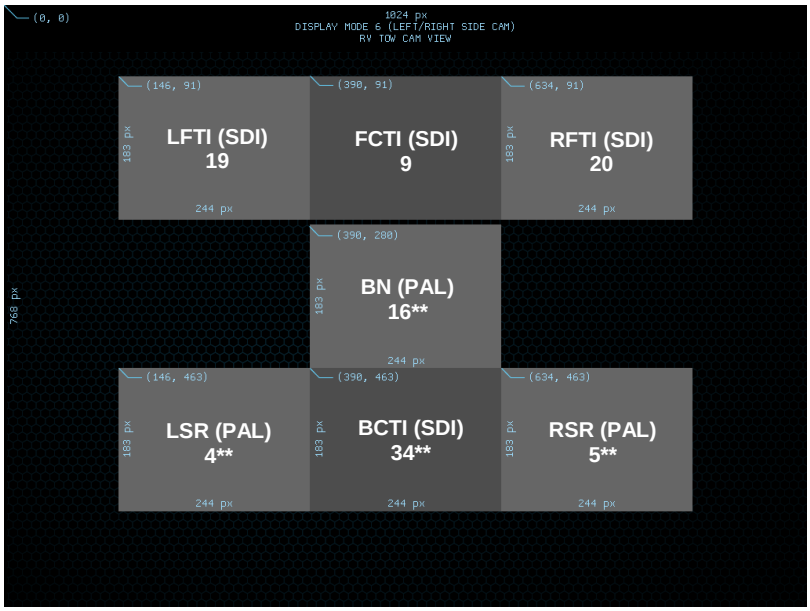
No.15.10 Day Mode Toggled Reverse	**DTRD**	
No.15.11 TI Mode Toggled Reverse	**DTRT**	

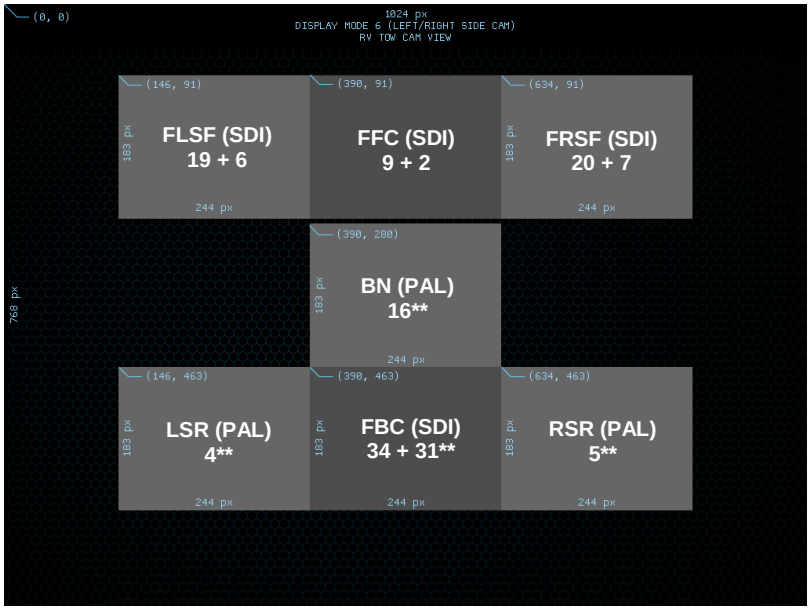
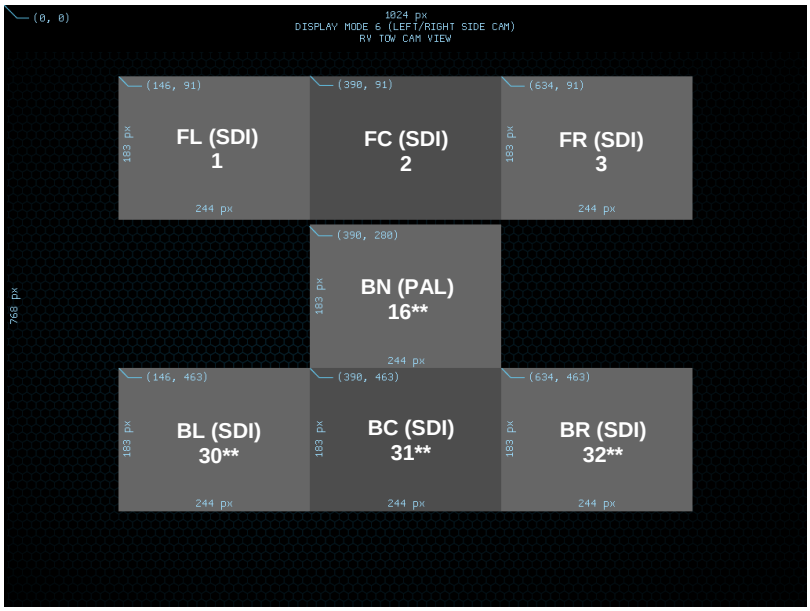
No.15.12 Fusion Mode Toggled Reverse	**DTRF**	
No.15.13 Day Mode All Forward	**DAFD**	

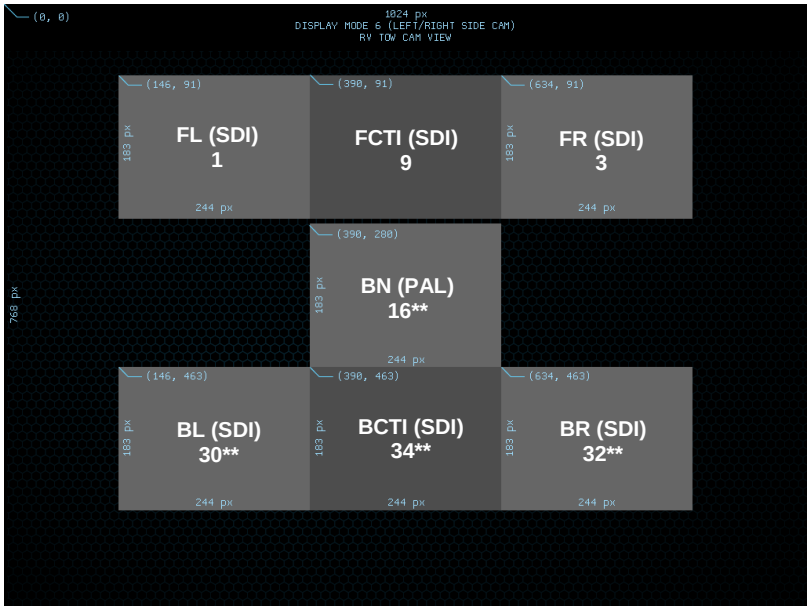
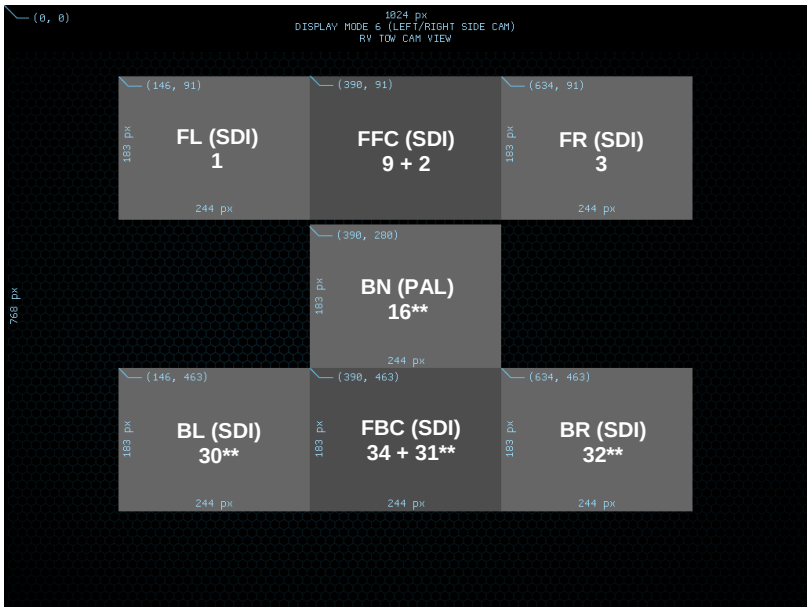
No.15.14 TI Mode All Forward	**DAFT**	
No.15.15 Fusion Mode All Forward	**DAFF**	

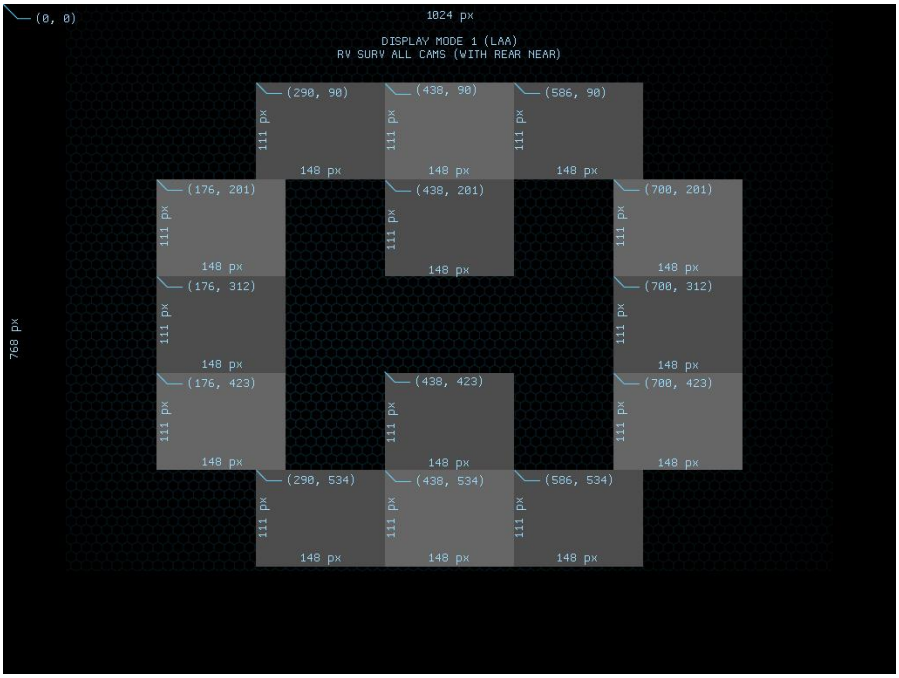
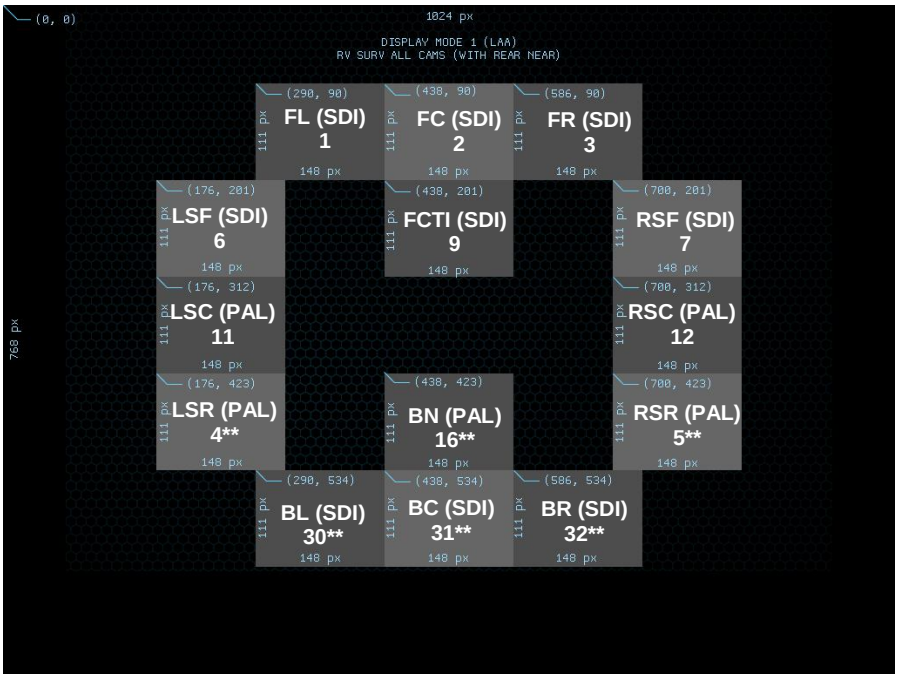
No.15.16 Day Mode All Reverse	**DARD**	
No.15.17 TI Mode All Reverse	**DART**	

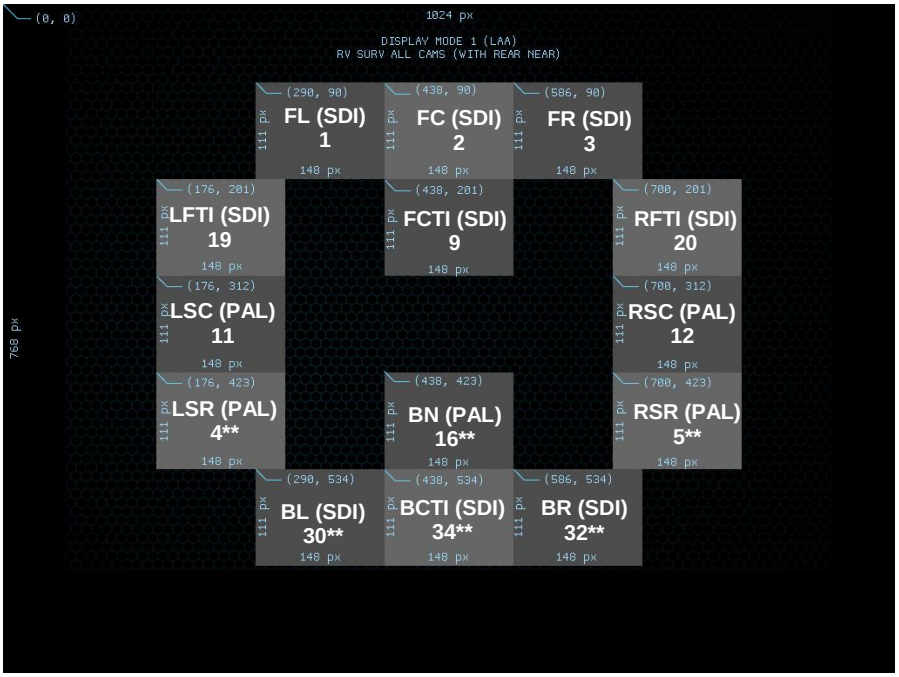
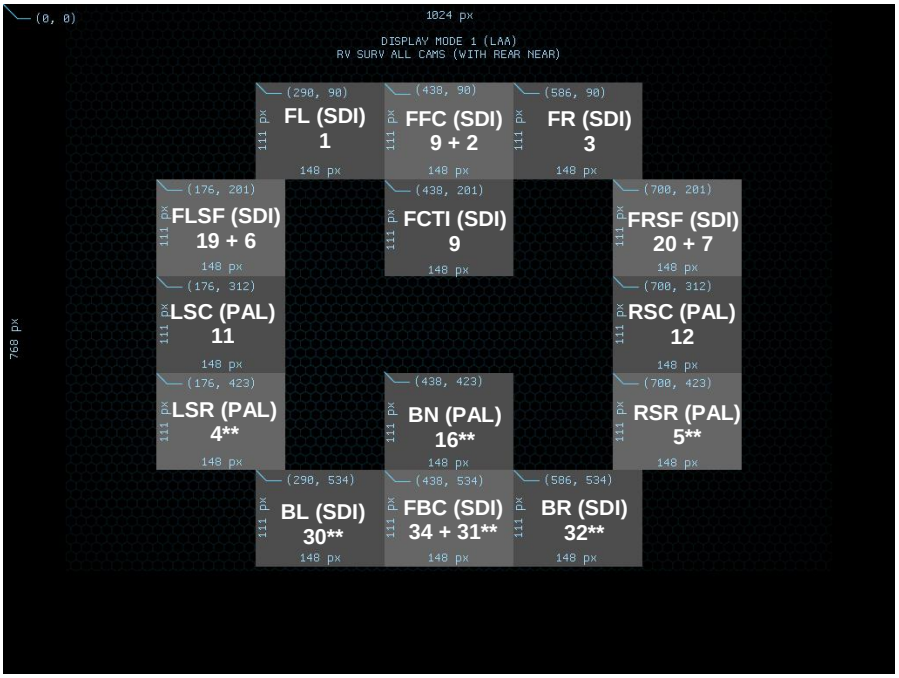
No.15.18 Fusion Mode All Reverse	**DARF**	
No.16	**Recovery Towing Cams**	

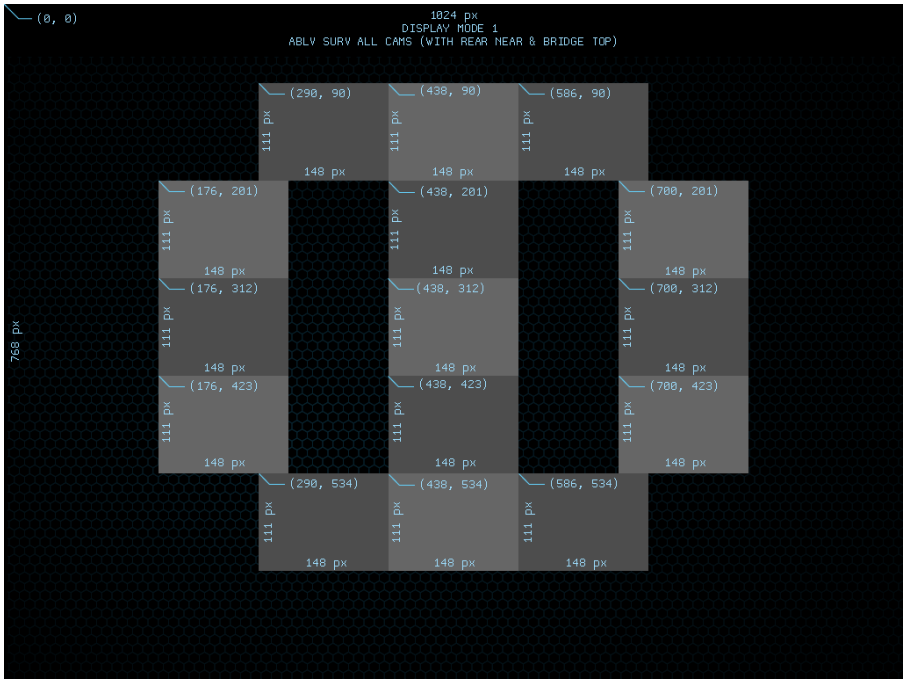
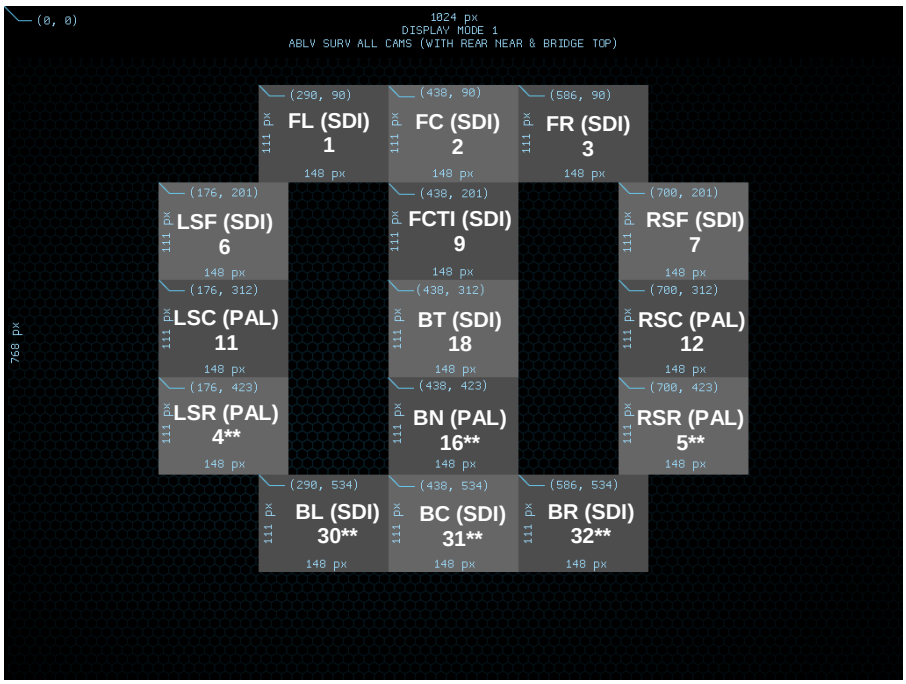
No.16.1 Day Mode Default RV Only	**RT0D**	
No.16.2 TI Mode Default RV Only	**RT0T**	

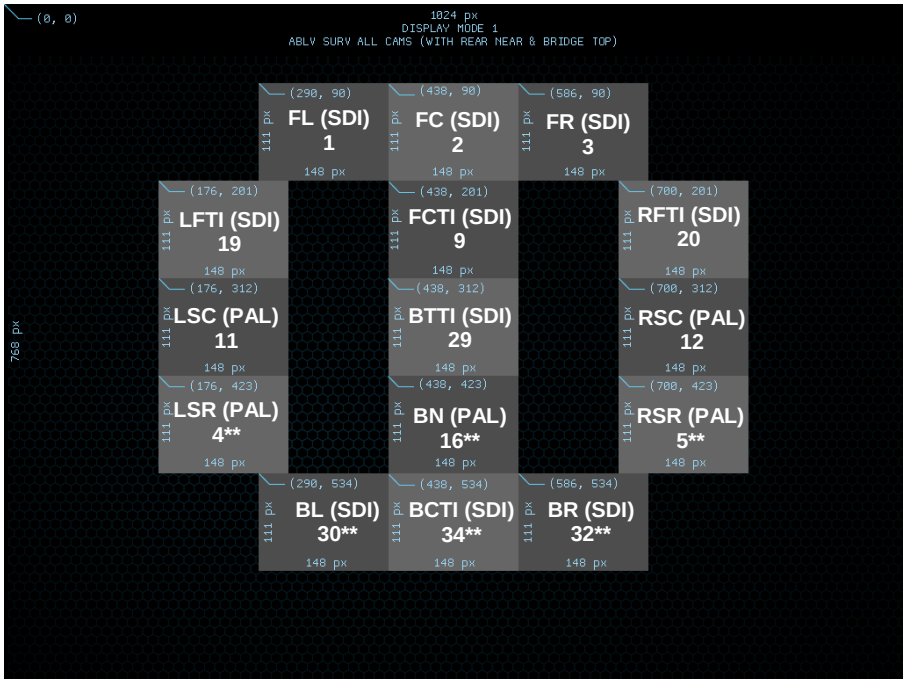
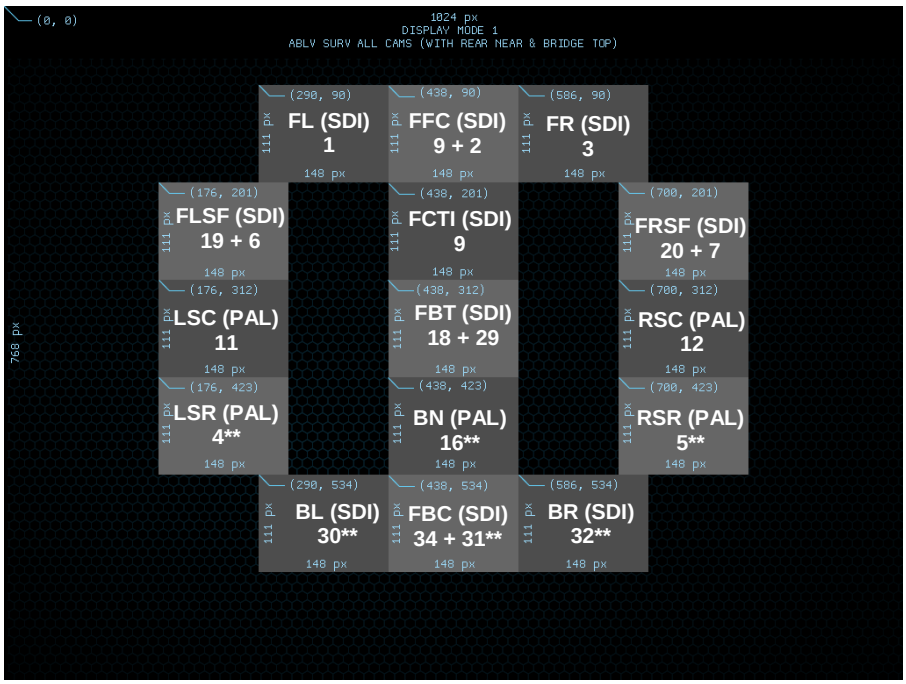
No.16.3 Fusion Mode Default RV Only	**RT0F**	
No.16.4 Day Mode Toggled RV Only	**RTTD**	

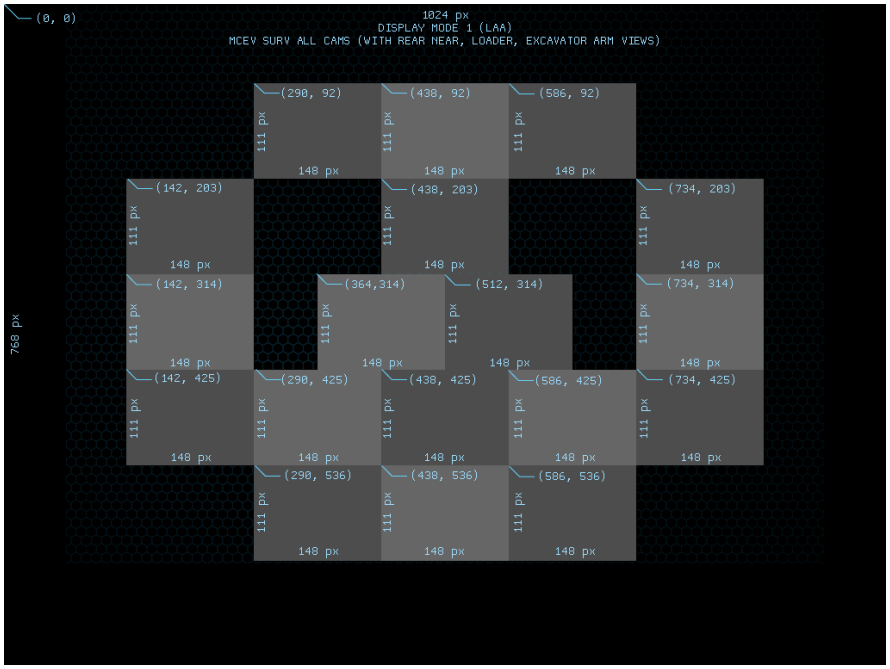
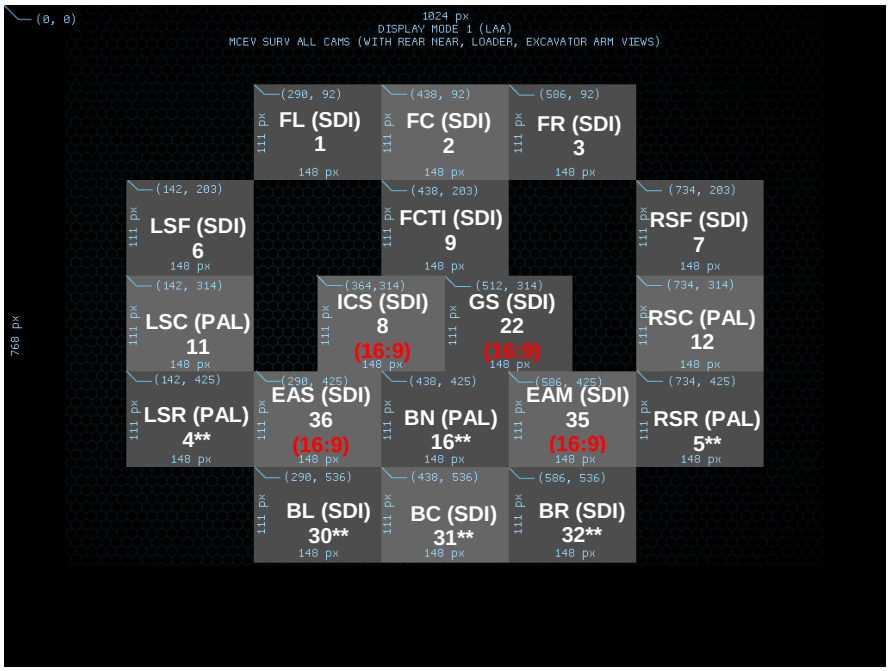
No.16.5 TI Mode Toggled RV Only	**RTTT**	
No.16.6 Fusion Mode Toggled RV Only	**RTTF**	

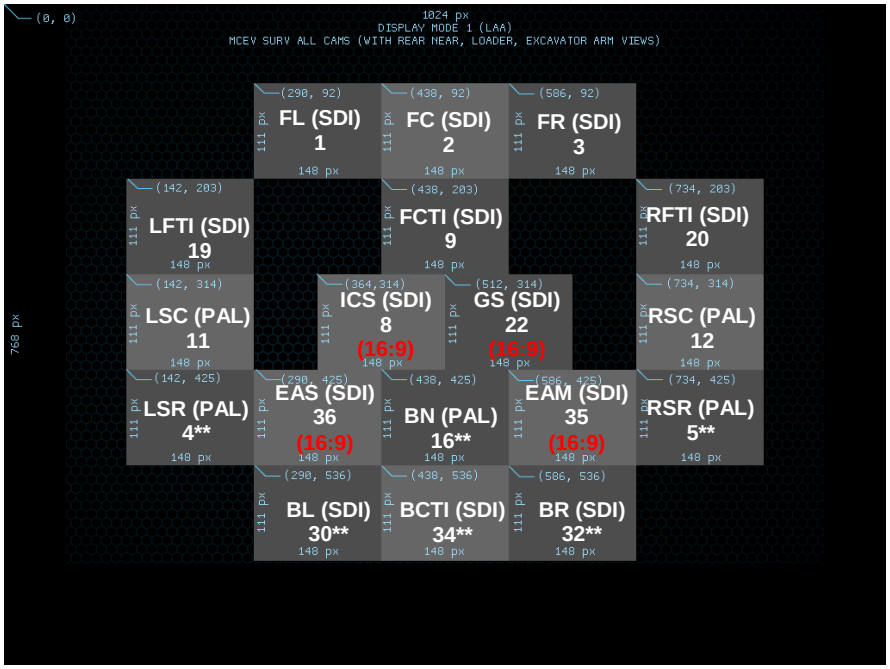
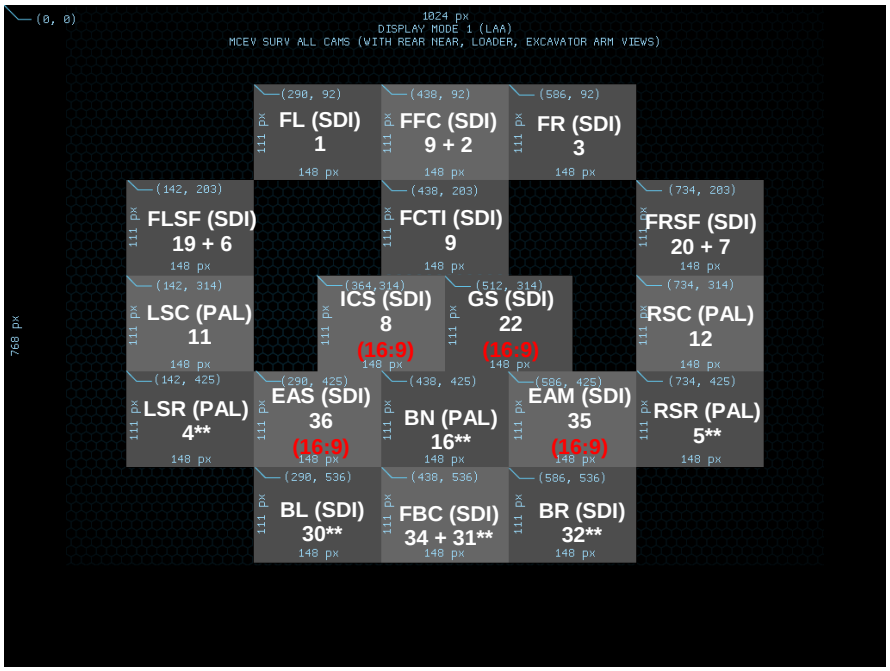
No.17	**RV All Round Cam**	
No.17.1 Day Mode RV Only	**RDAC**	

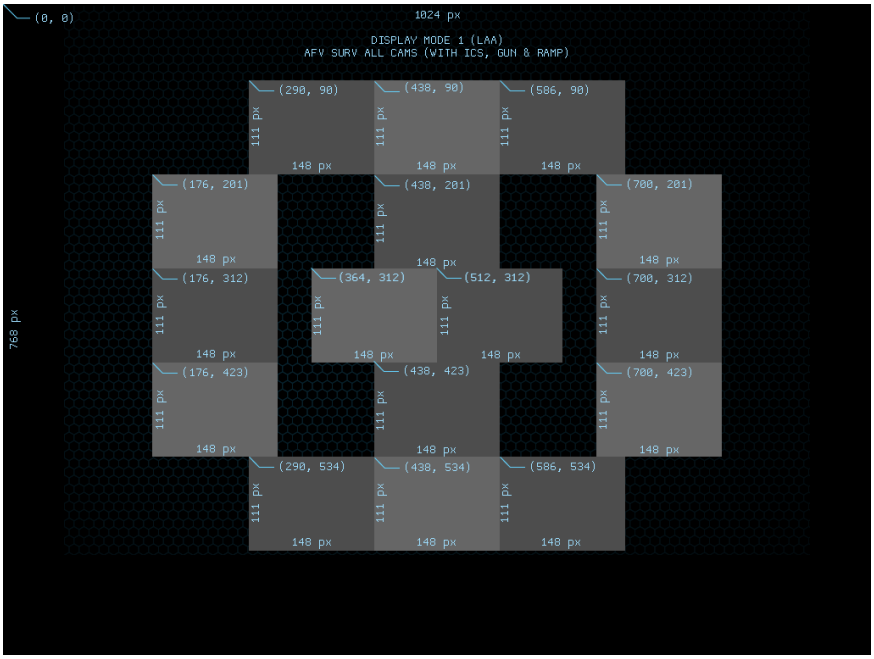
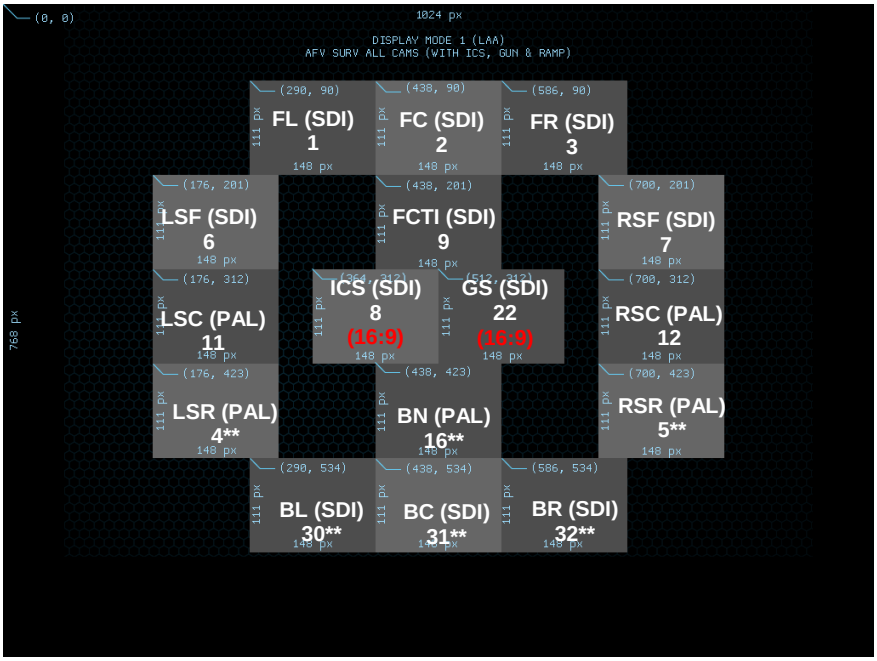
No.17.2 TI Mode RV Only	**RTAC**	
No.17.3 Fusion Mode RV Only	**RFAC**	

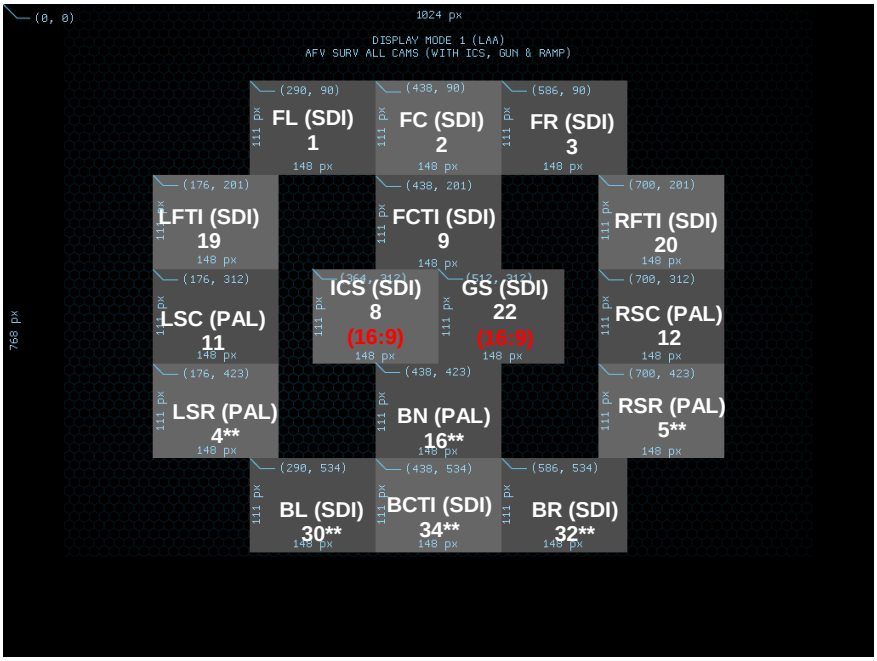
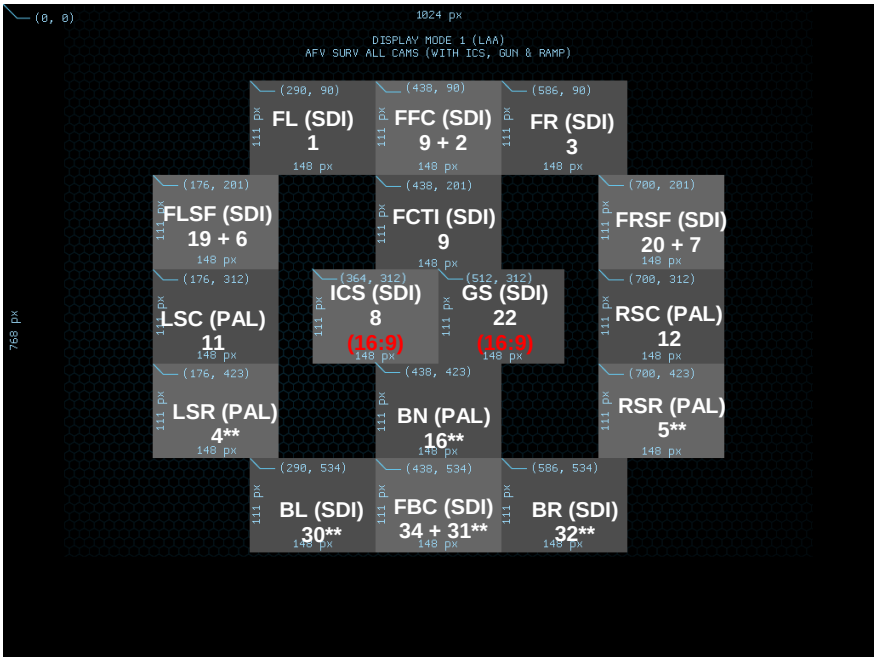
No.18	**AVLB All Round Cam**	
No.18.1 Day Mode AVLB Only	**BDAC**	

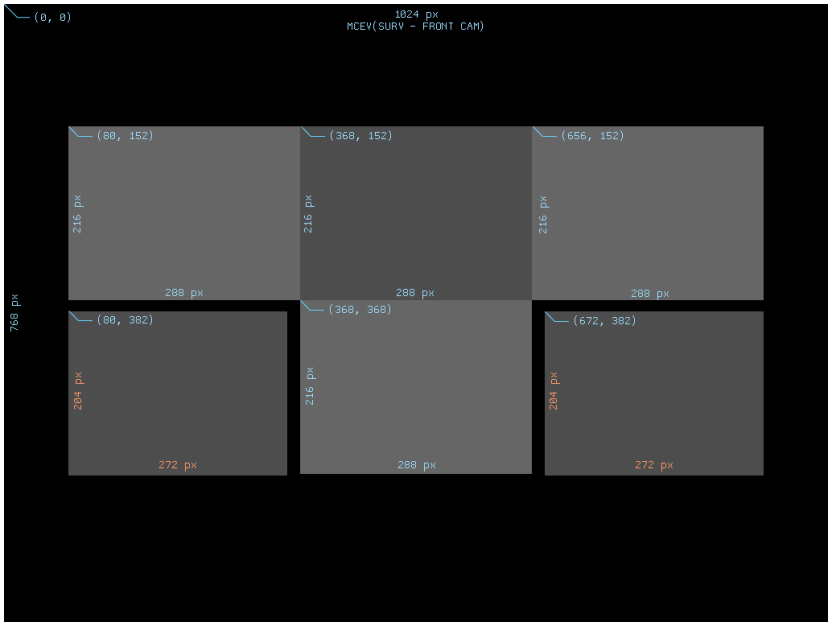
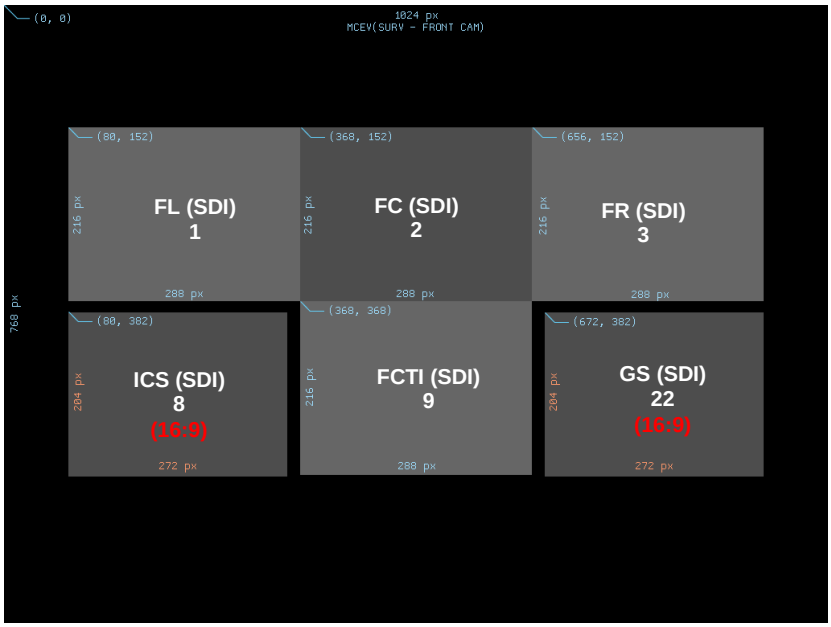
No.18.2 TI Mode AVLB Only	**BTAC**	
No.18.3 Fusion Mode AVLB Only	**BFAC**	

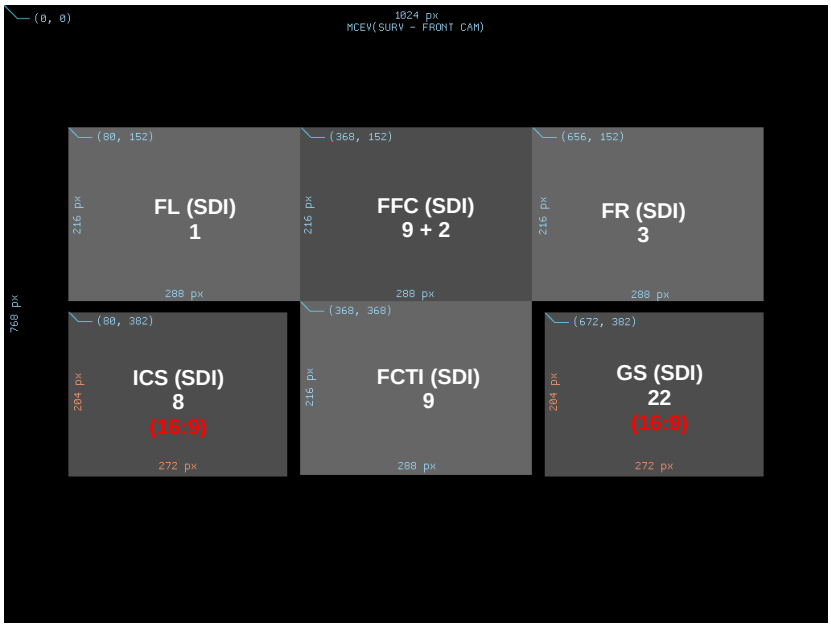
No.19	**MCEV All Round Cam**	
No.19.1 Day Mode MCEV Only	**MDAC**	

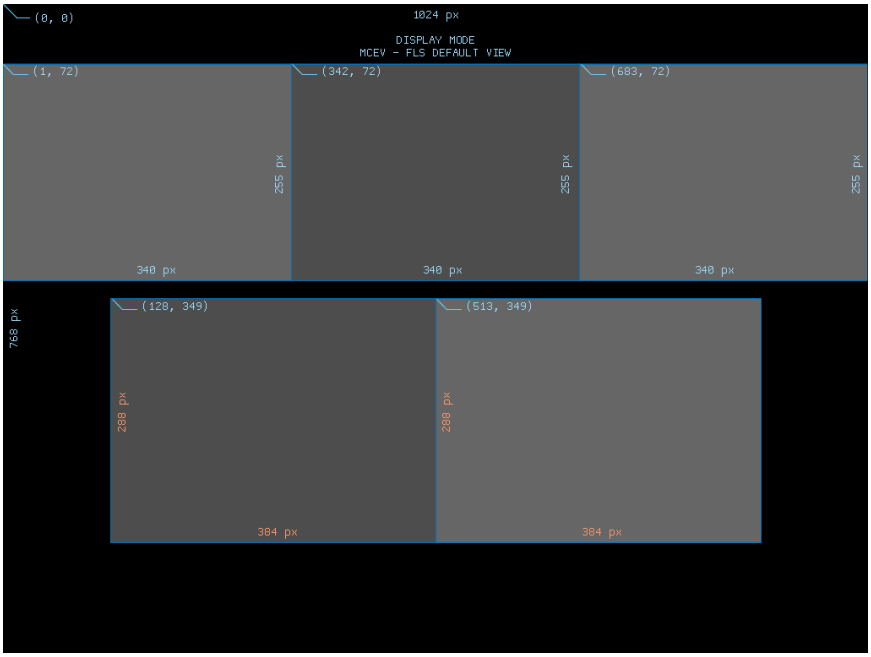
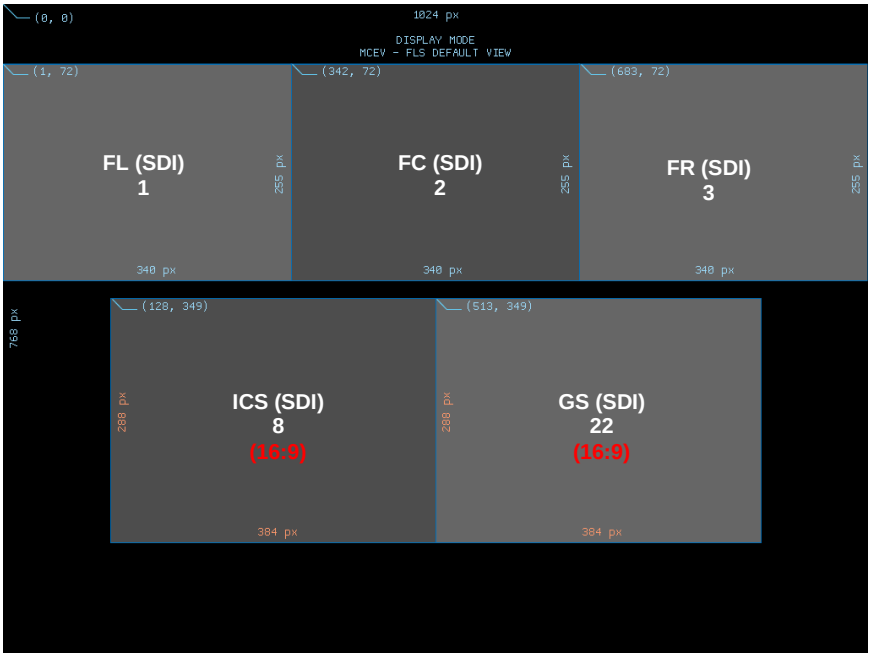
No.19.2 TI Mode MCEV Only	**MTAC**	
No.19.3 Fusion Mode MCEV Only	**MFAC**	

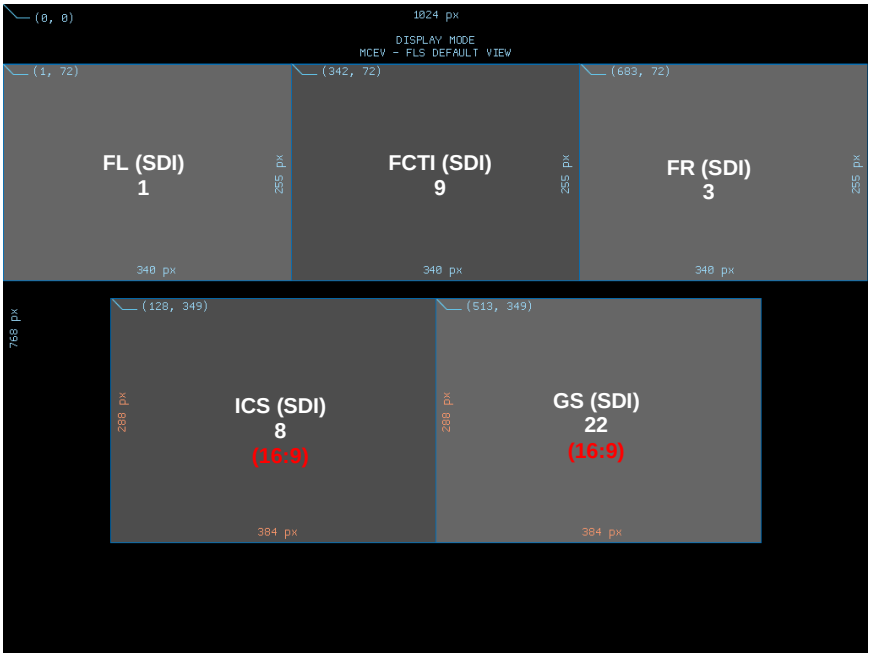
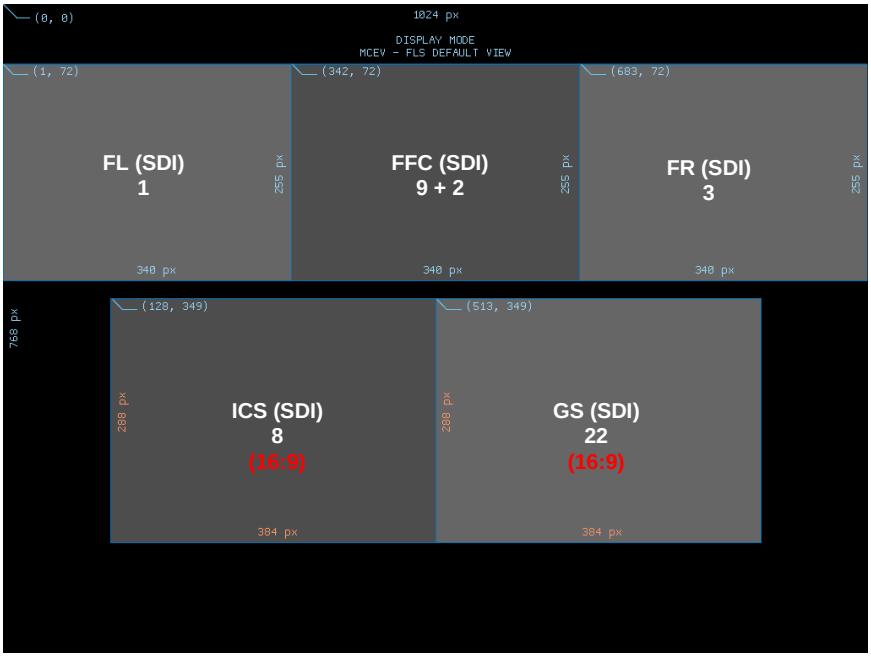
No.20	**GCV All Round Cam**	
No.20.1 Day Mode GCV Only	**GDAC**	

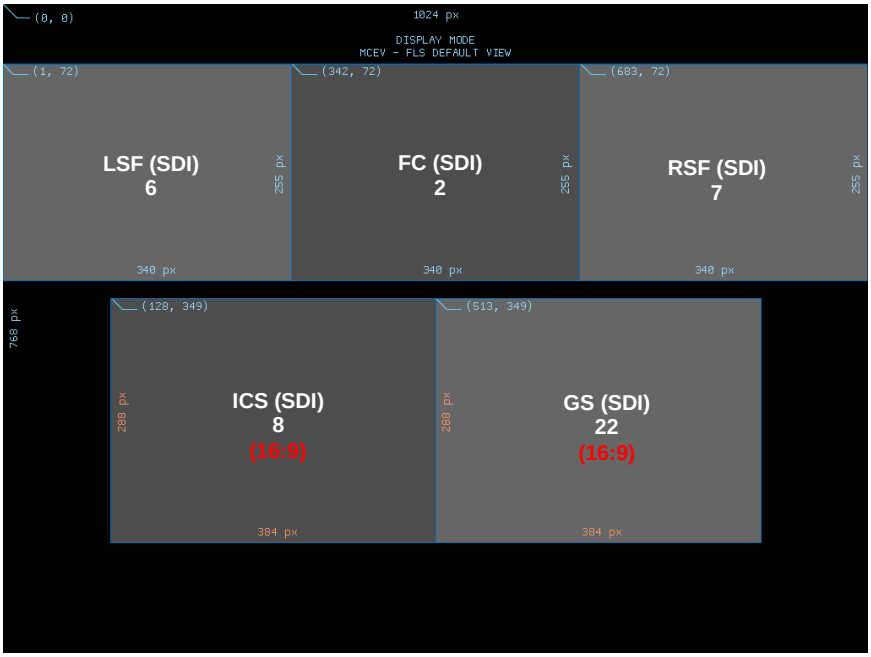
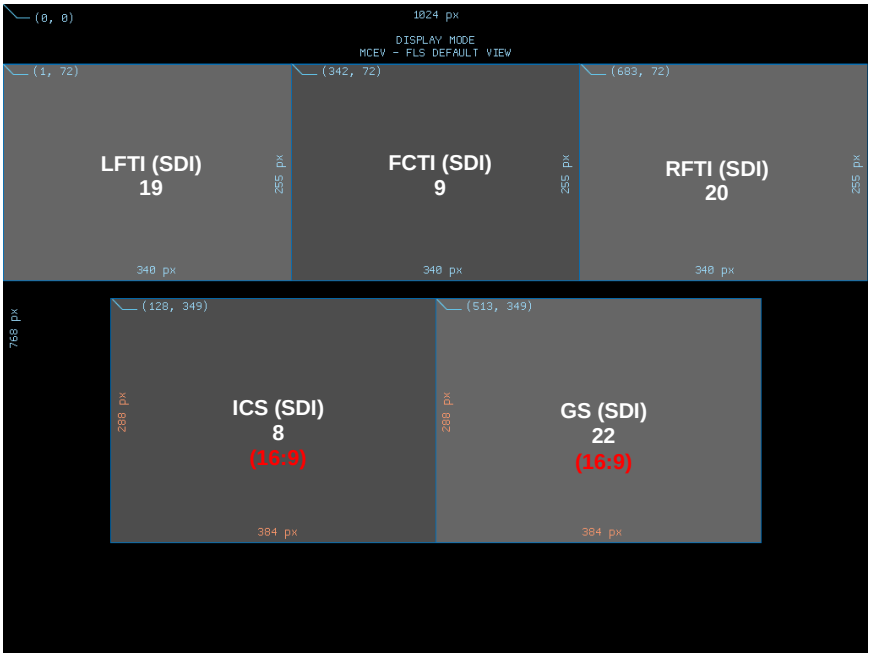
No.20.2 TI Mode GCV Only	**GTAC**	
No.20.3 Fusion Mode GCV Only	**GFAC**	

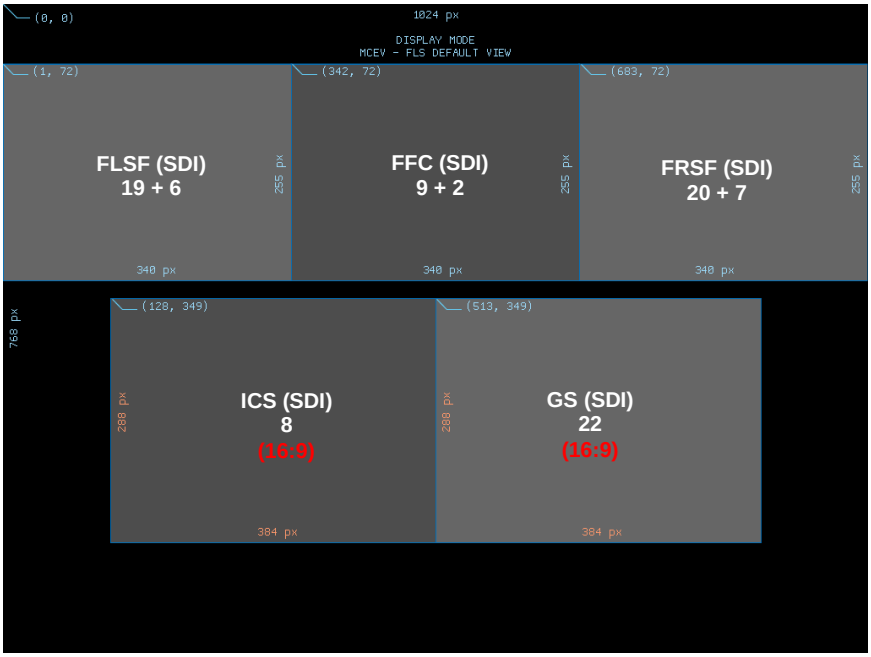
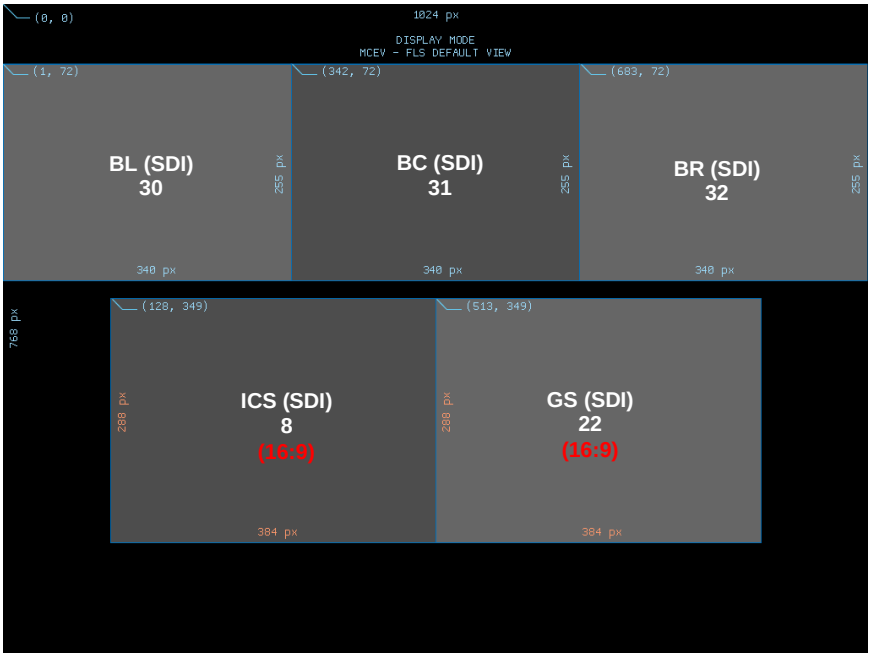
No.21	**MCEV Front Cam**	
No.21.1 Day Mode MCEV Only	**0MAF**	

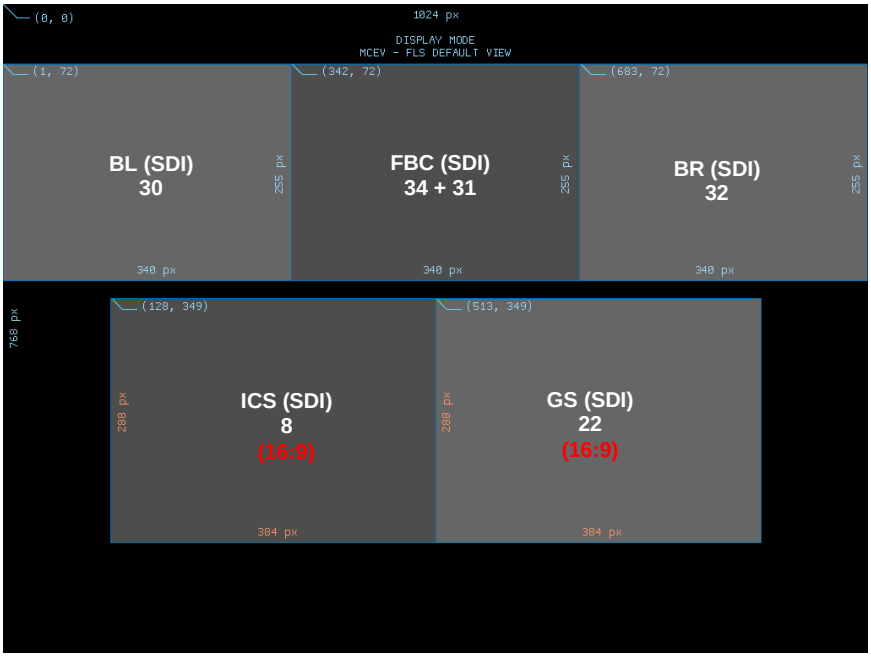
No.21.2 TI Mode MCEV Only	**TMAF**	
No.21.3 Fusion Mode MCEV Only	**FMAF**	

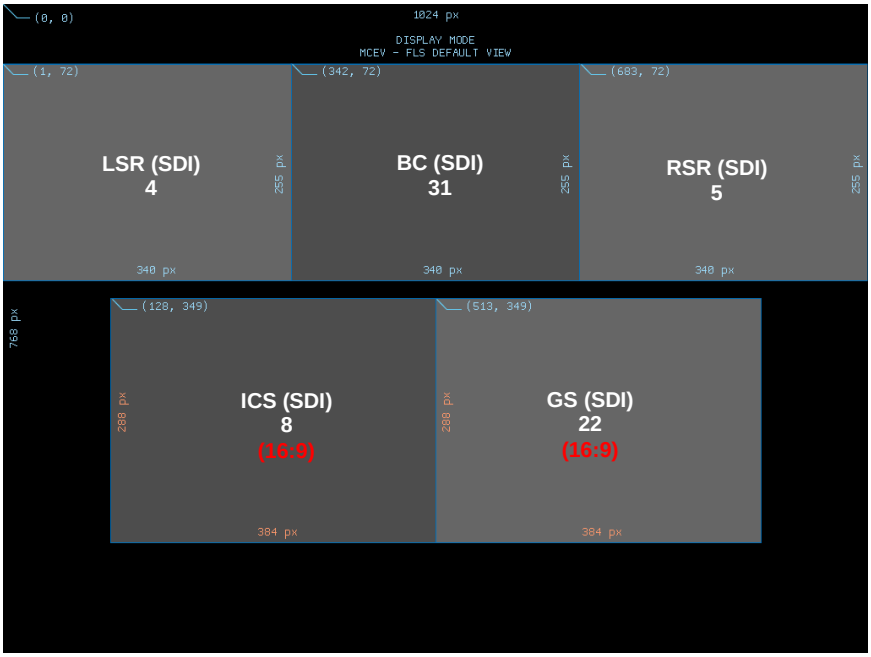
No.22	**MCEV FLS**	
No.22.1 Day Mode Default View MCEV Only	**MF0D**	

No.22.2 TI Mode Default View MCEV Only	**MF0T**	
No.22.3 Fusion Mode Default View MCEV Only	**MF0F**	

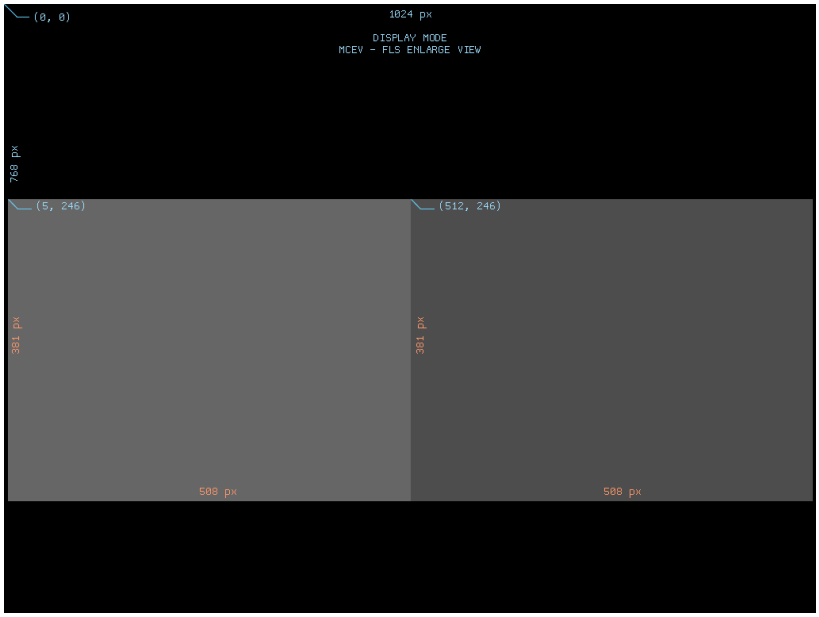
No.22.4 Day Mode Toggled View MCEV Only	**MFTD**	
No.22.5 TI Mode Toggled View MCEV Only	**MFTT**	

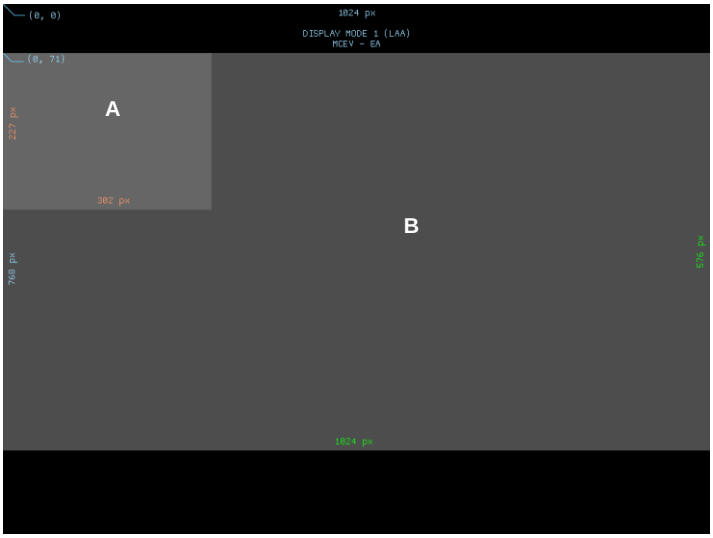
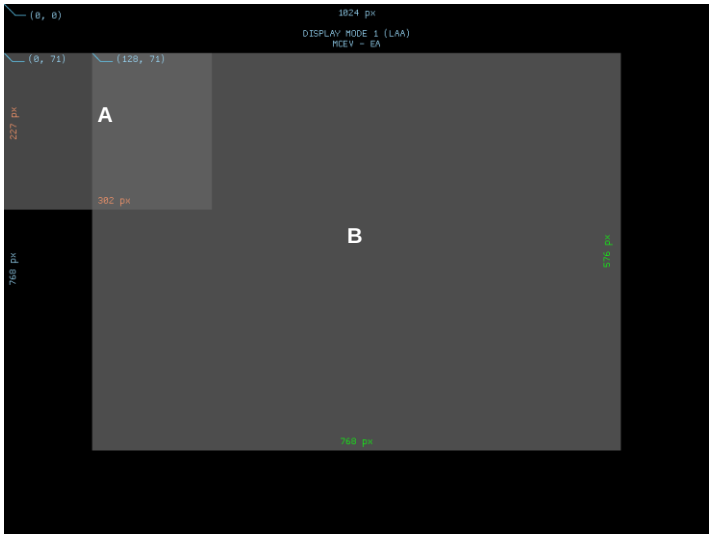
No.22.6 Fusion Mode Toggled View MCEV Only	**MFTF**	
No.22.7 Day Mode Reverse View MCEV Only	**MF1D**	

No.22.8 TI Mode Reverse View MCEV Only	**MF1T**	
No.22.9 Fusion Mode Reverse View MCEV Only	**MF1F**	

No.22.10 Day Mode Reverse-Toggled View MCEV Only	**MFRD**	
No.22.11 TI Mode Reverse-Toggled View MCEV Only	**MFRT**	

No.22.12 Fusion Mode Reverse-Toggled View MCEV Only	**MFRF**	

No.23	**MCEV FLS Enlarged**	
No.23.1 FLS Enlarged MCEV Only	**MFEL**	

No.24 MCEV Only	**MCEV EA** 16:9	
MCEV Only	4:3	

		A	B
No.24.001	M001	EAS (SDI) 36	EAM (SDI) 35
No.24.002	M002	FL (SDI) 1	
No.24.003	M003	FC (SDI) 2	
No.24.004	M004	FCTI (SDI) 9	
No.24.005	M005	FFC (SDI) 9 + 2	
No.24.006	M006	FR (SDI) 3	
No.24.007	M007	LSF (SDI) 6	
No.24.008	M008	LFTI (SDI) 19	
No.24.009	M009	FLSF (SDI) 19 + 6	
No.24.010	M010	RSF (SDI) 7	
No.24.011	M011	RFTI (SDI) 20	
No.24.012	M012	FRSF (SDI) 20 + 7	
No.24.013	M013	LSC (PAL) 11	
No.24.014	M014	RSC (PAL) 12	
No.24.015	M015	LSR (PAL) 4**	
No.24.016	M016	RSR (PAL) 5**	
No.24.017	M017	BL (SDI) 30**	
No.24.018	M018	BC (SDI) 31**	
No.24.019	M019	BCTI (SDI) 34**	
No.24.020	M020	FBC (SDI) 34 + 31**	
No.24.021	M021	BR (SDI) 32**	
No.24.022	M022	BN (PAL) 16**	
No.24.023	M023	ICS (SDI) 8	
No.24.024	M024	GS (SDI) 22	
No.24.025	M025	EAM (SDI) 35	
No.24.026	M026	FL (SDI) 1	EAS (SDI) 36
No.24.027	M027	FC (SDI) 2	
No.24.028	M028	FCTI (SDI) 9	
No.24.029	M029	FFC (SDI) 9 + 2	
No.24.030	M030	FR (SDI) 3	
No.24.031	M031	LSF (SDI) 6	
No.24.032	M032	LFTI (SDI) 19	
No.24.033	M033	FLSF (SDI) 19 + 6	
No.24.034	M034	RSF (SDI) 7	
No.24.035	M035	RFTI (SDI) 20	
No.2.4036	M036	FRSF (SDI) 20 + 7	
No.24.037	M037	LSC (PAL) 11	
No.24.038	M038	RSC (PAL) 12	
No.24.039	M039	LSR (PAL) 4**	
No.24.040	M040	RSR (PAL) 5**	
No.24.041	M041	BL (SDI) 30**	
No.24.042	M042	BC (SDI) 31**	

No.24.043	M043	BCTI (SDI) 34**	
No.24.044	M044	FBC (SDI) 34 + 31**	
No.24.045	M045	BR (SDI) 32**	
No.24.046	M046	BN (PAL) 16**	
No.24.047	M047	ICS (SDI) 8	
No.24.048	M048	GS (SDI) 22	
No.24.049	M049	EAM (SDI) 35	
No.24.050	M050	EAS (SDI) 36	
No.24.051	M051	FL (SDI) 1	GS (SDI) 22
No.24.052	M052	FC (SDI) 2	
No.24.053	M053	FCTI (SDI) 9	
No.24.054	M054	FFC (SDI) 9 + 2	
No.24.055	M055	FR (SDI) 3	
No.24.056	M056	LSF (SDI) 6	
No.24.057	M057	LFTI (SDI) 19	
No.24.058	M058	FLSF (SDI) 19 + 6	
No.24.059	M059	RSF (SDI) 7	
No.24.060	M060	RFTI (SDI) 20	
No.24.061	M061	FRSF (SDI) 20 + 7	
No.24.062	M062	LSC (PAL) 11	
No.24.063	M063	RSC (PAL) 12	
No.24.064	M064	LSR (PAL) 4**	
No.24.065	M065	RSR (PAL) 5**	
No.24.066	M066	BL (SDI) 30**	
No.24.067	M067	BC (SDI) 31**	
No.24.068	M068	BCTI (SDI) 34**	
No.24.069	M069	FBC (SDI) 34 + 31**	
No.24.070	M070	BR (SDI) 32**	
No.24.071	M071	BN (PAL) 16**	
No.24.072	M072	ICS (SDI) 8	
No.24.073	M073	GS (SDI) 22	
No.24.074	M074	EAM (SDI) 35	
No.24.075	M075	EAS (SDI) 36	
No.24.076	M076	FL (SDI) 1	ICS (SDI) 8
No.24.077	M077	FC (SDI) 2	
No.24.078	M078	FCTI (SDI) 9	
No.24.079	M079	FFC (SDI) 9 + 2	
No.24.080	M080	FR (SDI) 3	
No.24.081	M081	LSF (SDI) 6	
No.24.082	M082	LFTI (SDI) 19	
No.24.083	M083	FLSF (SDI) 19 + 6	
No.24.084	M084	RSF (SDI) 7	
No.24.085	M085	RFTI (SDI) 20	

No.24.086	M086	FRSF (SDI) 20 + 7	
No.24.087	M087	LSC (PAL) 11	
No.24.088	M088	RSC (PAL) 12	
No.24.089	M089	LSR (PAL) 4**	
No.24.090	M090	RSR (PAL) 5**	
No.24.091	M091	BL (SDI) 30**	
No.24.092	M092	BC (SDI) 31**	
No.24.093	M093	BCTI (SDI) 34**	
No.24.094	M094	FBC (SDI) 34 + 31**	
No.24.095	M095	BR (SDI) 32**	
No.24.096	M096	BN (PAL) 16**	
No.24.097	M097	ICS (SDI) 8	
No.24.098	M098	GS (SDI) 22	
No.24.099	M099	EAM (SDI) 35	
No.24.100	M100	EAS (SDI) 36	
No.24.101	M101	FL (SDI) 1	BN (PAL) 16**
No.24.102	M102	FC (SDI) 2	
No.24.103	M103	FCTI (SDI) 9	
No.24.104	M104	FFC (SDI) 9 + 2	
No.24.105	M105	FR (SDI) 3	
No.24.106	M106	LSF (SDI) 6	
No.24.107	M107	LFTI (SDI) 19	
No.24.108	M108	FLSF (SDI) 19 + 6	
No.24.109	M109	RSF (SDI) 7	
No.24.110	M110	RFTI (SDI) 20	
No.24.111	M111	FRSF (SDI) 20 + 7	
No.24.112	M112	LSC (PAL) 11	
No.24.113	M113	RSC (PAL) 12	
No.24.114	M114	LSR (PAL) 4**	
No.24.115	M115	RSR (PAL) 5**	
No.24.116	M116	BL (SDI) 30**	
No.24.117	M117	BC (SDI) 31**	
No.24.118	M118	BCTI (SDI) 34**	
No.24.119	M119	FBC (SDI) 34 + 31**	
No.24.120	M120	BR (SDI) 32**	
No.24.121	M121	BN (PAL) 16**	
No.24.122	M122	ICS (SDI) 8	
No.24.123	M123	GS (SDI) 22	
No.24.124	M124	EAM (SDI) 35	
No.24.125	M125	EAS (SDI) 36	
No.24.126	M126	FL (SDI) 1	BR (SDI) 32**
No.24.127	M127	FC (SDI) 2	
No.24.128	M128	FCTI (SDI) 9	

No.24.129	M129	FFC (SDI) 9 + 2	
No.24.130	M130	FR (SDI) 3	
No.24.131	M131	LSF (SDI) 6	
No.24.132	M132	LFTI (SDI) 19	
No.24.133	M133	FLSF (SDI) 19 + 6	
No.24.134	M134	RSF (SDI) 7	
No.24.135	M135	RFTI (SDI) 20	
No.24.136	M136	FRSF (SDI) 20 + 7	
No.24.137	M137	LSC (PAL) 11	
No.24.138	M138	RSC (PAL) 12	
No.24.139	M139	LSR (PAL) 4**	
No.24.140	M140	RSR (PAL) 5**	
No.24.141	M141	BL (SDI) 30**	
No.24.142	M142	BC (SDI) 31**	
No.24.143	M143	BCTI (SDI) 34**	
No.24.144	M144	FBC (SDI) 34 + 31**	
No.24.145	M145	BR (SDI) 32**	
No.24.146	M146	BN (PAL) 16**	
No.24.147	M147	ICS (SDI) 8	
No.24.148	M148	GS (SDI) 22	
No.24.149	M149	EAM (SDI) 35	
No.24.150	M150	EAS (SDI) 36	
No.24.151	M151	FL (SDI) 1	FBC (SDI) 34 + 31**
No.24.152	M152	FC (SDI) 2	
No.24.153	M153	FCTI (SDI) 9	
No.24.154	M154	FFC (SDI) 9 + 2	
No.24.155	M155	FR (SDI) 3	
No.24.156	M156	LSF (SDI) 6	
No.24.157	M157	LFTI (SDI) 19	
No.24.158	M158	FLSF (SDI) 19 + 6	
No.24.159	M159	RSF (SDI) 7	
No.24.160	M160	RFTI (SDI) 20	
No.24.161	M161	FRSF (SDI) 20 + 7	
No.24.162	M162	LSC (PAL) 11	
No.24.163	M163	RSC (PAL) 12	
No.24.164	M164	LSR (PAL) 4**	
No.24.165	M165	RSR (PAL) 5**	
No.24.166	M166	BL (SDI) 30**	
No.24.167	M167	BC (SDI) 31**	
No.24.168	M168	BCTI (SDI) 34**	
No.24.169	M169	FBC (SDI) 34 + 31**	
No.24.170	M170	BR (SDI) 32**	
No.24.171	M171	BN (PAL) 16**	

No.24.172	M172	ICS (SDI) 8	
No.24.173	M173	GS (SDI) 22	
No.24.174	M174	EAM (SDI) 35	
No.24.175	M175	EAS (SDI) 36	
No.24.176	M176	FL (SDI) 1	BCTI (SDI) 34**
No.24.177	M177	FC (SDI) 2	
No.24.178	M178	FCTI (SDI) 9	
No.24.179	M179	FFC (SDI) 9 + 2	
No.24.180	M180	FR (SDI) 3	
No.24.181	M181	LSF (SDI) 6	
No.24.182	M182	LFTI (SDI) 19	
No.24.183	M183	FLSF (SDI) 19 + 6	
No.24.184	M184	RSF (SDI) 7	
No.24.185	M185	RFTI (SDI) 20	
No.24.186	M186	FRSF (SDI) 20 + 7	
No.24.187	M187	LSC (PAL) 11	
No.24.188	M188	RSC (PAL) 12	
No.24.189	M189	LSR (PAL) 4**	
No.24.190	M190	RSR (PAL) 5**	
No.24.191	M191	BL (SDI) 30**	
No.24.192	M192	BC (SDI) 31**	
No.24.193	M193	BCTI (SDI) 34**	
No.24.194	M194	FBC (SDI) 34 + 31**	
No.24.195	M195	BR (SDI) 32**	
No.24.196	M196	BN (PAL) 16**	
No.24.197	M197	ICS (SDI) 8	
No.24.198	M198	GS (SDI) 22	
No.24.199	M199	EAM (SDI) 35	
No.24.200	M200	EAS (SDI) 36	
No.24.201	M201	FL (SDI) 1	BC (SDI) 31**
No.24.202	M202	FC (SDI) 2	
No.24.203	M203	FCTI (SDI) 9	
No.24.204	M204	FFC (SDI) 9 + 2	
No.24.205	M205	FR (SDI) 3	
No.24.206	M206	LSF (SDI) 6	
No.24.207	M207	LFTI (SDI) 19	
No.24.208	M208	FLSF (SDI) 19 + 6	
No.24.209	M209	RSF (SDI) 7	
No.24.210	M210	RFTI (SDI) 20	
No.24.211	M211	FRSF (SDI) 20 + 7	
No.24.212	M212	LSC (PAL) 11	
No.24.213	M213	RSC (PAL) 12	
No.24.214	M214	LSR (PAL) 4**	

No.24.215	M215	RSR (PAL) 5**	
No.24.216	M216	BL (SDI) 30**	
No.24.217	M217	BC (SDI) 31**	
No.24.218	M218	BCTI (SDI) 34**	
No.24.219	M219	FBC (SDI) 34 + 31**	
No.24.220	M220	BR (SDI) 32**	
No.24.221	M221	BN (PAL) 16**	
No.24.222	M222	ICS (SDI) 8	
No.24.223	M223	GS (SDI) 22	
No.24.224	M224	EAM (SDI) 35	
No.24.225	M225	EAS (SDI) 36	
No.24.226	M226	FL (SDI) 1	BL (SDI) 30**
No.24.227	M227	FC (SDI) 2	
No.24.228	M228	FCTI (SDI) 9	
No.24.229	M229	FFC (SDI) 9 + 2	
No.24.230	M230	FR (SDI) 3	
No.24.231	M231	LSF (SDI) 6	
No.24.232	M232	LFTI (SDI) 19	
No.24.233	M233	FLSF (SDI) 19 + 6	
No.24.234	M234	RSF (SDI) 7	
No.24.235	M235	RFTI (SDI) 20	
No.24.236	M236	FRSF (SDI) 20 + 7	
No.24.237	M237	LSC (PAL) 11	
No.24.238	M238	RSC (PAL) 12	
No.24.239	M239	LSR (PAL) 4**	
No.24.240	M240	RSR (PAL) 5**	
No.24.241	M241	BL (SDI) 30**	
No.24.242	M242	BC (SDI) 31**	
No.24.243	M243	BCTI (SDI) 34**	
No.24.244	M244	FBC (SDI) 34 + 31**	
No.24.245	M245	BR (SDI) 32**	
No.24.246	M246	BN (PAL) 16**	
No.24.247	M247	ICS (SDI) 8	
No.24.248	M248	GS (SDI) 22	
No.24.249	M249	EAM (SDI) 35	
No.24.250	M250	EAS (SDI) 36	
No.24.251	M251	FL (SDI) 1	RSR (PAL) 5**
No.24.252	M252	FC (SDI) 2	
No.24.253	M253	FCTI (SDI) 9	
No.24.254	M254	FFC (SDI) 9 + 2	
No.24.255	M255	FR (SDI) 3	
No.24.256	M256	LSF (SDI) 6	
No.24.257	M257	LFTI (SDI) 19	

No.24.258	M258	FLSF (SDI) 19 + 6	
No.24.259	M259	RSF (SDI) 7	
No.24.260	M260	RFTI (SDI) 20	
No.24.261	M261	FRSF (SDI) 20 + 7	
No.24.262	M262	LSC (PAL) 11	
No.24.263	M263	RSC (PAL) 12	
No.24.264	M264	LSR (PAL) 4**	
No.24.265	M265	RSR (PAL) 5**	
No.24.266	M266	BL (SDI) 30**	
No.24.267	M267	BC (SDI) 31**	
No.24.268	M268	BCTI (SDI) 34**	
No.24.269	M269	FBC (SDI) 34 + 31**	
No.24.270	M270	BR (SDI) 32**	
No.24.271	M271	BN (PAL) 16**	
No.24.272	M272	ICS (SDI) 8	
No.24.273	M273	GS (SDI) 22	
No.24.274	M274	EAM (SDI) 35	
No.24.275	M275	EAS (SDI) 36	
No.24.276	M276	FL (SDI) 1	LSR (PAL) 4**
No.24.277	M277	FC (SDI) 2	
No.24.278	M278	FCTI (SDI) 9	
No.24.279	M279	FFC (SDI) 9 + 2	
No.24.280	M280	FR (SDI) 3	
No.24.281	M281	LSF (SDI) 6	
No.24.282	M282	LFTI (SDI) 19	
No.24.283	M283	FLSF (SDI) 19 + 6	
No.24.284	M284	RSF (SDI) 7	
No.24.285	M285	RFTI (SDI) 20	
No.24.286	M286	FRSF (SDI) 20 + 7	
No.24.287	M287	LSC (PAL) 11	
No.24.288	M288	RSC (PAL) 12	
No.24.289	M289	LSR (PAL) 4**	
No.24.290	M290	RSR (PAL) 5**	
No.24.291	M291	BL (SDI) 30**	
No.24.292	M292	BC (SDI) 31**	
No.24.293	M293	BCTI (SDI) 34**	
No.24.294	M294	FBC (SDI) 34 + 31**	
No.24.295	M295	BR (SDI) 32**	
No.24.296	M296	BN (PAL) 16**	
No.24.297	M297	ICS (SDI) 8	
No.24.298	M298	GS (SDI) 22	
No.24.299	M299	EAM (SDI) 35	
No.24.300	M300	EAS (SDI) 36	

No.24.301	M301	FL (SDI) 1	RSC (PAL) 12
No.24.302	M302	FC (SDI) 2	
No.24.303	M303	FCTI (SDI) 9	
No.24.304	M304	FFC (SDI) 9 + 2	
No.24.305	M305	FR (SDI) 3	
No.24.306	M306	LSF (SDI) 6	
No.24.307	M307	LFTI (SDI) 19	
No.24.308	M308	FLSF (SDI) 19 + 6	
No.24.309	M309	RSF (SDI) 7	
No.24.310	M310	RFTI (SDI) 20	
No.24.311	M311	FRSF (SDI) 20 + 7	
No.24.312	M312	LSC (PAL) 11	
No.24.313	M313	RSC (PAL) 12	
No.24.314	M314	LSR (PAL) 4**	
No.24.315	M315	RSR (PAL) 5**	
No.24.316	M316	BL (SDI) 30**	
No.24.317	M317	BC (SDI) 31**	
No.24.318	M318	BCTI (SDI) 34**	
No.24.319	M319	FBC (SDI) 34 + 31**	
No.24.320	M320	BR (SDI) 32**	
No.24.321	M321	BN (PAL) 16**	
No.24.322	M322	ICS (SDI) 8	
No.24.323	M323	GS (SDI) 22	
No.24.324	M324	EAM (SDI) 35	
No.24.325	M325	EAS (SDI) 36	
No.24.326	M326	FL (SDI) 1	LSC (PAL) 11
No.24.327	M327	FC (SDI) 2	
No.24.328	M328	FCTI (SDI) 9	
No.24.329	M329	FFC (SDI) 9 + 2	
No.24.330	M330	FR (SDI) 3	
No.24.331	M331	LSF (SDI) 6	
No.24.332	M332	LFTI (SDI) 19	
No.24.333	M333	FLSF (SDI) 19 + 6	
No.24.334	M334	RSF (SDI) 7	
No.24.335	M335	RFTI (SDI) 20	
No.24.336	M336	FRSF (SDI) 20 + 7	
No.24.337	M337	LSC (PAL) 11	
No.24.338	M338	RSC (PAL) 12	
No.24.339	M339	LSR (PAL) 4**	
No.24.340	M340	RSR (PAL) 5**	
No.24.341	M341	BL (SDI) 30**	
No.24.342	M342	BC (SDI) 31**	
No.24.343	M343	BCTI (SDI) 34**	

No.24.344	M344	FBC (SDI) 34 + 31**	
No.24.345	M345	BR (SDI) 32**	
No.24.346	M346	BN (PAL) 16**	
No.24.347	M347	ICS (SDI) 8	
No.24.348	M348	GS (SDI) 22	
No.24.349	M349	EAM (SDI) 35	
No.24.350	M350	EAS (SDI) 36	
No.24.351	M351	FL (SDI) 1	FRSF (SDI) 20 + 7
No.24.352	M352	FC (SDI) 2	
No.24.353	M353	FCTI (SDI) 9	
No.24.354	M354	FFC (SDI) 9 + 2	
No.24.355	M355	FR (SDI) 3	
No.24.356	M356	LSF (SDI) 6	
No.24.357	M357	LFTI (SDI) 19	
No.24.358	M358	FLSF (SDI) 19 + 6	
No.24.359	M359	RSF (SDI) 7	
No.24.360	M360	RFTI (SDI) 20	
No.24.361	M361	FRSF (SDI) 20 + 7	
No.24.362	M362	LSC (PAL) 11	
No.24.363	M363	RSC (PAL) 12	
No.24.364	M364	LSR (PAL) 4**	
No.24.365	M365	RSR (PAL) 5**	
No.24.366	M366	BL (SDI) 30**	
No.24.367	M367	BC (SDI) 31**	
No.24.368	M368	BCTI (SDI) 34**	
No.24.369	M369	FBC (SDI) 34 + 31**	
No.24.370	M370	BR (SDI) 32**	
No.24.371	M371	BN (PAL) 16**	
No.24.372	M372	ICS (SDI) 8	
No.24.373	M373	GS (SDI) 22	
No.24.374	M374	EAM (SDI) 35	
No.24.375	M375	EAS (SDI) 36	
No.24.376	M376	FL (SDI) 1	RFTI (SDI) 20
No.24.377	M377	FC (SDI) 2	
No.24.378	M378	FCTI (SDI) 9	
No.24.379	M379	FFC (SDI) 9 + 2	
No.24.380	M380	FR (SDI) 3	
No.24.381	M381	LSF (SDI) 6	
No.24.382	M382	LFTI (SDI) 19	
No.24.383	M383	FLSF (SDI) 19 + 6	
No.24.384	M384	RSF (SDI) 7	
No.24.385	M385	RFTI (SDI) 20	
No.24.386	M386	FRSF (SDI) 20 + 7	

No.24.387	M387	LSC (PAL) 11	
No.24.388	M388	RSC (PAL) 12	
No.24.389	M389	LSR (PAL) 4**	
No.24.390	M390	RSR (PAL) 5**	
No.24.391	M391	BL (SDI) 30**	
No.24.392	M392	BC (SDI) 31**	
No.24.393	M393	BCTI (SDI) 34**	
No.24.394	M394	FBC (SDI) 34 + 31**	
No.24.395	M395	BR (SDI) 32**	
No.24.396	M396	BN (PAL) 16**	
No.24.397	M397	ICS (SDI) 8	
No.24.398	M398	GS (SDI) 22	
No.24.399	M399	EAM (SDI) 35	
No.24.400	M400	EAS (SDI) 36	
No.24.401	M401	FL (SDI) 1	RSF (SDI) 7
No.24.402	M402	FC (SDI) 2	
No.24.403	M403	FCTI (SDI) 9	
No.42.404	M404	FFC (SDI) 9 + 2	
No.2.4405	M405	FR (SDI) 3	
No.24.406	M406	LSF (SDI) 6	
No.24.407	M407	LFTI (SDI) 19	
No.24.408	M408	FLSF (SDI) 19 + 6	
No.24.409	M409	RSF (SDI) 7	
No.24.410	M410	RFTI (SDI) 20	
No.24.411	M411	FRSF (SDI) 20 + 7	
No.24.412	M412	LSC (PAL) 11	
No.24.413	M413	RSC (PAL) 12	
No.24.414	M414	LSR (PAL) 4**	
No.2.4415	M415	RSR (PAL) 5**	
No.24.416	M416	BL (SDI) 30**	
No.24.417	M417	BC (SDI) 31**	
No.24.418	M418	BCTI (SDI) 34**	
No.24.419	M419	FBC (SDI) 34 + 31**	
No.24.420	M420	BR (SDI) 32**	
No.24.421	M421	BN (PAL) 16**	
No.24.422	M422	ICS (SDI) 8	
No.24.423	M423	GS (SDI) 22	
No.24.424	M424	EAM (SDI) 35	
No.24.425	M425	EAS (SDI) 36	
No.24.426	M426	FL (SDI) 1	FLSF (SDI) 19 + 6
No.24.427	M427	FC (SDI) 2	
No.24.428	M428	FCTI (SDI) 9	
No.24.429	M429	FFC (SDI) 9 + 2	

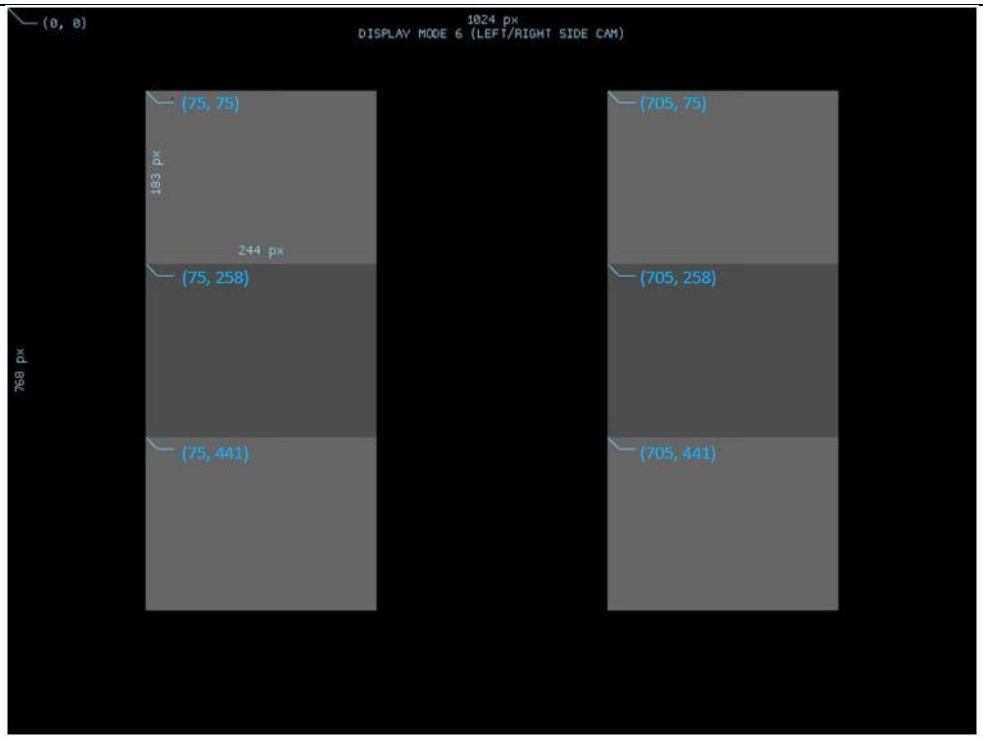
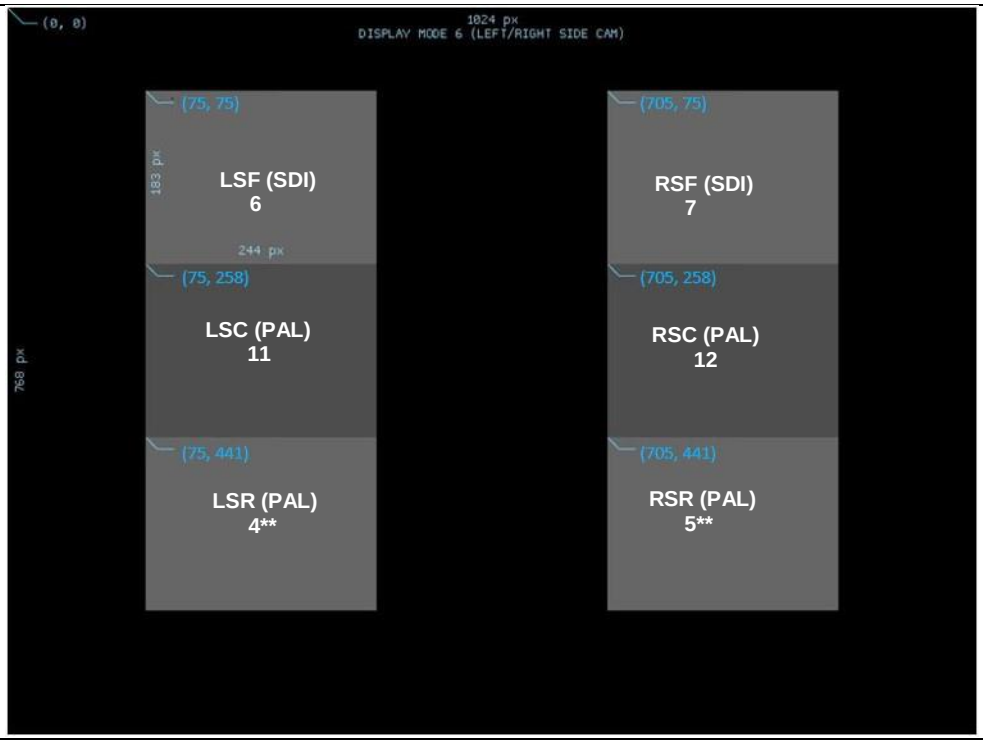
No.24.430	M430	FR (SDI) 3	
No.24.431	M431	LSF (SDI) 6	
No.24.432	M432	LFTI (SDI) 19	
No.24.433	M433	FLSF (SDI) 19 + 6	
No.24.434	M434	RSF (SDI) 7	
No.24.435	M435	RFTI (SDI) 20	
No.24.436	M436	FRSF (SDI) 20 + 7	
No.24.437	M437	LSC (PAL) 11	
No.24.438	M438	RSC (PAL) 12	
No.24.439	M439	LSR (PAL) 4**	
No.24.440	M440	RSR (PAL) 5**	
No.24.441	M441	BL (SDI) 30**	
No.24.442	M442	BC (SDI) 31**	
No.24.443	M443	BCTI (SDI) 34**	
No.24.444	M444	FBC (SDI) 34 + 31**	
No.24.445	M445	BR (SDI) 32**	
No.24.446	M446	BN (PAL) 16**	
No.24.447	M447	ICS (SDI) 8	
No.24.448	M448	GS (SDI) 22	
No.24.449	M449	EAM (SDI) 35	
No.24.450	M450	EAS (SDI) 36	
No.24.451	M451	FL (SDI) 1	LFTI (SDI) 19
No.24.452	M452	FC (SDI) 2	
No.24.453	M453	FCTI (SDI) 9	
No.24.454	M454	FFC (SDI) 9 + 2	
No.24.455	M455	FR (SDI) 3	
No.24.456	M456	LSF (SDI) 6	
No.24.457	M457	LFTI (SDI) 19	
No.24.458	M458	FLSF (SDI) 19 + 6	
No.24.459	M459	RSF (SDI) 7	
No.24.460	M460	RFTI (SDI) 20	
No.24.461	M461	FRSF (SDI) 20 + 7	
No.24.462	M462	LSC (PAL) 11	
No.24.463	M463	RSC (PAL) 12	
No.24.464	M464	LSR (PAL) 4**	
No.24.465	M465	RSR (PAL) 5**	
No.24.466	M466	BL (SDI) 30**	
No.24.467	M467	BC (SDI) 31**	
No.24.468	M468	BCTI (SDI) 34**	
No.24.469	M469	FBC (SDI) 34 + 31**	
No.24.470	M470	BR (SDI) 32**	
No.24.471	M471	BN (PAL) 16**	
No.24.472	M472	ICS (SDI) 8	

No.24.473	M473	GS (SDI) 22	
No.24.474	M474	EAM (SDI) 35	
No.24.475	M475	EAS (SDI) 36	
No.24.476	M476	FL (SDI) 1	LSF (SDI) 6
No.24.477	M477	FC (SDI) 2	
No.24.478	M478	FCTI (SDI) 9	
No.24.479	M479	FFC (SDI) 9 + 2	
No.24.480	M480	FR (SDI) 3	
No.24.481	M481	LSF (SDI) 6	
No.24.482	M482	LFTI (SDI) 19	
No.24.483	M483	FLSF (SDI) 19 + 6	
No.24.484	M484	RSF (SDI) 7	
No.24.485	M485	RFTI (SDI) 20	
No.24.486	M486	FRSF (SDI) 20 + 7	
No.24.487	M487	LSC (PAL) 11	
No.24.488	M488	RSC (PAL) 12	
No.24.489	M489	LSR (PAL) 4**	
No.24.490	M490	RSR (PAL) 5**	
No.24.491	M491	BL (SDI) 30**	
No.24.492	M492	BC (SDI) 31**	
No.24.493	M493	BCTI (SDI) 34**	
No.24.494	M494	FBC (SDI) 34 + 31**	
No.24.495	M495	BR (SDI) 32**	
No.24.496	M496	BN (PAL) 16**	
No.24.497	M497	ICS (SDI) 8	
No.24.498	M498	GS (SDI) 22	
No.24.499	M499	EAM (SDI) 35	
No.24.500	M500	EAS (SDI) 36	
No.24.501	M501	FL (SDI) 1	FR (SDI) 3
No.24.502	M502	FC (SDI) 2	
No.24.503	M503	FCTI (SDI) 9	
No.24.504	M504	FFC (SDI) 9 + 2	
No.24.505	M505	FR (SDI) 3	
No.24.506	M506	LSF (SDI) 6	
No.24.507	M507	LFTI (SDI) 19	
No.24.508	M508	FLSF (SDI) 19 + 6	
No.24.509	M509	RSF (SDI) 7	
No.24.510	M510	RFTI (SDI) 20	
No.24.511	M511	FRSF (SDI) 20 + 7	
No.24.512	M512	LSC (PAL) 11	
No.24.513	M513	RSC (PAL) 12	
No.24.514	M514	LSR (PAL) 4**	
No.24.515	M515	RSR (PAL) 5**	

No.24.516	M516	BL (SDI) 30**	
No.24.517	M517	BC (SDI) 31**	
No.24.518	M518	BCTI (SDI) 34**	
No.24.519	M519	FBC (SDI) 34 + 31**	
No.24.520	M520	BR (SDI) 32**	
No.24.521	M521	BN (PAL) 16**	
No.24.522	M522	ICS (SDI) 8	
No.24.523	M523	GS (SDI) 22	
No.24.524	M524	EAM (SDI) 35	
No.24.525	M525	EAS (SDI) 36	
No.24.526	M526	FL (SDI) 1	FFC (SDI) 9 + 2
No.24.527	M527	FC (SDI) 2	
No.24.528	M528	FCTI (SDI) 9	
No.24.529	M529	FFC (SDI) 9 + 2	
No.24.530	M530	FR (SDI) 3	
No.24.531	M531	LSF (SDI) 6	
No.24.532	M532	LFTI (SDI) 19	
No.24.533	M533	FLSF (SDI) 19 + 6	
No.24.534	M534	RSF (SDI) 7	
No.24.535	M535	RFTI (SDI) 20	
No.24.536	M536	FRSF (SDI) 20 + 7	
No.24.537	M537	LSC (PAL) 11	
No.24.538	M538	RSC (PAL) 12	
No.24.539	M539	LSR (PAL) 4**	
No.24.540	M540	RSR (PAL) 5**	
No.24.541	M541	BL (SDI) 30**	
No.24.542	M542	BC (SDI) 31**	
No.24.543	M543	BCTI (SDI) 34**	
No.24.544	M544	FBC (SDI) 34 + 31**	
No.24.545	M545	BR (SDI) 32**	
No.24.546	M546	BN (PAL) 16**	
No.24.547	M547	ICS (SDI) 8	
No.24.548	M548	GS (SDI) 22	
No.24.549	M549	EAM (SDI) 35	
No.24.550	M550	EAS (SDI) 36	
No.24.551	M551	FL (SDI) 1	FCTI (SDI) 9
No.24.552	M552	FC (SDI) 2	
No.24.553	M553	FCTI (SDI) 9	
No.24.554	M554	FFC (SDI) 9 + 2	
No.24.555	M555	FR (SDI) 3	
No.24.556	M556	LSF (SDI) 6	
No.24.557	M557	LFTI (SDI) 19	
No.24.558	M558	FLSF (SDI) 19 + 6	

No.24.559	M559	RSF (SDI) 7	
No.24.560	M560	RFTI (SDI) 20	
No.24.561	M561	FRSF (SDI) 20 + 7	
No.24.562	M562	LSC (PAL) 11	
No.24.563	M563	RSC (PAL) 12	
No.24.564	M564	LSR (PAL) 4**	
No.24.565	M565	RSR (PAL) 5**	
No.24.566	M566	BL (SDI) 30**	
No.24.567	M567	BC (SDI) 31**	
No.24.568	M568	BCTI (SDI) 34**	
No.24.569	M569	FBC (SDI) 34 + 31**	
No.24.570	M570	BR (SDI) 32**	
No.24.571	M571	BN (PAL) 16**	
No.24.572	M572	ICS (SDI) 8	
No.24.573	M573	GS (SDI) 22	
No.24.574	M574	EAM (SDI) 35	
No.24.575	M575	EAS (SDI) 36	
No.24.576	M576	FL (SDI) 1	FC (SDI) 2
No.24.577	M577	FC (SDI) 2	
No.24.578	M578	FCTI (SDI) 9	
No.24.579	M579	FFC (SDI) 9 + 2	
No.24.580	M580	FR (SDI) 3	
No.24.581	M581	LSF (SDI) 6	
No.24.582	M582	LFTI (SDI) 19	
No.24.583	M583	FLSF (SDI) 19 + 6	
No.24.584	M584	RSF (SDI) 7	
No.24.585	M585	RFTI (SDI) 20	
No.24.586	M586	FRSF (SDI) 20 + 7	
No.24.587	M587	LSC (PAL) 11	
No.24.588	M588	RSC (PAL) 12	
No.24.589	M589	LSR (PAL) 4**	
No.24.590	M590	RSR (PAL) 5**	
No.24.591	M591	BL (SDI) 30**	
No.24.592	M592	BC (SDI) 31**	
No.24.593	M593	BCTI (SDI) 34**	
No.24.594	M594	FBC (SDI) 34 + 31**	
No.24.595	M595	BR (SDI) 32**	
No.24.596	M596	BN (PAL) 16**	
No.24.597	M597	ICS (SDI) 8	
No.24.598	M598	GS (SDI) 22	
No.24.599	M599	EAM (SDI) 35	
No.24.600	M600	EAS (SDI) 36	
No.24.601	M601	FL (SDI) 1	FL (SDI) 1

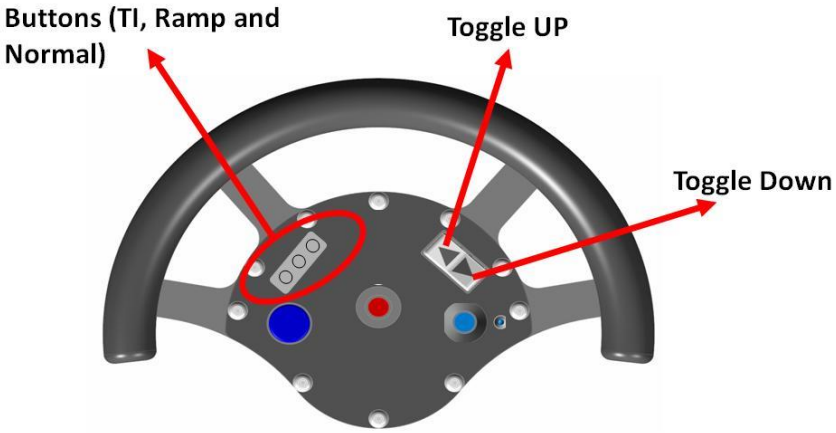
No.24.602	M602	FC (SDI) 2	
No.24.603	M603	FCTI (SDI) 9	
No.24.604	M604	FFC (SDI) 9 + 2	
No.24.605	M605	FR (SDI) 3	
No.24.606	M606	LSF (SDI) 6	
No.24.607	M607	LFTI (SDI) 19	
No.24.608	M608	FLSF (SDI) 19 + 6	
No.24.609	M609	RSF (SDI) 7	
No.24.610	M610	RFTI (SDI) 20	
No.24.611	M611	FRSF (SDI) 20 + 7	
No.24.612	M612	LSC (PAL) 11	
No.24.613	M613	RSC (PAL) 12	
No.24.614	M614	LSR (PAL) 4**	
No.24.615	M615	RSR (PAL) 5**	
No.24.616	M616	BL (SDI) 30**	
No.24.617	M617	BC (SDI) 31**	
No.24.618	M618	BCTI (SDI) 34**	
No.24.619	M619	FBC (SDI) 34 + 31**	
No.24.620	M620	BR (SDI) 32**	
No.24.621	M621	BN (PAL) 16**	
No.24.622	M622	ICS (SDI) 8	
No.24.623	M623	GS (SDI) 22	
No.24.624	M624	EAM (SDI) 35	
No.24.625	M625	EAS (SDI) 36	

No.26	**Side Cam View (Shifted)**	
No.26.1	**00SS**	

No.26.2	**TISS**	
No.26.3	**FISS**	

5.9 CLOSE HATCH DRIVING

5.9.1 STEERING WHEEL BUTTONS AND DISCRETE INPUTS FUNCTION



Inputs	Functions	
	Forward/ Neutral Gear	Reverse Gear
Gear Signal	Gear Forward Signal = 0	Gear Reverse Signal = 1
Toggle Up	Toggle between Front & Side Views	Toggle to Front View
Toggle Down	Toggle to Rear View	Toggle between rear and side view
TI Button	Change to TI View	Change to TI View
Ramp Button	Change to Ramp View	Change to Ramp View
Normal Button	Change to Front View	Change to Rear View

5.10 RS-422 CONTROL PROTOCOL FOR FUSION CAMERA

The following camera function shall be controlled using RS422 command

- Trigger NUC – Manual activation of the NUC function
- HOT White – Switch TI image to Hot White
- HOT Black – Switch TI image to Hot Black
- Day – Switch Camera CVBS output to Day Camera
- Night – Switch Camera CVBS output to TI Camera
- Fusion – Switch Camera CVBS output to Image Fusion

5.10.1 Communication Definition

- Baud Rate : 115200 bits/sec (Default)
- 1 Start Bit
- 8 Data Bit
- 1 Stop Bit
- No Parity

5.10.2 Message Format

1 Byte	1 Byte	1 Byte	6 Byte	1 Byte	1 Byte
STX	Device Address	Data Length	Data	Checksum	ETX

STX = 0x02
ETX = 0x03
Data Length = Always set to 0x06
Checksum = Device Address + Data Length + Data

5.10.3 Device Address Format

1 Byte	1 Byte	1 Byte	6 Byte	1 Byte	1 Byte
STX	Device Address	Data Length	Data	Checksum	ETX

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Type	Left	Centre	Right	Always '0'	CCD	TI	Fusion
Single/Multi	Device Position			X	Device ID		

Upper nibble (Bit 7-5) – Select Camera Assy Type/Camera Position

F = Common Mode (3-in-1 Left/Centre/Right cameras)
8 = Single/Dual (Single or Dual Camera)
4 = Left (3-in-1 Left Camera)
2 = Centre (3-in-1 Centre Camera)
1 = Right (3-in-1 Right Camera)

Lower nibble (Bit 3-0) – Select Camera Sensor

4 = CCD
2 = TI
1 = Fusion

5.10.4 Data Format

1 Byte	1 Byte	1 Byte	6 Byte	1 Byte	1 Byte
STX	Device Address	Data Length	Data	Checksum	ETX

1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
Command 1	Command 2	Data 1	Data 2	Data 3	Data 4

5.10.5 Data Settings

a) CVBS Output View Modes

	Command 1	Command 2	Data 1	Data 2	Data 3	Data 4
Fusion	0x70 (Write) 0x80 (Read)	0x10	0x00	0x00	0x00	0x00
Night						0x01
Day						0x02

b) Night Image HOT White/Black

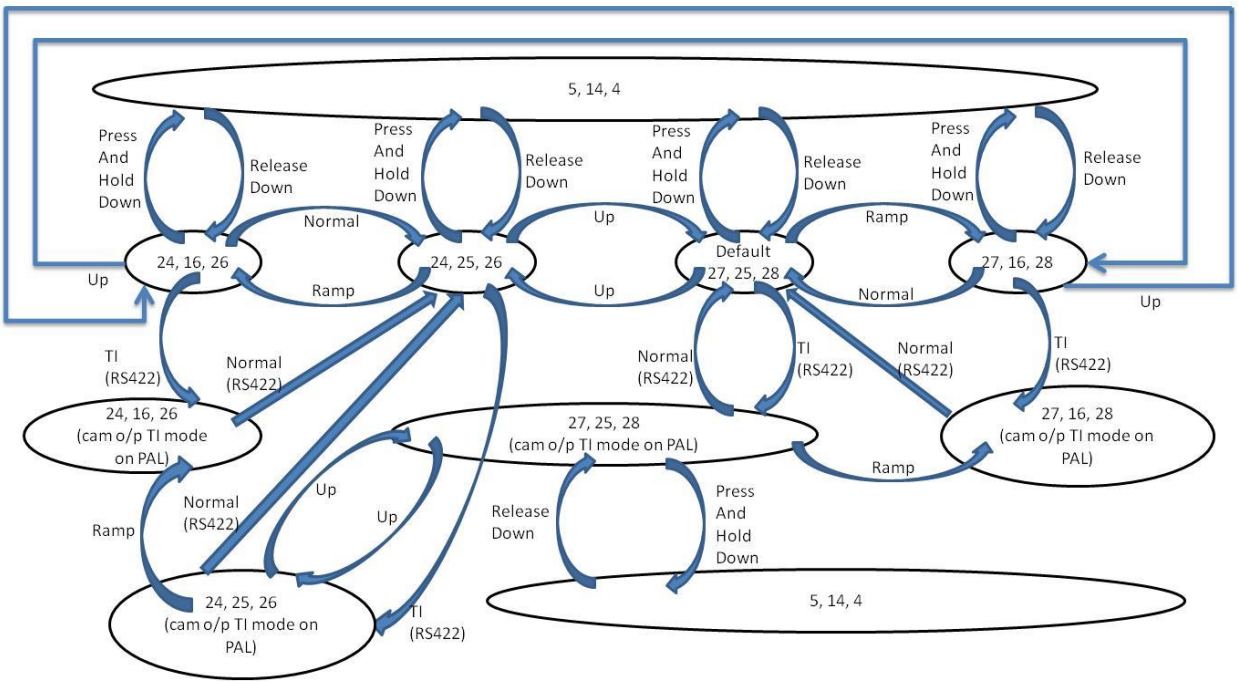
	Command 1	Command 2	Data 1	Data 2	Data 3	Data 4
Hot Black	0x40	0x00	0x00	0x00	0x00	0x00
Hot White						0x01

c) Manual NUC

Command 1	Command 2	Data 1	Data 2	Data 3	Data 4
0x60	0x02	0x00	0x00	0x00	0x00

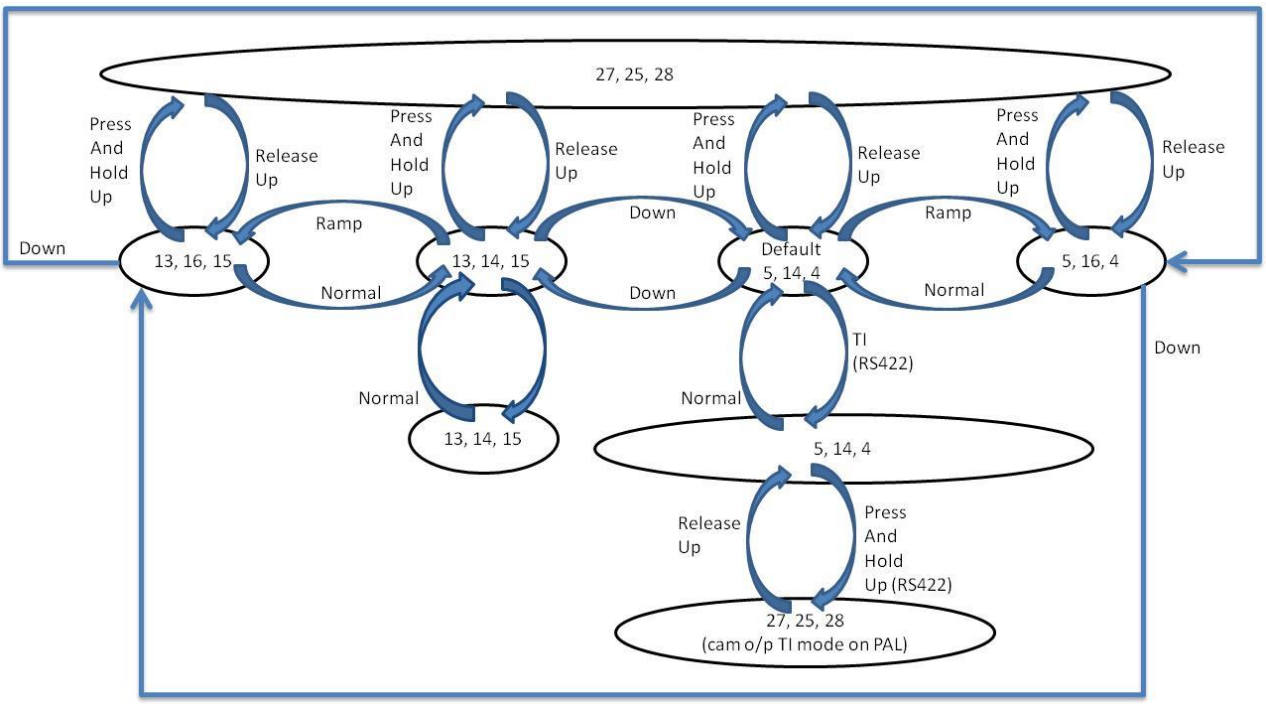
5.11 IDDP VIDEO OUTPUT STATE DIAGRAM

5.11.1 Forward or Neutral Gear



** TI / Normal switching via RS422 (Refer to 14.2 for control protocol)
Default DAY mode

5.11.2 Reverse Gear



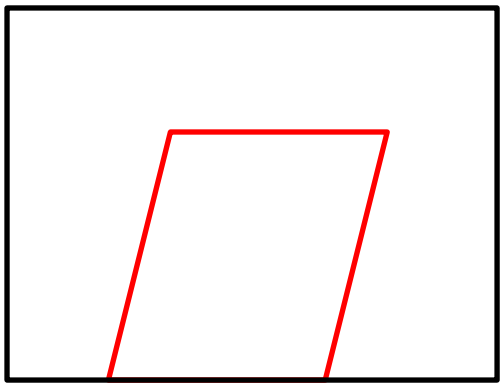
** TI / Normal switching via RS422 (Refer to 14.2 for control protocol)
Default DAY mode.

5.12 IDDP CAMERA ICON

Camera Configuration			Camera Icon		
Left	**Center**	**Right**	**Left**	**Center**	**Right**
Cam ID: 27	Cam ID: 25	Cam ID: 28			
Cam ID: 24	Cam ID: 25	Cam ID: 26			
Cam ID: 27	Cam ID: 16	Cam ID: 28			
Cam ID: 24	Cam ID: 16	Cam ID: 26			
Cam ID: 5	Cam ID: 14	Cam ID: 4			
Cam ID: 13	Cam ID: 16	Cam ID: 15			
Cam ID: 13	Cam ID: 14	Cam ID: 15			
Cam ID: 5	Cam ID: 16	Cam ID: 4			

5.12.1 IDDP OSD

iDDP Rear Near Camera (16) OSD for AFV:



iDDP Rear Near Camera (16) OSD for RV: Blank

iDDP Rear Near Camera (16) OSD for AVLB: Blank

iDDP Rear Near Camera (16) OSD for MCEV: Blank

5.13 IDDP VIDEO SWITCHING VIA RS-422 (FOR REMOTE DRIVING)

- **STX** - 0x02
- **ETX** - 0x03
- **ACK**- 0x06
- **NAK**- 0x15
- **nn** – checksum (8-bit binary)
- 'XX' **-** ASCII
- **e.g STX 'XXXX' nn ETX**

Checksum Calculation:
For messages with checksum: XOR all bytes between STX and ETX exclude checksum (nn)

Eg.
STX 'VR' nn ETX
0x02 0x56 0x52 0x04 0x03
Checksum=0x04
If the checksum is 0x02 or 0x03 or 0x00 then 'OR' checksum with 0x80.
ie. 0x02 becomes 0x82
0x03 becomes 0x83
0x00 becomes 0x80

Driving Mode	XXXX	Display Sequence (Cam ID)			Remark	DVCU to Host Response
		Left	Center	Right		
Enable Remote Driving	'DDEN'				DVCU disable discrete inputs from steering wheel and gear	ACK followed by XXXX or NACK
Disable Remote Driving	'DDDS'				DVCU enable discrete inputs from steering wheel and gear	ACK followed by XXXX or NACK
Front Cameras	'DDNF'	24	25	26	DVCU sent RS422 command to all Fusion cameras to switch to DAY mode	ACK followed by XXXX or NACK

Front + Side Cameras	'DDSF'	27	25	28	DVCU sent RS422 command to all Fusion cameras to switch to DAY mode	ACK followed by XXXX or NACK
TI Mode (Front + Side)	'DSFT'	27	25	28	DVCU sent RS422 command to all Fusion cameras to switch to TI mode	ACK followed by XXXX or NACK
TI Mode (Front)	'DDFT'	24	25	26	DVCU sent RS422 command to all Fusion cameras to switch to TI mode	ACK followed by XXXX or NACK

Driving Mode	XXXX	Display Sequence (Cam ID)			Remark	DVCU to Host Response
		Left	Center	Right		
Rear Cameras	'DDNB'	13	14	15	DVCU sent RS422 command to all Fusion cameras to switch to DAY mode	ACK followed by XXXX or NACK
Rear + Side Cameras	'DDSB'	5	14	4	DVCU sent RS422 command to all Fusion cameras to switch to DAY mode	ACK followed by XXXX or NACK
TI Mode (Rear)	'DSBT'	5	14	4	DVCU sent RS422 command to all Fusion cameras to switch to TI mode	ACK followed by XXXX or NACK
Rear Near Cam	'DDRB'	Last View	16	Last View		ACK followed by XXXX or NACK

5.14 INTERFACE CONTROL REQUIREMENT

All unused/unspecified pins in the connector must be inserted and without any electrical connection.

All undefined pins assignment shall be base on document no. VCUH2-ICD-00-03-NY.

Connector: J1		**Type: D38999/24WE26PN**
Pin No.	Function	Usage
A, B, C	+24Vdc	DVCU Power
E, F, G	+24Vdc Return	
P	TX_D1+	GigE From DDPP Duplicate CCC SA
R	TX_D1-	
S	RX_D2+	
T	BI_D3+	
U	BI_D3-	
V	RX_D2-	
W	BI_D4+	
X	BI_D4-	
Y	Shielding	

Connector: J2		**Type: D38999/24WF32SN**
Pin No.	Function	Usage
A	Wireless iDDP Left Video – PAL	WRC Driving
B	Wireless iDDP Left Video Return– PAL	
L	Wireless iDDP Center Video – PAL	
M	Wireless iDDP Center Video Return– PAL	
X	Wireless iDDP Right Video – PAL	
Y	Wireless iDDP Right Video Return– PAL	
D	WRC TX+ (RS-422)	WRC RS422 Control
E	WRC TX- (RS-422)	
F	Shield	
G	WRC RX+ (RS-422)	
H	WRC RX- (RS-422)	
J	Shield	
P	Fusion Cam1 TX+ (RS-422)	Fusion Camera Control
R	Fusion Cam1 TX- (RS-422)	
S	Shield	
T	Fusion Cam1 RX+ (RS-422)	
U	Fusion Cam1 RX- (RS-422)	
V	Shield	
a	Fusion Cam2 TX+ (RS-422)	
b	Fusion Cam2 TX- (RS-422)	

c	Shield	Fusion Camera Control
d	Fusion Cam2 RX+ (RS-422)	
e	Fusion Cam2 RX- (RS-422)	
f	Shield	

Connector: J3		**Type: D38999/24WE26SN**
Pin No.	Function	Usage
A	iDDP Left Video - PAL	iDDP Video
B	iDDP Left Video Return- PAL	
C	NC	
D	iDDP Center Video - PAL	
E	iDDP Center Video Return- PAL	
F	NC	
G	iDDP Right Video - PAL	
H	iDDP Right Video Return- PAL	
K	+24Vdc Power Switch	iDDP Video Switching
L	+24Vdc Return Power Switch	
M	Rev Gear +	
N	Rev Gear -	
P	FWD Switch +	
R	FWD Switch -	
S	REV Switch +	
T	REV Switch -	
U	TI Switch +	
V	TI Switch -	
W	Rear Near Switch +	
X	Rear Near Switch -	
Y	Front Switch +	
Z	Front Switch -	
a	Fusion	
b	Spare	
c	TI NUC	

Connector: J4		**Type: D38999/24WD19SN**
Pin No.	Function	Usage
D	Fusion Cam3 RS422 TX+	Fusion Camera Control
E	Fusion Cam3 RS422 TX-	
F	Shield	
G	Fusion Cam3 RS422 RX+	
H	Fusion Cam3 RS422 RX-	
J	Shield	
N	Fusion Cam4 RS422 TX+	Fusion Camera Control
P	Fusion Cam4 RS422 TX-	
R	Shield	
S	Fusion Cam4 RS422 RX+	
T	Fusion Cam4 RS422 RX-	
U	Shield	

Connector: J5		**Type: D38999/24WE35SB**
Pin No.	Function	Usage
1	CVBS In (PAL)	Front Left FL, Cam ID: 24
2	CVBS In Return (PAL)	
3	Video Shield	
4	CVBS In (PAL)	Front Center FC, Cam ID: 25
5	CVBS In Return (PAL)	
6	Video Shield	
7	CVBS In (PAL)	Front Right FR, Cam ID: 26
8	CVBS In Return (PAL)	
9	Video Shield	
10	CVBS In (PAL)	Rear Near BN, Cam ID: 16
11	CVBS In Return (PAL)	
12	Video Shield	
13	CVBS In (PAL)	Rear Left BL, Cam ID: 13
14	CVBS In Return (PAL)	
15	Video Shield	
16	CVBS In (PAL)	Rear Center BC, Cam ID: 14
17	CVBS In Return (PAL)	
18	Video Shield	
19	CVBS In (PAL)	Rear Right BR, Cam ID: 15
20	CVBS In Return (PAL)	
21	Video Shield	
22	CVBS In (PAL)	Left Side Front LSF, Cam ID: 27
23	CVBS In Return (PAL)	
24	Video Shield	

25	CVBS In (PAL)	Left Side Center LSC, Cam ID: 11
26	CVBS In Return (PAL)	
27	Video Shield	
28	CVBS In (PAL)	Left Side Rear LSR, Cam ID: 4
29	CVBS In Return (PAL)	
30	Video Shield	
31	CVBS In (PAL)	Right Side Front RSF, Cam ID: 28
32	CVBS In Return (PAL)	
33	Video Shield	
34	CVBS In (PAL)	Right Side Center RSC, Cam ID: 12
35	CVBS In Return (PAL)	
36	Video Shield	
37	CVBS In (PAL)	Right Side Rear RSR, Cam ID: 5
38	CVBS In Return (PAL)	
39	Video Shield	
40	CVBS In (PAL)	AVR AVR, Cam ID: 10
41	CVBS In Return (PAL)	
42	Video Shield	
43	CVBS In (PAL)	BVS (AVLB) BVS, Cam ID: 17
44	CVBS In Return (PAL)	
45	Video Shield	
46	CVBS In (PAL)	Bore Sight BS, Cam ID: 37
47	CVBS In Return (PAL)	
48	Video Shield	

Connector: J6		**Type: D38999/24WE35SA**
Pin No.	Function	Usage
1	+12Vdc (700mA)	Front Center Fusion 3in1 PWR
2	+12Vdc Return	
3	+12Vdc (700mA)	
4	+12Vdc Return	
5	+12Vdc (700mA)	
6	+12Vdc Return	
7	+12Vdc (500mA)	
8	+12Vdc Return	
9	+12Vdc (500mA)	Rear Near Cam PWR
10	+12Vdc Return	
11	+12Vdc (700mA)	Rear Center Fusion 3in1 PWR
12	+12Vdc Return	
13	+12Vdc (700mA)	
14	+12Vdc Return	
15	+12Vdc (700mA)	
16	+12Vdc Return	
17	+12Vdc (500mA)	
18	+12Vdc Return	

19	+12Vdc (700mA)	Left Side Front Fusion Cam PWR
20	+12Vdc Return	
21	+12Vdc (500mA)	
22	+12Vdc Return	
23	+12Vdc (500mA)	Left Side Center Cam PWR
24	+12Vdc Return	
25	+12Vdc (500mA)	Left Side Rear Cam PWR
26	+12Vdc Return	
27	+12Vdc (700mA)	Right Side Front Fusion Cam PWR
28	+12Vdc Return	
29	+12Vdc (500mA)	
30	+12Vdc Return	
31	+12Vdc (500mA)	Right Side Center Cam PWR
32	+12Vdc Return	
33	+12Vdc (500mA)	Right Side Rear Cam PWR
34	+12Vdc Return	

Connector: J9		**Type: 8070-1903-22NF23-12SA**
Pin No.	Function	Usage
1	HD-SDI IN (1920x1080P 30fps 16:9)	ICS/120 HD Camera ICS, Cam ID: 8
2	HD-SDI IN (1920x1080P 30fps 16:9)	GSU/120 HD Camera GS, Cam ID: 22
3	HD-SDI IN (1920x1080P 30fps 16:9)	120 HD Camera EAS, Cam ID: 36
4	SD-SDI IN	TOP DAY (AVLB) BT, Cam ID: 18
5	SD-SDI IN	TOP TI (AVLB) BTTI, Cam ID: 29
6	SD-SDI IN	Spare 4
7	SD-SDI IN	Spare 5
8	HD-SDI IN (1920x1080P 30fps 16:9)	180 HD Camera EAM, Cam ID: 35
9	HD-SDI IN (1920x1080P 30fps 16:9)	Spare 3
10	HD-SDI IN (1920x1080P 30fps 16:9)	Bore Sight
11	SD-SDI IN	LAY DAY (AVLB) LAY, Cam ID: 23
12	SD-SDI IN	LAY TI (AVLB) LAYTI, Cam ID: 21

Connector: J10		Type: 8070-1905-22NF18-12SA
Pin No.	Function	Usage
1	SD-SDI IN	Rear Left DAY BL, Cam ID: 30
2	SD-SDI IN	Rear Right DAY BR, Cam ID: 32
3	SD-SDI IN	Left Side Front DAY LSF, Cam ID: 6
4	SD-SDI IN	Left Side Front TI LFTI, Cam ID: 19
5	SD-SDI IN	Front Left Day FL, Cam ID: 1
6	SD-SDI IN	Rear Center DAY BC, Cam ID: 31
7	SD-SDI IN	Rear Center TI BCTI, Cam ID: 34
8	SD-SDI IN	Front Right Day FR: Cam ID: 3
9	SD-SDI IN	Right Side Front DAY RSF, Cam ID: 7
10	SD-SDI IN	Right Side Front TI RFTI, Cam ID: 20
11	SD-SDI IN	Front Center DAY FC, Cam ID: 2
12	SD-SDI IN	Front Center TI FCTI, Cam ID: 9

Connector: J11		**Type: 8070-1907-22NF18-55SA**
Pin No.	Function	Usage
1	TX D1 +	VC SA
6	TX D1 -	
4	RX D2 +	
11	BI D3 +	
12	BI D3 -	
5	RX D2 -	
10	BI D4 +	
18	BI D4 -	
2, 7, 13, 17, 25, 26, 19, 20	Shield	
8	TX D1 +	Trooper SA
14	TX D1 -	
9	RX D2 +	
16	BI D3 +	
23	BI D3 -	
15	RX D2 -	
24	BI D4 +	
31	BI D4 -	
3, 19	Shield	
28	TX D1 +	Gunner SA
29	TX D1 -	
36	RX D2 +	
44	BI D3 +	
45	BI D3 -	
37	RX D2 -	
51	BI D4 +	
52	BI D4 -	
21, 22, 30, 38,46	Shield	
40	TX D1 +	Driver SA
33	TX D1 -	
41	RX D2 +	
42	BI D3 +	
48	BI D3 -	
47	RX D2 -	
53	BI D4 +	
49	BI D4 -	
32, 27, 34, 35, 43, 50, 54, 55	Shield	

5.15 CONFIGURATION MANAGEMENT

5.15.1 Contractor shall implement a configuration management process to establish and maintain consistency between the product requirements, the product, and associated product configuration information.

5.15.2 Minor changes / modifications are initiated by the contractor without any implication of performance, schedule and cost of the project; ST Kinetics shall be informed in writing. The configuration information (drawings, document deliverables, BOM, training materials, etc) affected by the change shall be updated and provided to ST Kinetics.

5.15.3 For major changes that impact the form, fit, function or any changes that affect the product inter-changeability (including technical publications, logistics support, STEs) with its previous revision, a request shall be submitted to ST Kinetics for approval prior to the change implementation.

5.15.4 For critical changes that results in functional or performance deviation from the original requirements or affects schedule and costs, a proposal shall be submitted to ST Kinetics for approval.

5.15.5 Each DVCU shall be serialized in accordance to the following format.

P/N	2200219782
HW REV	A
DESC	DVCU
S/N	ZZ / YY / WW / XXX
S/W REV	A

- Manufacturing Code: <S/N: ZZ/YY/WW/XXX>
  Where:
  ZZ = Manufacturer Initial (E.g TO for Team One)
  YY = Year item manufactured
  WW = Calendar week item manufactured (Indicated by the Contractor)
  XXX = Serial number by the Contractor

5.15.6 The location of the serial plate shall be at the right side of the DVCU as shown in Figure 4.

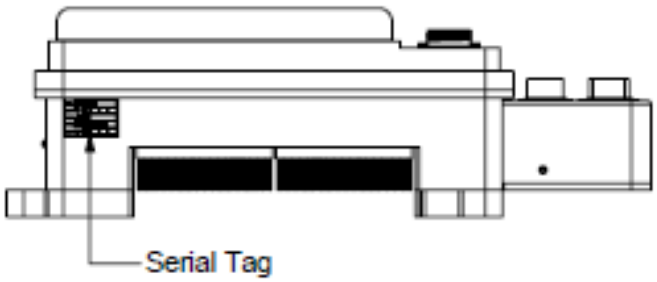


Figure 4 Location of serial plate

5.15.7 The label shall be indicated on the E-boxes by the Contractor.

5.16 EMI / EMC & POWER REQUIREMENT

This section identifies the EMI / EMC, Operating Voltage and Electrostatic Discharge requirements.

5.16.1 APPLICABLE DOCUMENTS

The following military / industrial standards (or equivalent) are applicable to this program:

5.16.1.1 MIL-E-6051: Electromagnetic Compatibility Requirement, Systems

5.16.1.2 MIL-STD-464: Electromagnetic Environmental Effects Requirements for Systems

5.16.1.3 MIL-E-6051: Requirements for Electromagnetic Interference Characteristics

5.16.1.4 MIL-STD-831: Preparation of Test Reports

5.16.1.5 MIL-STD-188-124: Grounding, Bonding and Shielding

5.16.1.6 MIL-STD-1310: Shipboard Bonding and Grounding Methods for EMC and Safety

5.16.1.7 MIL-STD-454: Standard General Requirements for Electronic Equipment

5.16.1.8 MIL-STD-1385: General Requirement for Preclusion of Ordnance Hazards of

5.16.1.9 Electromagnetic Radiation

5.16.1.10 MIL-STD-1275: Characteristics of 28 Volt DC Electrical Systems in Military Vehicles

5.16.1.11 MIL-STD-883: Test Method Standard, Microcircuits

5.16.1.12 IEC-61000-4-2: International Standard Testing and Measurement Techniques

5.16.1.13 Other Equivalent Testing Standards, if any.

5.16.2 EMI / EMC Requirements

5.16.2.1 The System shall meet but not limited to the following EMC requirements:

- CE 102 (Conducted emissions, power leads, 10 kHz to10 MHz)
- RE 102 (Radiated emissions, electric field, 2MHz to 18 GHz)
- CS101 (Conducted susceptibility, power leads, 30 Hz to 150 kHz)
- CS114 (Conducted susceptibility, bulk cable injection, 10 kHz to 200 MHz)
- CS115 (Conducted susceptibility, bulk cable injection, impulse excitation)
- CS116 (Conducted susceptibility, damped sinusoid transients, cables and power leads, 10 kHz to 100MHz)
- RS103 (Radiated susceptibility, magnetic fields, 2 MHz to 18 GHz)

5.16.2.2 The system shall be qualified to MIL-STD-461E (Ground Army).

5.16.2.3 ST Kinetics will arrange and provide the test lab for a maximum of 2 pre-scan sessions (1 day each) of EMI/EMC test and a maximum of 1 full EMI/EMC qualifications test sessions. Contractor shall ensure that all necessary tests are completed within the stipulated test sessions in accordance to the test plan. The Contractor shall provide the necessary equipment (including tester), logistics and resources for carrying out the test at their own cost

5.16.2.4 In the event that the System is unable to pass the EMI/EMC qualification test within the test sessions provided by ST Kinetics, Contractor shall make good the design and then conduct re-tests (pre-scan and qualification) based on the Test Requirements at their own cost. Test Reports shall be submitted to ST Kinetics for verification afterwards.

5.16.2.5 If the System deviates from MIL-STD-461E specification limits or complies with standards other than MIL-STD-461E, the Contractor is to submit a waiver analysis report to seek for waiver approval from ST Kinetics. The System EMI qualification reports shall be provided.

5.16.2.6 The Electromagnetic Interference (EMI) level of the System, including all connecting cables, shall be established and provided to ST Kinetics. The Contractor shall describe the test plan and its results, conforming to MIL-STD-831 (or equivalent).

5.16.2.7 Grounding and Bonding

The Contractor shall ensure proper grounding for the System to control EMI and electrical safety. The rationale for using single point, multiple point or hybrid grounding shall be provided. The techniques of bonding the equipment shall be described.

5.16.2.8 Shielding

The System shall have adequate shielding from electric field and magnetic field interference, by means of shielded enclosure. The shielding requirement and rationale for shielding should be provided.

5.16.2.9 Filtering

The System shall have adequate filtering by means of power line filter and signal line filter to prevent interference. The filtering requirement and rationale for filtering shall be provided.

5.16.2.10 Cabling

The Contractor shall select the type of cables and the routing of the cables to ensure that cable coupling from nearby cables as well as from radiated electric and magnetic field is minimum and will not affect the operation of the System. The rationale for cable shielding, separation of cables, etc., shall be provided

5.16.2.11 Printed Circuit Board and Components

Conformal coating shall be required for printed wiring and multi-layer board in accordance with MIL-STD-454 (or equivalent). Connectors and fastening devices shall be of high corrosion resistance grade to resist the worst environment that the System may encounter.

5.16.3 Documentation Requirement:

5.16.3.1 EMC Design Review (part of design review document)

5.16.3.1.1 The Contractor shall describe the approach taken to ensure compliance to EMI/EMC during the design review. The review may cover the following areas:

- Component selection
- Best practices adopted
- Design approach

5.16.3.2 EMC Test Plan (EMCTP)

The Contractor shall provide an EMCTP used to demonstrate the EMI/EMC of the System. An EMI safety margin of 6 dB shall be established for the System. Contractor shall provide a detailed EMCTP to define the measurements required to show System EMC. The EMCTP shall include the purpose of each measurement, the measurement procedures, the data-recording format and the list of equipment needed in accordance with MIL-E-6051 or MIL-STD-461 (or equivalent).

5.16.3.3 EMC Test Report (EMCTR)

The Contractor shall provide a complete EMCTR describing the EMCTP and its results, conforming to MIL-STD-831 (or equivalent). The report shall contain complete information on all applicable tests and other information as required. Data analysis, interpretation of results as well as recommendations for EMI solution for problems encountered during tests shall be provided. The EMC Test Report shall be provided to ST Kinetics one (1) month after completion of test.

5.16.3.4 Power Requirements

5.16.3.4.1 The Contractor shall design the System to meet MIL-STD-1275B requirements pertaining to operating voltages and voltage spikes/surges.

5.16.3.4.2 The System shall not malfunction or have any unacceptable response with the application of the operating voltage within a voltage range of +18 VDC to +32 VDC, where the applied nominal voltage is 28 VDC.

5.16.3.4.3 The System shall have necessary protection against voltage spikes and dips and shall be subjected to operating voltage surges from both normal mode and generator-only mode. It shall also be subjected to voltage spikes with sufficient energy content to test the System response.

5.16.3.4.4 The System shall have necessary protection against power supply reverse polarity.

5.16.3.4.5 The Contractor shall support the MIL-STD-1275B testing with suitable testers and test cablings.

5.17 ENVIRONMENT REQUIREMENTS

This section outlines the Environmental Qualification Test (EQT) requirement for DVCU in meeting the environmental conditions during operation and storage without experiencing physical damage or deterioration in performance. The DVCU is referred to as the system in this section.

5.17.1 Applicable Documents

5.17.1.1 MIL-STD 810E: Environmental Test Methods and Engineering Guidelines

5.17.1.2 IEC 60529: Degree of Protection provided by Enclosures (IP Code).

5.17.1.3 STANAG 2895: Extreme Climatic Conditions and Derived Conditions for use in Defining Design / Test Criteria for NATO Forces Material

5.17.1.4 Other equivalent testing standards, if any.

5.17.2 Responsibilities of Contractor

5.17.2.1 Contractor shall ensure the design of the system meets the EQT requirements as stated in this document.

5.17.2.2 For the system that has been previously qualified, the contractor shall provide Certificate of Conformance (COC) to ST Kinetics. the relevant test reports or technical specifications shall also be submitted to ST Kinetics for verification.

5.17.2.3 In the event, that the proposed equipment is unable to meet the environmental requirements as stated in Table 5.10.2-1 and Table 5.10.2-2. The contractor shall make good design and conduct tests based on test requirements as specified in this document. Test reports shall be submitted to ST Kinetics for verification.

5.17.2.4 For the equipment which environmental tests have not been performed, the contractor shall conduct tests and test reports shall be submitted to ST Kinetics for verification.

5.17.2.5 It is the responsibility of the contractor to manufacture the system according to the specifications as indicated in the test reports/ catalogues.

TABLE 5.10.2-1: ENVIRONMENTAL QUALIFICATION TEST PROFILE

System Test	Requirements	Test Standard and Methods	Duration
High Temperature	Max Operating Temperature = 55°C	MIL-STD 810E, Method 501.5, Proc II, Table 501.5-II capped at 55°C	24Hr X 3 Cycles (operational)
	Max storage Temperature = 71 °C	MIL-STD 810E, Method 501.5, Proc I, Table 501.5-III (induced condition)	24Hr X 7 Cycles (storage)
Low Temperature	Operating Temperature = -10°C	MIL-STD 810E, Method 502.5, Proc II with minimum 5 hours at -10°C	1 Cycle (operational)
	Storage Temperature = -21°C	MIL-STD 810E, Method 502.5, Proc I with detailed profile in STANAG 2895 (Induced air temp at C0) as in Table A-2	24Hr X 3 Cycles (storage)
Humidity	Max 95% RH, Storage up to 100%	Mil Std 810E Method 507.5, Proc II, Figure 507.5-7, Table 507.5-IX	24Hr X 10 Cycles
Solar Radiation (only for equipment directly exposed to sunlight)	1120W/m² at 49ºC	Mil Std 810G, Method 505.5, Proc II. Fig. 505.5-2, A1Conditions	10 days

System Test	Requirements	Test Standard and Methods	Duration
Fungus	To minimize fungus growth.	MIL-STD 810G, Method 508.5	
Salt Fog	Protect against effects of salt laden atmosphere	MIL-STD 810G, Method 509.5	
Vibration	Tracked vehicle vibration profile	MIL-STD 810E, Method 514.4, Cat 8, Proc I, Table 514.4-AXVI of Mil-Std-810E, profile as in Table A-3.	One axis 270 minutes, total 810 minutes for three axis
Shock	Mobility shock (40g/11ms, sawtooth)	MIL-STD 810G, Method 516.6, Proc I	40g@11msec, 6 shock for each axis including positive and negative. Total of 18 shocks
Corrosion	Design to withstand corrosion, especially Uniform Attack Galvanic Corrosion, Crevice Corrosion	Qualified by Analysis with material selection	NA
Contamination	without degradation exposure to contaminating fluids such as (a) Petrol and diesel fuel (b) Hydraulic fluid (c) Engine and gearbox oil (d) Fire extinguishing fluid	Qualified by Analysis with material selection	NA

System Test	Requirements	Test Standard and Methods	Duration
Sand & Dust	Withstand air containing sand and dust.	IP6X	2 hrs for each equipment
Rain/jet of water	Withstand the effects of rain in its operating and non-operating state	IPX5	IPX5: 3mins for each equipment
Immersion /Leakage (only for equipment that might be submerged to water during vehicle operation)	Immerse up to the maximum possible depth	IEC 60529 (IPX7)	30mins for IPX7

C0 CYCLES for Materiel

Local Time	Meteorological Conditions			Storage and Transit Conditions	
	Ambient Air Temp	Relative Humidity	Solar Radiation	Induced Air Temp	Relative Humidity
h	°C	%	W/m²	°C	%
0300	-19	Tending to saturation	Negligible on days when accompanying temperatures occur	-21	Tending to saturation
0600	-19			-21	
0900	-15			-19	
1200	-8			-12	
1500	-6			-10	
1800	-10			-14	
2100	-17			-19	
2400	-19			-21	

TABLE 5.10.2-2: ENVIRONMENTAL QUALIFICATION TEST PROFILE FOR LOW TEMPERATURE STORAGE

5.17.3 Test Requirements

5.17.3.1 A list of the test requirements with the required test standards and methods is provided in appendix of this document.

5.17.3.2 In the event that the test standards employed are different from the requirements as stated in this document, the contractor shall explain the differences and provide justifications that they are equivalent or better.

5.17.4 Requests for Waiver

5.17.4.1 For the equipment that has been deployed in the similar or worse environmental conditions as stated in appendix and the contractor intends to request for waiver of tests, the contractor shall minimally provide justification as shown in Table 5.10.4 to ST Kinetics for consideration.

5.17.4.2 It is the contractor's responsibility to provide as much information as possible on the waiver justifications to ST Kinetics for consideration.

5.17.4.3 ST Kinetics shall have the right to verify the contractor claims by conducting verification testing if necessary. In the event that the results are not satisfactory, the contractor shall be responsible to make good the design in order to meet the requirements as indicated in this document.

5.17.4.4 In the event, that request for waiver of test is not accepted, the contractor shall be responsible to conduct the test as stated in appendix.

Table 5.10.4. Justification For Environmental Qualification

Name of Test	Required Test Level	Product Spec.	Justification
E.g High Temp. (Operating)	Contract requirement. E.g. 55 degree	Product specifications. E.g. No spec	E.g. Has been used in xxx vehicle, which is in the Climatic Conditions of Singapore (A2 Conditions as defined in STNAG 2895).
E.g Salt Fog Test	Contract requirement. E.g. Protect against effects of salt laden atmosphere	Product specifications. E.g. No spec	E.g. This box is made of Anodized Aluminum, which is resistant to Corrosion like salt fog

5.18 SAFETY REQUIREMENTS

This section defines and describes the Safety Requirements of the DVCU.

5.18.1 Applicable Documents

Document Prefix	Document Description
MIL-STD-882D	Standard Practice for System Safety
AMCP 706-125	Engineering Design Handbook, Electrical Wire and Cable
MIL-HDBK-454B	General Guidelines for Electronic Equipment, Department of Defence Handbook

Any other equivalent standards, if any.

5.18.2 Wiring

When selecting wiring for vehicular electrical systems, consideration must be given to high physical strength, high temperature resistance, high dielectric and high abrasion resistance. Refer to Chapter 8 and to AMCP 706-125, Engineering Design Handbook, Electrical Wire and Cable for wire selection and cable design. Also refer to MIL-HDBK-454B, General Guidelines for Electronic Equipment, Department of Defence Handbook. Specify frequent wiring supports to prevent chafing and to prevent the free end of a broken wire from contacting grounded metal surfaces. Protection must be achieved with heavy duty binding or jacket material over wire bundle. Wiring used must be able withstand high physical strength, high temperature resistance, high dielectric and high abrasion resistance.

5.18.3 Mechanical Hazard

Requirements are included to ensure that the DVCU and its parts have adequate mechanical strength and stability. DVCU must also be free from the presence of sharp edges. Refer to MIL-HDBK-454B, General Guidelines for Electronic Equipment, Department of Defence Handbook.

5.18.4 Fire

Material used in the construction of the DVCU should not be flammable.

5.18.5 Safety Critical Items

N.A

5.19 ACCEPTANCE REQUIREMENTS

This section defines and describes the Acceptance Requirements of the DVCU.

5.19.1 General

5.19.1.1 This section stipulates the formal acceptance tests required for DVCU. Acceptance tests shall be carried out by the contractor to verify that the DVCU conforms to its specifications and requirements in this document.

5.19.1.2 It should be noted that the successful completion of these acceptance tests themselves do not necessarily constitute delivery or sell-off. The acceptance tests are necessary proof to show that the DVCU meets specifications and requirements. The successful completion of the tests shall form a necessary criterion for delivery.

5.19.1.3 The tests stipulated here shall form the minimum tests required for this DVCU. The contractor may, at her own professional discretion, propose to carry out additional tests to ensure that the DVCU meets its specifications subjected to ST Kinetics approval.

5.19.1.4 All acceptance tests shall be carried out locally in accordance with the approved Acceptance Test Procedure and in the presence of ST Kinetics' personnel, unless ST Kinetics specifically declines to witness the test.

5.19.1.5 For each Acceptance Test, an acceptance test certificate shall be issued only when all of the following are satisfied:

- Successful completion of all Acceptance Tests as specified herein and in accordance with the applicable Acceptance Test Criteria / Procedure.

- Submission of all documentation reflecting the successful completion of all In-Process and Acceptance tests.

5.19.2 In-Process Inspection & Testing

The Contractor shall perform, as part of its quality control process, a series of formal and documented in-process inspection and testing prior to start of any acceptance testing. The In-Process Inspection and Testing will cover the sub-assembly, assembly and system level.

The test plans, procedures and the results of the In-Process Inspection and Testing will be provided to ST Kinetics for review. The ST Kinetics representatives will be informed and invited to the In-Process Testing so as to provide ST Kinetics the progress and status of the program.

5.19.3 Type of Acceptance Tests

5.19.3.1 The Contractor shall work, manage, co-ordinate, perform and certify the acceptance tests specified in paragraph 3 of this section. The acceptance tests shall be conducted in accordance with the Acceptance Test Procedures approved by ST Kinetics. The contractor shall also provide the necessary equipment, logistics and resources for carrying out the relevant tests.

5.19.3.2 The Acceptance Tests shall include, but not limited to the following:

- EMI / EMC Qualification Test
- Environment Qualification Test
- Factory Acceptance Test (FAT)
- On Vehicle Acceptance Test (Support in acceptance test)

On-Vehicle Acceptance Test will be performed by ST Kinetics. Technical support including failure analysis, integration and troubleshooting with regards to the DVCU shall be provided by the contractor. The contractor shall be responsible for its own cost within their scope of supply to rectify the error.

5.19.4 System Verification

5.19.4.1 System Testing Concept

The contractor will outline the concept of system testing, starting from the assembly level to the complete system level. All the different testing stages will be identified and described in detail. The contractor will provide the testing setup for each stages of the testing phase. The use of different simulation tools or simulators at different testing phase has to be stated clearly. The capabilities of the simulation tools and simulators requirements at the different testing phase have to be stated clearly.

5.19.5 Acceptance Test Documentation

5.19.5.1 The contractor shall provide the following Acceptance Test Documentation (ATPC and ATP shall be provided as a single document):

- Acceptance Test Plans & Criteria (ATPC)
- Acceptance Test Procedures (ATP)
- Acceptance Test Report (ATR)

5.19.5.2 For each of the Acceptance Tests listed, the Acceptance Test Plans and Criteria shall be submitted in accordance with the ST Kinetics' schedule.

5.19.6 Acceptance Test Procedures (ATP)

5.19.6.1 The contractor shall submit the final ATP and procedures in accordance with ST Kinetics' schedule before conducting of the test.

5.19.6.2 The Acceptance Test Procedures shall be developed from the ATPC.

5.19.6.3 The Acceptance Test Procedures shall include step-by-step description of how the test shall be conducted, specification data sheets and the test results pass / fail criteria. It shall also include a conformance table to indicate whether each measurement meets its specifications.

5.19.6.4 The contractor shall inform ST Kinetics in writing ahead of the date of testing.

5.19.7 Acceptance Tests Reports (ATR) Requirements

5.19.7.1 The test report shall include but not limited to the following information:

- Updated acceptance test procedures if required
- Complete test results / records / printouts
- Hard copies of measured data
- Discussion of the results
- In case of the test failure, a description of the corrective action taken and repeat test results shall be included.

5.19.7.2 For each of the acceptance tests, the contractor shall submit the final report to ST Kinetics after successful completion of the respective test.

5.19.7.3 The contractor shall be responsible to ensure that proper corrective actions are recommended, implemented and proven effective for defects / faults found during acceptance tests.

5.19.8 General Requirements / Preparation Prior to Tests

5.19.8.1 Prior to each acceptance test, the DVCU to be tested shall be calibrated and subjected to the approved Acceptance Test Procedure by the contractor QA, only upon successful completion, formal testing is then allow to be carried out.

5.19.8.2 Applicable records / results from informal / production testing conducted on the DVCU prior to the formal testing shall be made available to ST Kinetics upon request before the formal Acceptance Test is conducted.

5.19.8.3 The contractor shall be liable to provide all the necessary equipment, logistics and resources for preparation prior to the tests.

5.19.9 Design Update

5.19.9.1 Design update shall be held to update the of the development of the DVCU. The contractor shall demonstrate and verify to ST Kinetics that the design and the system development / system integration approaches met the contract's technical specifications during the design update.

5.20 DELIVERABLE

The following is a list of deliverables the contractor is must meet besides fulfilling the physical specs of the module.

Contractor shall provide ST Kinetics with **3D modeling of the Module** with all components placed within the space envelope given by ST Kinetics. Individual component must be reflected and selectable in the UG modeling.

Contractor shall design and conform to the EQT, ESS and EMI/EMC test stated in this document.

Changes to electrical schematic are expected during fabrication phase. Contractor shall cater for any possible modification support before the final delivery of the product.

Contractor shall provide tester if needed along with a test plan to verify the full functionality of DVCU.

Contractor shall provided a **24 months** warranty against manufacturer defects and workmanship with the option of 2 years extension.

DVCU shall be delivered conforming to the above specifications along with Certificate of Conformance (COC) and test reports.

6 APPENDIX A

BIT Information

0			32	Remark
STATUS		ACKNOWLEDGE		GigEVision Acknowledge
LENGTH		ACK_ID		Protocol Format
Front Left Fault	Front Center Fault	Front Right Fault	Rear Near Fault	
Rear Left Fault	Rear Center Fault	Rear Right Fault	Left Side Front Fault	
Left Side Center Fault	Left Side Rear Fault	Right Side Front Fault	Right Side Center Fault	
Right Side Rear Fault	AVR Fault	BVS Fault	Spare 6 Fault	
ICS Fault	GSU Fault	Spare 4 Fault	Top Day Fault	
Top TI Fault	Spare 2 Fault	Spare 5 Fault	Spare 7 Fault	
Spare1 Fault	Spare 3 Fault	Lay Day Fault	Lay TI Fault	
Rear Left Fault	Rear Right Fault	Left Side Front Fault	Left Side Front TI Fault	
Front Left Fault	Rear Center Fault	Rear Center TI Fault	Front Right Fault	
Right Side Front Fault	Right Side Front TI Fault	Front Center Fault	Front Center TI Fault	
DVCU unique ID				
Average System loading over 5min				
Average System Memory Utilization over 5min				
System Temperature				
DVCU Software Version No.(1st)	DVCU Software Version No.(2nd)	DVCU Software Version No.(3rd)	ICS/GS/Vehicle Variant	BIT Information (56 bytes)
Current Display Mode Protocol				DVCU Acknowledgement

LENGTH = 59 (for BIT) + Number of bytes for ACKNOWLEDGEMENT Protocol
ACKNOWLEDGE = 0x8001 (tie to heartbeat acknowledgement)

ICS/GSU/Vehicle Variant

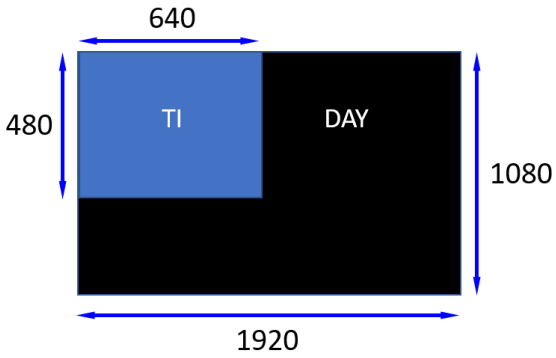
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
ICS Mode	GSU Mode	Vehicle Variant					
0=Day 1=TI	0=Day 1=TI	1=AFV, 2=RV, 3=AVLB, 4=MCEV					

Status	Description	Connector	Pin	Type	Value
Front Left Fault	Front Left Driving Camera No Video Input	J5	1,2	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Center Fault	Front Center Driving Camera No Video Input	J5	4,5	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Right Fault	Front Right Driving Camera No Video Input	J5	7,8	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Near Fault	Rear Near Driving Camera No Video Input	J5	10,11	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Left Fault	Rear Left Driving Camera No Video Input	J5	13,14	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Center Fault	Rear Center Driving Camera No Video Input	J5	16,17	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Right Fault	Rear Right Driving Camera No Video Input	J5	19,20	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Left Side Front Fault	Left Side Front Driving Camera No Video Input	J5	22,23	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Left Side Center Fault	Left Side Center Driving Camera No Video Input	J5	25,26	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Left Side Rear Fault	Left Side Rear Driving Camera No Video Input	J5	28,29	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Right Side Front Fault	Right Side Front Driving Camera No Video Input	J5	31,32	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Right Side Center Fault	Right Side Center Driving Camera No Video Input	J5	34,35	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Right Side Rear Fault	Right Side Rear Driving Camera No Video Input	J5	37,38	Boolean (8bits)	FALSE = No fault, TRUE = Fault
AVR Fault	AVR No Video Input	J5	40,41	Boolean (8bits)	FALSE = No fault, TRUE = Fault
BVS Fault	BVS No Video Input	J5	43,44	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare1 Fault	No Video Input (Spare 1)	J5	46,47	Boolean (8bits)	FALSE = No fault, TRUE = Fault
ICS Fault	ICS No Video Input	J9	1	Boolean (8bits)	FALSE = No fault, TRUE = Fault
GSU Fault	GSU No Video Input	J9	2	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 2 Fault	No Video Input (Spare 2)	J9	3	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Top Day Fault	Top of the Bridge Day Camera No Video Input	J9	4	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Top TI Fault	Top of the Bridge TI Camera No Video Input	J9	5	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 3 Fault	No Video Input (Spare3)	J9	6	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 4 Fault	No Video Input (Spare4)	J9	7	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 5 Fault	No Video Input (Spare5)	J9	8	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 6 Fault	No Video Input (Spare6)	J9	9	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Spare 7 Fault	No Video Input (Spare7)	J9	10	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Lay Day Fault	Laying Arm Day Camera No Video Input	J9	11	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Lay TI Fault	Laying Arm TI Camera No Video Input	J9	12	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Left Fault	Rear Left Camera No Video Input	J10	1	Boolean (8bits)	FALSE = No fault, TRUE = Fault

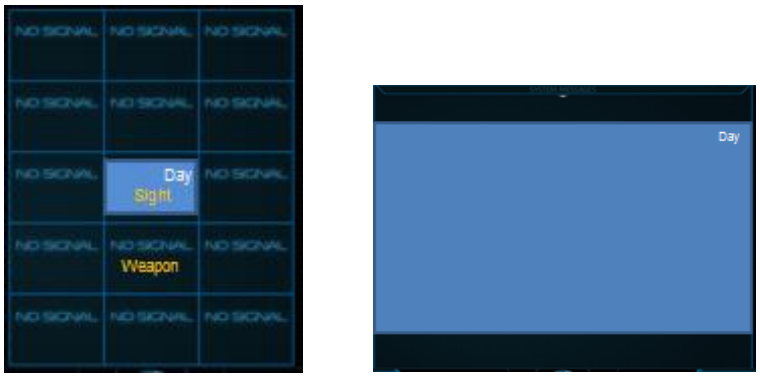
Rear Right Fault	Rear Right Camera No Video Input	J10	2	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Left Side Front Fault	Left Side Front Day Camera No Video Input	J10	3	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Left Side Front TI Fault	Left Side Front TI Camera No Video Input	J10	4	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Left Fault	Front Left Camera No Video Input	J10	5	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Center Fault	Rear Center Day Camera No Video Input	J10	6	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Rear Center TI Fault	Rear Center TI Camera No Video Input	J10	7	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Right Fault	Front Right Camera No Video Input	J10	8	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Right Side Front Fault	Right Side Front Day Camera No Video Input	J10	9	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Right Side Front TI Fault	Right Side Front TI Camera No Video Input	J10	10	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Center Fault	Front Center Day Camera No Video Input	J10	11	Boolean (8bits)	FALSE = No fault, TRUE = Fault
Front Center TI Fault	Front Center TI Camera No Video Input	J10	12	Boolean (8bits)	FALSE = No fault, TRUE = Fault
DVCU unique ID	DVCU Serial Number	NA	NA	Integer (32bits)	(Serial Number)
Average System loading over 5min	Average System loading over 5 min in term of %	NA	NA	Integer (32bits)	(In term of %)
Average System Memory Utilization over 5min	Average System Memory Utilization over 5 min in term of %	NA	NA	Integer (32bits)	(In term of %)
System Temperature	System Temperature in term of degree celsius	NA	NA	Integer (32bits)	(In term of degree celsius)
DVCU Software Version No.(1st)	DVCU Software Version No. 1st digit	NA	NA	Integer (8bits)	Version No. 1st digit
DVCU Software Version No.(2nd)	DVCU Software Version No. 2nd digit	NA	NA	Integer (8bits)	Version No. 2nd digit
DVCU Software Version No.(3rd)	DVCU Software Version No. 3rd digit	NA	NA	Integer (8bits)	Version No. 3rd digit

7 APPENDIX B

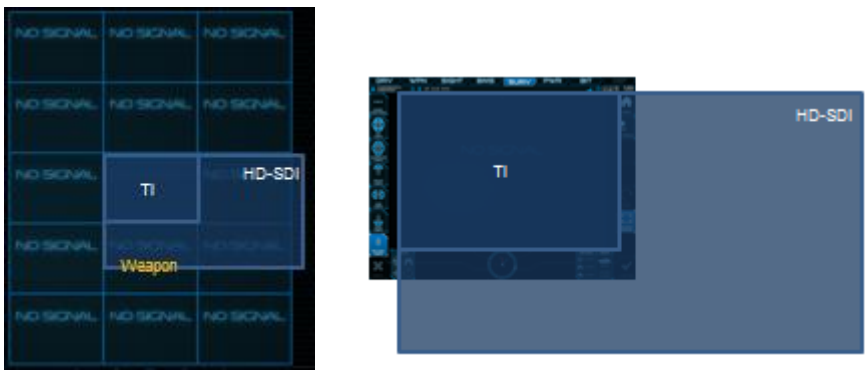
ICS and GSU Video



ICS and GSU TI and DAY Resolution



ICS and GSU Day Display



ICS and GSU TI Display

Camera Layout Change:

Header	Message ID	Message Type	Data[4]	Checksum	End
0xAA	Sequence ID	0x43	Command	Checksum	0xBB

Vehicle Type:

Header	Message ID	Message Type	Data[4]	Checksum	End
0xAA	Sequence ID	0x44	0x01 0x00 0x00 0x00	Checksum	0xBB

Data[4]: 0x01 0x00 0x00 0x00 = AFV

0x02 0x00 0x00 0x00 = RV

0x03 0x00 0x00 0x00 = AVLB

0x04 0x00 0x00 0x00 = MCEV

GS/ICS mode change:

Header	Message ID	Message Type	Data[4]	checksum	End
0xAA	sequence ID	0x45	0x01 0x01 0x00 0x00	checksum	0xBB

data[0]: GS mode: 0x00 = Day, 0x01 =TI
data[1]: ICS mode: 0x00 = Day, 0x01 = TI