

NL128102AC31-02A

**Diagonal Size 51.0 cm (20.1 Type), 1280 × 1024 Pixels,
16,777,216 Color, TMDS Interface/CRT Monitor Compatible
Interface, Ultra-Wide Viewing Angle**

NL128102AC31-02A module is composed of the amorphous silicon thin film transistor liquid crystal display (a-Si TFT LCD) panel structure with driver LSIs for driving the TFT (Thin Film Transistor) array and a backlight unit. The a-Si TFT LCD panel structure is injected liquid crystal material into a narrow gap between the TFT array glass substrate and a color-filter glass substrate.

Color (Red, Green, Blue) data signals from a host system (e.g. PC, signal generator, etc.) are modulated into best form for active matrix system by a signal processing board, and sent to the driver LSIs which drive the individual TFT arrays.

The TFT array as an electro-optical switch regulates the amount of transmitted light from the backlight assembly, when it is controlled by data signals. Color images are created by regulating the amount of transmitted light through the TFT array of red, green and blue dots.

APPLICATIONS

- Desk-top type of PCs, Engineering work stations
- Display terminals for control system
- Monitors

FEATURES

- 2 input signals are available: TMDS interface or CRT interface
- Control functions with on screen display:
e.g.: brightness, contrast, color, gamma, auto gain control, display position, display size, clock phase, auto adjustment, OSD position and language
- DDC functions (for analog: corresponding to DDC1 and DDC2B, for digital: corresponding to DDC2B)
- Corresponding to VESA DPMS (analog)
- Corresponding to DDWG and DMPM (digital)
- Multi-scan function: e.g., SXGA, XGA, SVGA, VGA, VGA-TEXT, MAC
- Free supply voltage sequence
- Ultra-wide viewing angle
- High luminance
- High contrast
- Wide color gamut
- Incorporated direct type backlight with inverter
- Backlight unit replaceable
- Inverter replaceable
- Approved by UL1950 Third Edition (File No. E170632) and CSA-C22.2 No.950-95 (File No. E170632)

*On Screen Display

Application with the OSD function might conflict with patents in Europe and/or the U.S.A. If customer applies the OSD function appreciate the patents at customer side.

VESA: Video Electronics Standards Association

DPMS: Display Power Management Signaling

DDC1: Display Data Channel 1

DDC2B: Display Data Channel 2B

DDWG: Digital Display Working Group

DMPM: Digital Monitor Power Management

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.**

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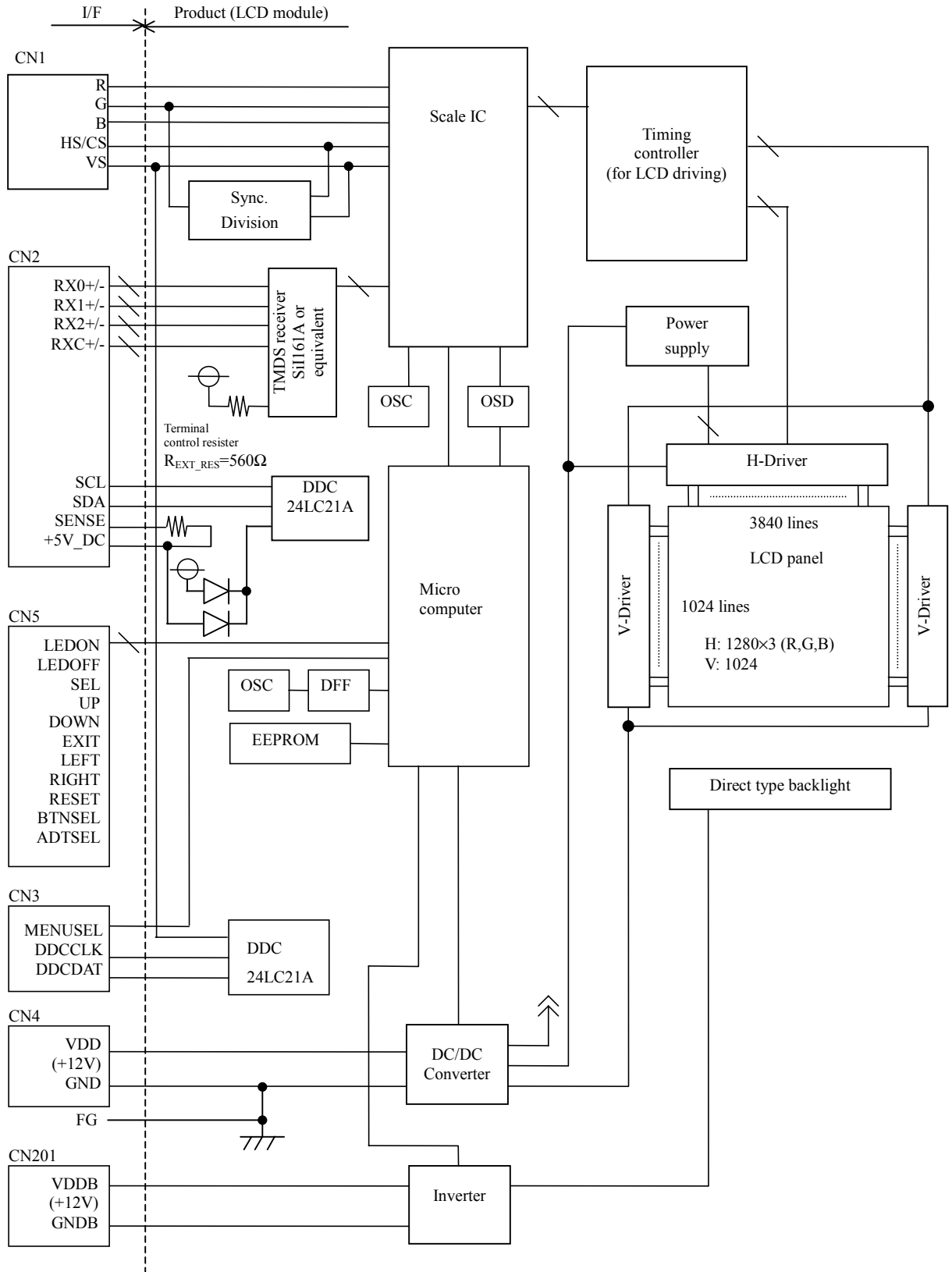
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1. GENERAL SPECIFICATIONS

<i>Display area</i>	399.36 (H) × 319.49 (V) mm (typ.)
<i>Diagonal size of display</i>	51.0 cm (20.1 inches)
<i>Drive system</i>	a-Si TFT active matrix
<i>Display color</i>	16,777,216 colors
<i>Pixel</i>	1280 (H) × 1024 (V) pixels
<i>Pixel arrangement</i>	RGB (Red dot, Green dot, Blue dot) vertical stripe
<i>Dot pitch</i>	0.104 (H) × 0.312 (V) mm
<i>Pixel pitch</i>	0.312 (H) × 0.312 (V) mm
<i>Module size</i>	470.0 (typ., H) × 382.0 (typ., V) × 42.5 (max., D) mm
<i>Weight</i>	2,380 g (typ.)
<i>Contrast ratio</i>	300:1 (typ.)
<i>Viewing angle</i>	At the contrast ratio 10:1 <ul style="list-style-type: none"> • Horizontal: Left side 85° (typ.), Right side 85° (typ.) • Vertical: Up side 85° (typ.), Down side 85° (typ.)
<i>Designed viewing direction</i>	Viewing angle with optimum grayscale (γ=2.2): normal axis (perpendicular)
<i>Polarizer pencil-hardness</i>	3H (min.) [by JIS K5400]
<i>Color gamut</i>	At LCD panel center 60 % (typ.) [against NTSC color space]
<i>Response time</i>	30 ms (typ.), Black to White (10%→90%) 23 ms (typ.), White to Black (90%→10%)
<i>Luminance</i>	250 cd/m ² (typ.)
<i>Signal system</i>	CRT interface or TMDS interface ① CRT interface: Analog RGB signals and Synchronous signals (Vsync(VS) and Hsync(HS) or Composite(CS)) ② TMDS interface: RGB 8-bit signals, Synchronous signals (Hsync(HS), Vsync(VS)) and Data enable signal (DE)
<i>Supply voltages</i>	LCD driving: 12V Backlight inverter: 12V
<i>Backlight</i>	Direct light type: 12 cold cathode fluorescent lamps <div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px; display: inline-block;"> Replaceable parts <ul style="list-style-type: none"> • Backlight unit: type No. 201LHS02 • Inverter: type No. 201PW021 </div>
<i>Power consumption</i>	At maximum luminance and checkered flag pattern 49.6 W (typ.)

2. BLOCK DIAGRAM



Note1: GND (signal ground) is connected to FG (frame ground) and GNDB (backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

3. DETAILED SPECIFICATIONS

3.1 MECHANICAL SPECIFICATIONS

Parameter	Specification	Unit
Module size	470.0 ± 1.0 (H) × 382.0 ± 1.0 (V) × 42.5 (max., D) Note1	mm
Display area	399.36 (H) × 319.49 (V) Note1	mm
Weight	2,380 (typ.), 2,490 (max.)	g

Note1: See "6.OUTLINE DRAWINGS".

3.2 ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Rating	Unit	Remarks
Supply voltage	LCD driving	VDD	-0.3 to +14	V	Ta = 25°C
	Backlight inverter	VDDDB	-0.3 to +14	V	
Input voltage (HS/CS, VS)		Vin1	-0.3 to +5.5	V	Ta = 25°C VDD=12V
Input voltage (SCL, SDA, DDCCLK, DDCDAT, WPRT)		Vin2	-0.3 to +5.5	V	
Input voltage (analog R,G,B)		Vin3	-6.0 to +6.0	V	
Input voltage (RX2±, RX1±, RX0±, RXC±)		Vin4	-0.3 to +3.6	V	
Storage temperature		Tst	-20 to +60	°C	Note1
Operating temperature	Front surface	Top1	0 to +55	°C	Note2
	Rear surface	Top2	≤ 65	°C	
Relative humidity Note3		RH	≤ 95	%	Ta ≤ 40°C
			≤ 85	%	40 < Ta ≤ 50°C
			≤ 70	%	50 < Ta ≤ 55°C
Absolute humidity Note3		-	≤ 78 Note4	g/m ³	Ta > 55°C

Note1: Measured at the display area center (including self-heat)

Note2: Measured at the rear shield center (including self-heat)

Note3: No condensation

Note4: Ta = 55°C, RH = 70%

3.3 ELECTRICAL CHARACTERISTICS

3.3.1 Driving for LCD panel

(Ta = 25°C)

Parameter	Symbol	min.	typ.	max.	Unit	Remarks	
Supply voltage	VDD	10.8	12.0	13.2	V	-	
Ripple voltage	VRP	-	-	100	mV	for VDD	
Supply current	IDD	-	630 Note1	900 Note2	mA	VDD = 12.0V	
		-	100 Note1	120 Note2	mA	Power saving mode VDD=12.0V (CRT interface)	
		-	130 Note1	200 Note2	mA	Power saving mode VDD=12.0V (TMDS interface)	
Logic input voltage	Low	VinL1	0	-	0.8	V	TTL level HS/CS, VS
	High	VinH1	2.0	-	5.0	V	
Logic input voltage	Low	VinL2	0	-	1.4	V	SCL, SDA, DDCCLK, DDCDAT, WPRT
	High	VinH2	3.7	-	4.8	V	
Logic input current	Low	IinL1	-10	-	-	μA	HS/CS, VS
	High	IinH1	-	-	2.3	μA	
Logic input current	Low	IinL1	-10	-	-	μA	SCL, SDA, DDCCLK, DDCDAT, WPRT
	High	IinH1	-	-	10	μA	
Logic output voltage	Low	VoL2	-	-	0.4	V	SDA, DDCDAT
	High	VoH2	2.4	-	-	V	
TMDS differential input amplitude	VID	-	500	-	mV	TMDS differential input signal RX2±, RX1±, RX0±, RX0±	
TMDS terminal resistor	RT	-	560	-	Ω	-	
Analog RGB signals maximum amplitude (white - black)	VIRGB	0	0.7	0.9	Vp-p	-	
Sync level	VIS	0.2	0.3	0.6	Vp-p	G terminal (sync on green)	

Note1: SXGA 75Hz mode (3.7 PRESET TIMINGS No.12) and checkered flag pattern [by EIAJ ED-2522]

Note2: SXGA 75Hz mode (3.7 PRESET TIMINGS No.12) and theoretical maximum current pattern

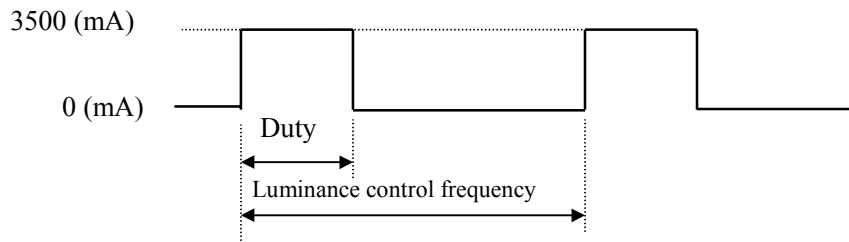
3.3.2 Driving for backlight inverter

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VDDB	10.8	12.0	13.2	V	-
Supply current	IDDB	-	3,500	4,200	mA	at maximum luminance, VDDB = 12.0V Note1

Note1: All pixels are white.

3.3.3 Inverter current wave



Maximum luminance control : 100%

Minimum luminance control : 20%

Luminance control frequency \cong VS frequency \times K*

*VS frequency \leq 75Hz: K = 4.6

VS frequency > 75Hz: K = 3.6

3.3.4 Supply voltage ripple

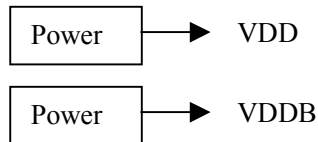
This product works, even if the ripple voltage levels are beyond the permissible values as following the table, but there might be noise on the display image.

Supply voltage	Ripple voltage (Measure at input terminal of power supply)	Unit
VDD (for LCD panel driving; 12.0V)	≤ 100	mVp-p
VDDDB (for backlight inverter; 12.0V)	≤ 200	mVp-p

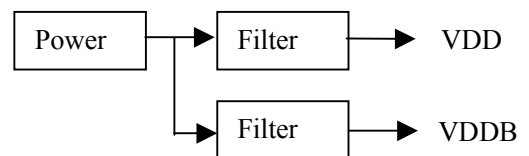
Note1: The permissible ripple voltage includes spike noise.

Example of the power supply connection

a) Separate the power supply



b) Put the filter



3.3.5 Fuses

Item	Fuse		Rating	Unit	Remark
	Type	Supplier			
VDD	CCF1NTE3.15	KOA Corporation	6.3	A	Fusing current Note1
			60	V	-
VDDDB	R451007	Littelfuse Inc.	14	A	Fusing current Note1
			125	V	-

Note1: The power capacity should be more than the fusing current rating. If the power capacity is less than the criteria value, the fuse may not blow, and then nasty smell, smoking and so on may occur.

3.4 SUPPLY VOLTAGE SEQUENCE

3.4.1 Caution at power-on the product

(1)VDD

In terms of voltage variation (voltage drop) while VDD rising edge is below 11.4V, a protection circuit may work, and then this product may not work.

(2)VDDDB

12V for backlight should be started up within 800ms, otherwise, the protection circuit makes the backlight turn off.

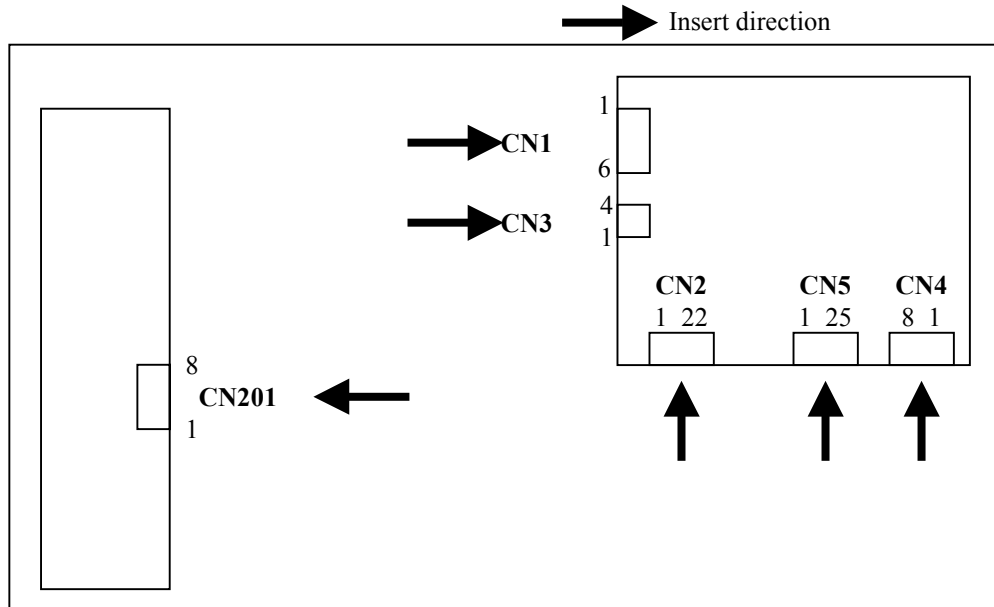
(3) Supply voltage must not apply while each control signals (SEL, UP, DOWN, EXIT, LEFT, RIGHT, RESET and ADTSEL) are connected to GND. Otherwise the product may cause malfunction.

(4) If the power supply voltage is applied while UP and DOWN are connected to GND, the input control signals become ineffective mode. To reset this mode, turn off the power once and turn on the power while UP and DOWN are connected to GND. Then, the mode will be released.

(5) Setting of BTNSEL is decided when turning the LCD module's power on.
The setting can not be changed while the LCD module is working.

3.5 CONNECTIONS AND FUNCTIONS FOR INTERFACE PINS

3.5.1 Positions of sockets



Analog input sockets: CN1 and CN3
 Digital input sockets: CN2
 Common: CN4, CN5 and CN201

3.5.2 Connections for interface pins

CN1 socket

Part No.: MRF03-6R-SMT

Adaptable plug : MRF03-6P-1.27(for cable type) or MRF03-6PR-SMT(for board to board type)

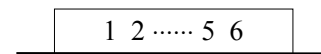
Supplier: HIROSE ELECTRIC CO., LTD.

Pin No.	Symbol	Pin No.	Symbol
1	B	4	VS
2	G	5	HS/CS
3	R	6	N.C.

Note1: N.C. (non-connection) must be open.

Note2: A coaxial cable should be connected with GND.

CN1: Figure of socket

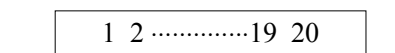


CN2 socket

Part No.: FI-XD7S-HF
 Adaptable plug: FI-XD7M (FPC, coaxial type) or FI-XD7H (for cable type)
 Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Pin No.	Symbol
1	RX2+ Note2	11	RXC- Note2
2	RX2- Note2	12	GND
3	GND	13	N.C.
4	RX1+ Note2	14	N.C.
5	RX1- Note2	15	GND
6	GND	16	SENSE
7	RX0+ Note2	17	+5V DC
8	RX0- Note2	18	GND
9	GND	19	SDA
10	RXC+ Note2	20	SCL

CN2: Figure of socket



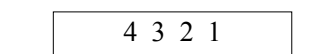
Note1: N.C. (non-connection) must be open.
 Note2: Use 50Ω twinax or twin-coax wire for the cable.

CN3 socket

Part No.: IL-Z-4PL-SMTY
 Adaptable plug: IL-Z-4S-S125C3
 Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Pin No.	Symbol
1	DDCCLK	3	MENUSEL
2	DDCDAT	4	GND

CN3: Figure of socket

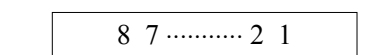


CN4 socket

Part No.: IL-Z-8PL-SMTY
 Adaptable plug: IL-Z-8S-S125C3
 Supplier: Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Pin No.	Symbol
1	VDD	5	GND
2	VDD	6	GND
3	VDD	7	GND
4	VDD	8	GND

CN4: Figure of socket

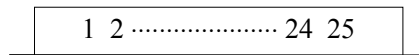


CN5 socket

Part No.: DF14A-25P-1.25H
 Adaptable plug: DF14-25S-1.25C
 Supplier: HIROSE ELECTRIC CO, LTD.

Pin No.	Symbol	Pin No.	Symbol
1	LEDON	14	EXIT
2	LEDOFF	15	GND
3	GND	16	N.C.
4	N.C.	17	GND
5	ADTSEL	18	TEST Note1
6	RIGHT	19	BTNSEL
7	LEFT	20	WPRT
8	RESET	21	N.C.
9	N.C.	22	N.C.
10	GND	23	GND
11	SEL	24	N.C.
12	UP	25	N.C.
13	DOWN		

CN5: Figure of socket



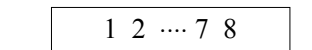
Note1: Pin No.18 (TEST) must be connected to GND.
 Note2: N.C. (non-connection) must be open.

CN201

Part No.: DF3-8P-2H
 Adaptable plug :DF3-8S-2C
 Supplier: HIROSE ELECTRIC CO., LTD.

Pin No.	Symbol	Pin No.	Symbol
1	GNDB	5	VDDDB
2	GNDB	6	VDDDB
3	GNDB	7	VDDDB
4	GNDB	8	VDDDB

CN201: Figure of socket



Remark1: All GND, GNDB, VDD and VDDDB terminals should be used without a non-connected line.
 Remark2: GND (signal ground) is connected to FG (frame ground) and GNDB (backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

3.5.3 Functions for interface pins

Symbol	I/O	Logic	Function
R	Input	-	Analog red video signal input(0.7Vp-p), Input impedance 75Ω
G	Input	-	Analog green video signal input(0.7Vp-p), Sync on green input, Input impedance 75Ω
B	Input	-	Analog blue video signal input(0.7Vp-p), Input impedance 75Ω
HS/CS	Input	Positive/ Negative	Horizontal synchronous signal input / composite synchronous signal input(TTL level), Positive / Negative auto recognition, Input impedance 2.2kΩ
VS	Input	Positive/ Negative	Vertical synchronous signal input(TTL level) Positive / Negative auto recognition, Clock input for DDC1, Input impedance 2.2kΩ
RX2+	Input	-	TMDS differential data input R (+)
RX2-	Input	-	TMDS differential data input R (-)
RX1+	Input	-	TMDS differential data input G (+)
RX1-	Input	-	TMDS differential data input G (-)
RX0+	Input	-	TMDS differential data input B (+)
RX0-	Input	-	TMDS differential data input B (-)
RXC+	Input	-	TMDS differential clock input (+)
RXC-	Input	-	TMDS differential clock input (-)
+5V DC	-	-	+5V power supply (DDC power supply for digital input)
SENSE	Output	Positive	Connection detective signal
SCL	Input	Positive	Clock for DDC2B (for digital input)
SDA	Input/ Output	Positive	Data for DDC2B (for digital input) read / write
DDCCLK	Input	Positive	Clock for DDC2B (for analog input)
DDCDAT	Input/ Output	Positive	Data for DDC1/2B (for analog input) read / write
WPRT	Input	Positive	WPRT is "Low" when the DDC data for analog is input.
LEDON	Output	Positive	Indicator for LED power on "High": LED select, "Low": Other status Open collector output
LEDOFF	Output	Positive	Indicator for power saving mode "High": Power mode select, "Low": Other status Open collector output
SEL	Input	Negative	Control function select signal (TTL level) SEL is pulled up in the module. "Open": SEL off, "Low": SEL on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
UP	Input	Negative	Control signal (TTL level) The signal increases the value of the selected functions. UP is pulled up in the module. "Open": UP off, "Low": UP on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.

Symbol	I/O	Logic	Function
DOWN	Input	Negative	Control signal (TTL level) The signal decreases the value of the selected functions. DOWN is pulled up in the module. "Open": DOWN off, "Low": DOWN on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
EXIT	Input	Negative	Control function exit signal (TTL level) EXIT is pulled up in the module. "Open": EXIT off, "Low": EXIT on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
RIGHT Note1	Input	Negative	Control signal (TTL level) The signal increases the value of the selected functions. RIGHT is pulled up in the module. "Open": RIGHT off, "Low": RIGHT on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
LEFT Note1	Input	Negative	Control signal (TTL level) The signal decreases the value of the selected functions. LEFT is pulled up in the module. "Open": LEFT off, "Low": LEFT on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
RESET Note1	Input	Negative	Control signal (TTL level) RESET is pulled up in the module. "Open": RESET off, "Low": RESET on Details of the functions are mentioned in 3.11. CONTROL FUNCTIONS.
BTNSEL	Input	-	Number of adjustment button selection signal (TTL level) BTNSEL is pulled up in the module. "Open": BTNSEL off, "Low": BTNSEL on Detail of the functions is mentioned in 3.5.4 Selection of number of adjustment button.
TEST	Input	-	Must be connected to GND. TEST is pulled up in the module.
MENUSEL	Input	-	OSD display direction selection signal (TTL level) MENUSEL is pulled up in the module. Details of the functions are mentioned in 3.5.5 Selection of OSD display direction.
ADTSEL	Input	-	Analog input / digital input selection signal ADTSEL is pulled up in the module. Details of the functions are mentioned in 3.5.6 INPUT SIGNAL SELECTION.
VDD	-	-	Power supply for Logic and LCD driving +12V (±10%)
Vddb	-	-	Power supply for backlight +12V (±10%)
GND	-	-	Ground for logic and LCD driving (VDD) Note1
GNDb	-	-	Ground for backlight inverter (Vddb) Note1

Note1: GND (signal ground) is connected to FG (frame ground) and GNDb (backlight ground) in the LCD module. These grounds should be connected to system ground in customer equipment.

3.5.4 Selection of the number of adjustment button

BTNSEL	"Low"	"Open"
Function	4 adjustment buttons (SEL, UP, DOWN and EXIT) are selected.	7 adjustment buttons (SEL, UP, DOWN, RIGHT, LEFT, EXIT and RESET) are selected.

Note1: The number of adjustment button is decided when turning the LCD module's power on.

3.5.5 Selection of OSD display direction

MENUSEL	"Low"	"Open"
Function	OSD is displayed in normal direction. (rotation angle = 0°)	OSD is displayed in left rotation direction. (rotation angle =90°)

3.5.6 Input signal selection

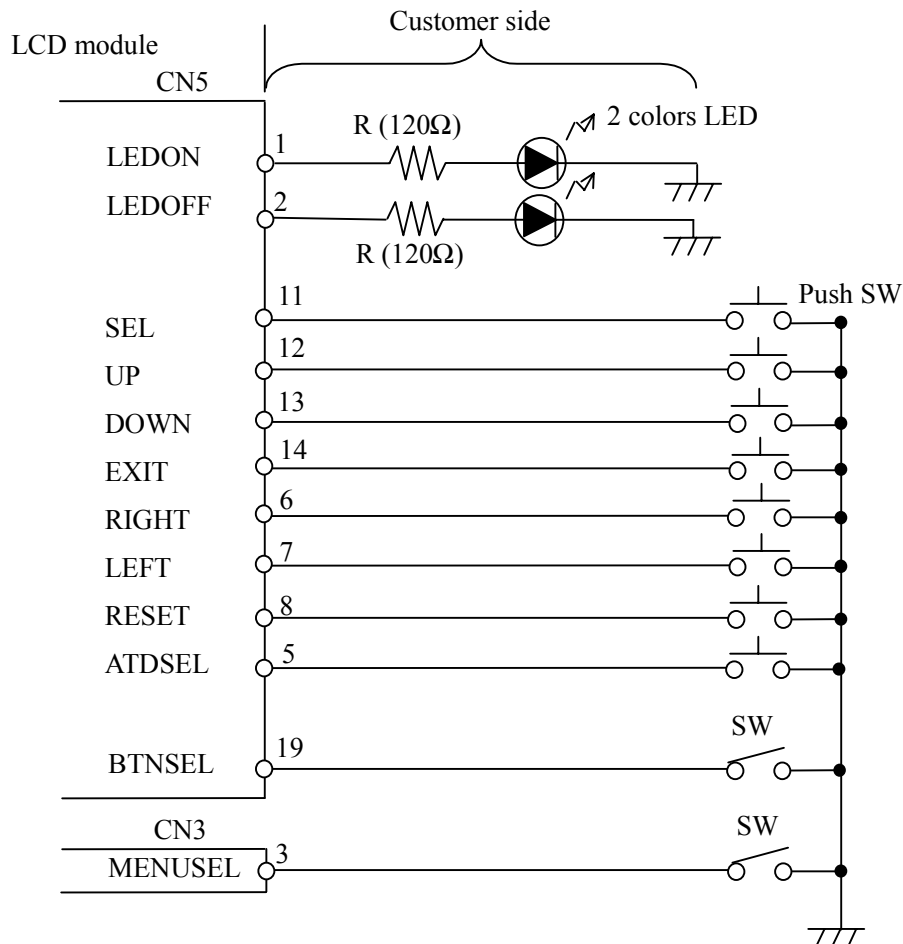
Every time ADTSEL is "Low", corresponding to analog signal input and digital signal input are changed. Auto selection function of input signals works when turning the LCD module's power on. In case that both analog and digital signals are input, the signal that is used when turning the LCD module's power off last time is selected preferentially.

The setting is analog when shipping from the factory.

3.5.7 Equivalent circuit

Symbol	I/O	Equivalent circuit
R,G, B	Input	
HS/CS, VS	Input	
LEDON, LEDOFF	Output	<p>RN2306 (Toshiba) or equivalent</p>

<Example of LED circuit>



3.6 INPUT SYNCHRONOUS SIGNALS

This module is corresponding to the synchronous signals below.

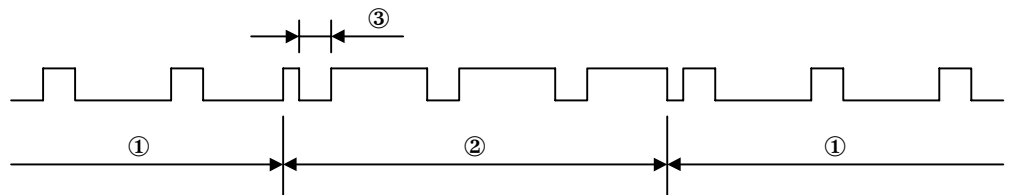
3.6.1 Analog input

Recognition of the LCD module	Synchronous signal		
	HS/CS	VS	Sync. On Green
Separate synchronous signal mode (HS, VS)	Input	Input	Input or no input
Composite synchronous signal mode Note1	Input (CS)	No input	Input or no input
Sync on Green mode Note2	No input	No input	Input
Power saving mode Note3	Input (HS)	No input	Input or no input
	No input	Input	Input or no input
	No input	No input	No input

Note1: Composite synchronous signals type

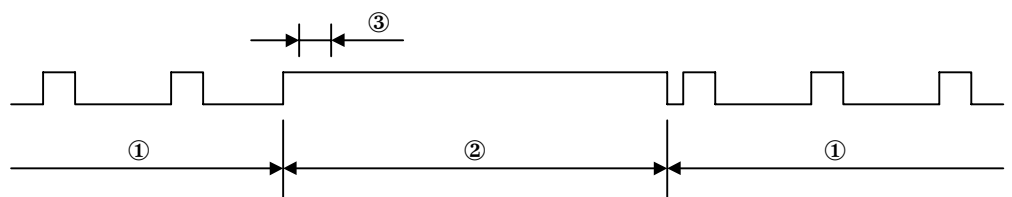
(1) Type A

There are HS pulses (equivalent) in VS period.
Type A becomes composite synchronous mode.



(2) Type B

There are no HS pulses (equivalent) in VS period.
Type B becomes power saving mode

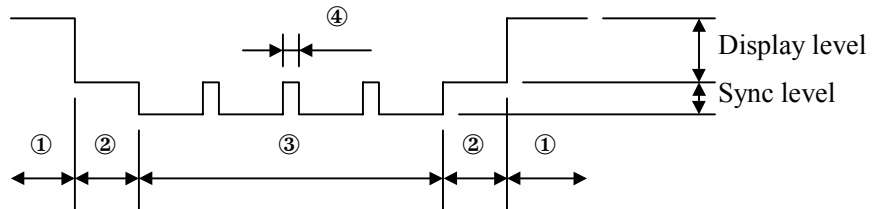


- ① Non VS period
- ② VS period
- ③ HS pulse (equivalent)

Note2: Sync on green signals type

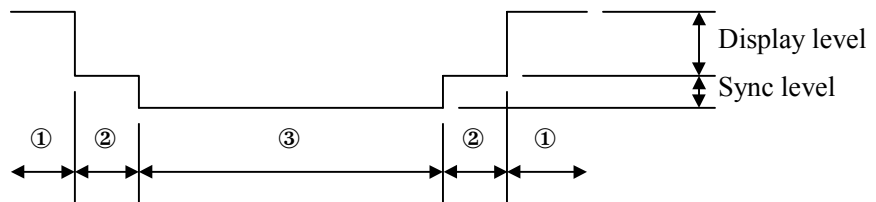
(1) SonG type A

There are HS pulses (equivalent) in VS period.
Type A becomes composite synchronous mode.



(2) SonG type B

There are no HS pulses (equivalent) in VS period.
Type B becomes power saving mode



- ① Display level
- ② Black level period
- ③ VS period
- ④ HS pulse (equivalent)

Note3: If one of R, G or B signals are input, it may not become power saving mode.

3.6.2 TMDS input

Recognition of the LCD module	Synchronous signal		
	HS	VS	DE
Normal mode	Input	Input	Input
Power saving mode	Input or no input	Input or no input	No input

3.7 PRESET TIMINGS

The twelve kinds of timings below are already programmed in this module. The input synchronous signals are automatically recognized.

No.	Display size	VS (Hz)	HS (kHz)	DOTCLK (MHz)	V Pulse (H)	V B.Porch (H)	H Pulse (DOTCLK)	H B.Porch (DOTCLK)	Sync logic V,H	Remarks
1	640×480	59.992	31.469	25.175	2	33	96	48	-, -	VGA
2	720×400	70.087	31.469	28.322	2	35	108	45	+, -	VGA TXT
3	800×600	60.317	37.879	40.000	4	23	128	88	+, +	VESA
4	640×480 *1	66.667	35.000	30.240	3	39	64	96	SonG type A	Macintosh
5	640×480	75.000	37.500	31.500	3	16	64	120	-, -	VESA
6	1024×768	60.004	48.363	65.000	6	29	136	160	-, -	VESA
7	800×600	75.000	46.875	49.500	3	21	80	160	+, +	VESA
8	832×624 *1	74.565	49.735	57.283	3	39	64	224	SonG type A	Macintosh
9	1024×768	70.069	56.476	75.000	6	29	136	144	-, -	VESA
10	1024×768	75.029	60.023	78.750	3	28	96	176	-, -	VESA
11	1280×1024	60.020	63.981	108.000	3	38	112	248	+, +	VESA
12	1280×1024	75.025	79.976	135.000	3	38	144	248	+, +	VESA

*1: This timing is corresponding to analog signal input only.

Note1: Even if above preset timing is entered, a little adjustment of the functions such as Horizontal period, CLK-delay and display position, are required. The adjusted values are memorized in every preset No.

Note 2: When inputting a signal except the above preset timing, this module may display with near preset timing of the frequency of HS and VS

E.g.: 640×480 dot, HS: 37.861kHz, VS: 72.809Hz

→ It is displayed with presetting number 5.

Adopt the evaluation, because adjustment may not fit, in case that the magnifying ratio differs, or in case that customer uses it with except for the display timing that was preset.

Note 3: The display color tone may be difference between Sync on Green input and others.

Note 4: In case that input timings are deviated substantially from above preset timings, it may cause to display deterioration. Even if the preset timing is entered correctly, in case that there is a waveform rounding or distortion, it may cause to display deterioration.

3.8 EXPANSION MODE

Expansion mode is a function to expand the screen size in different resolutions. For example, VGA signal has 640×480 pixels. But, if the display data can be expanded to 2.0 times vertically and horizontally, VGA screen image can be displayed fully on the screen of SXGA resolution. This module automatically recognizes the timing shown in item 3.7 PRESET TIMINGS as an expansion mode.

Adopt this mode after evaluating display quality, because the appearance in the expansion mode is happened to become bad in some cases.

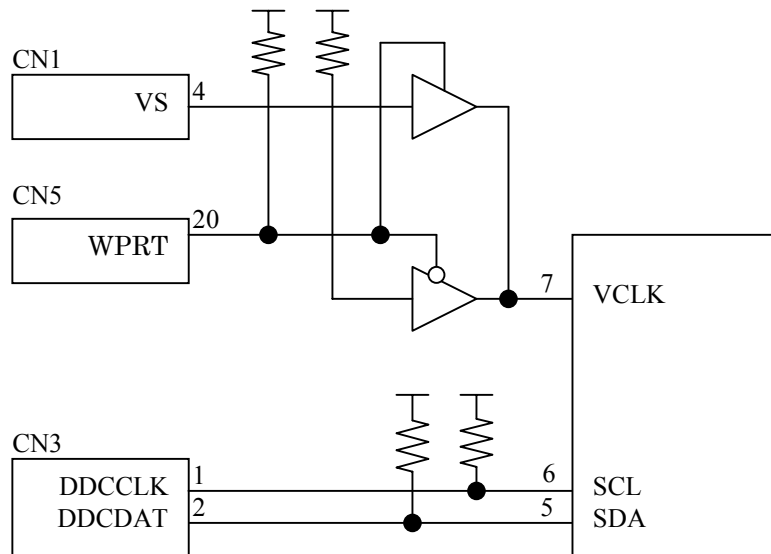
3.9 DDC FUNCTIONS

This function is corresponding to VESA DDC™ and EDID™ (Structure Version 1). Follow the specifications of the IC when customer writes a data. (VCLK is fixed on "High".) Write a data into necessary addresses in advance when customer uses this function.

EDID: Extended Display Identification Data

<Internal equivalent circuit diagram>

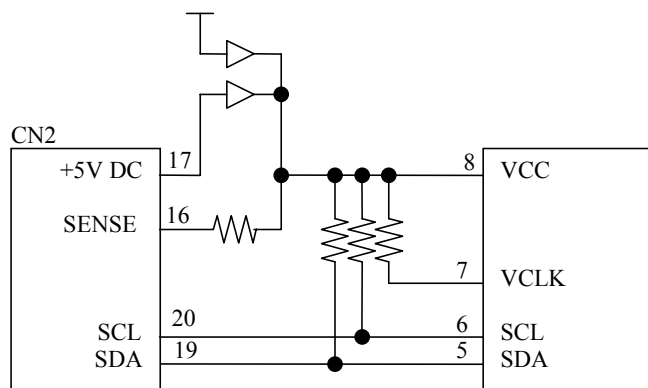
Analog (DDC1/2B)



Product: Microchip Technology Inc.
24LC21A or equivalent

Note1: VS is fixed on "High" or WPRT is fixed on "Low", when a data is input.
Note2: Data "55" in address "00" and "FF" in other address are already written when shipping.

Digital (DDC2B)



Product: Microchip Technology Inc.
24LC21A or equivalent

Note1: Minimum necessary EDID data which video card can recognize the LCD module as digital interface monitor are written when shipping.
When customer uses the DDC function, write the necessary data on the LCD module.

3.10 DPMS

Analog input

This function is corresponding to VESA DPMS™ Standard.

VESA DPMS Standard				NL128102AC31-02A			
State	Signal			Power saving	Recovery time	Power saving	Recovery time
	Horizontal	Vertical	Video				
On	Pulses	Pulses	Active	None	Not applicable	None	Not applicable
Stand-by	No pluses	Pluses	Blanked	Minimum	Short	Maximum	Short
Suspend	Pluses	No pluses	Blanked	Substantial	Longer	Maximum	Short
Off	No pluses	No pluses	Blanked	Maximum	System dependent	Maximum	Short

3.11 CONTROL FUNCTIONS

3.11.1 Control function items

In order to achieve the best picture quality, the follow functions should be adjusted by setting SEL ([S]), UP([↑]), DOWN([↓]), LEFT([←]), RIGHT([→]), RESET([R]) and EXIT([E]) signals. Adjustment values are memorized every display modes.

No.	Item		At digital signal input	Function
1	Brightness		valid	Brightness of backlight control
2	Contrast	W, R, G, B	valid	White-level of video signals synchronous color and each color control
		W		White-level of video signal synchronous color control
3	Color	W, R, G, B	valid	Color level of video signals synchronous color and each color control
		W		Color level of video signal synchronous color control
4	Gamma	W, R, G, B	valid	Gamma of video signals synchronous color and each color control
		W		Gamma of video signal synchronous color control
5	Auto gain control		invalid	According to the amplitude of the input signal, the gain can be automatically adjusted.
6	Position	H. Position	invalid	Horizontal position adjustment
		V. Position		Vertical position adjustment
7	Size	H. Size	invalid	Horizontal display period adjustment
8	Clock	Clock Phase	invalid	Clock phase adjustment
9	Auto adjust		invalid	Position, size and clock can be automatically adjusted.
10	OSD position		valid	OSD position adjustment The display position of OSD can be moved.
11	Language		valid	The display language of OSD can choose from English, German, French and Spanish.
12	All Reset		valid	Reset to initial value The values in No.1 to No.8, No.10 and No.11 are returned to the initial values.
13	Information		valid	Video signal information Display resolution, HS frequency and VS frequency

Note1: The memorized values are not affected even if the LCD module's power is off. But the selected value is not memorized, in case that a selected mode is changed to another one or the power is off during adjusting.

Note2: The auto adjustment value may not become an optimal value for the best picture quality by customer equipment and display screens. And the auto adjustment function does not act normally when both Sync On Green signal and separate synchronous signals are input, in those cases, adjust each function (position, size and clock) manually.

Note3: Auto adjustment function should be executed under following condition. Otherwise, the display quality after auto adjustment executing may be distorted.

- ① In R, G or B, equal to or more than 1 color must be displayed. (It should be more than half tone.)
- ② The dot in the screen 4 corner must be displayed.

Note4: A screen may be distorted only a moment when each adjustment value is changed.

Note5: As for the input signal information, when a signal except the presetting timing is input, the resolution which is different from the input signal may display.

3.11.2 Conversion tables of control functions (Contrast, Color and Gamma)

"X" is input data (0-255) , "Y" is output data (0-255).

①CONTRAST

$Y = A/128 \times X$ A: Valid range 0-255 (± 4 steps, Initial value = 128)

②COLOR

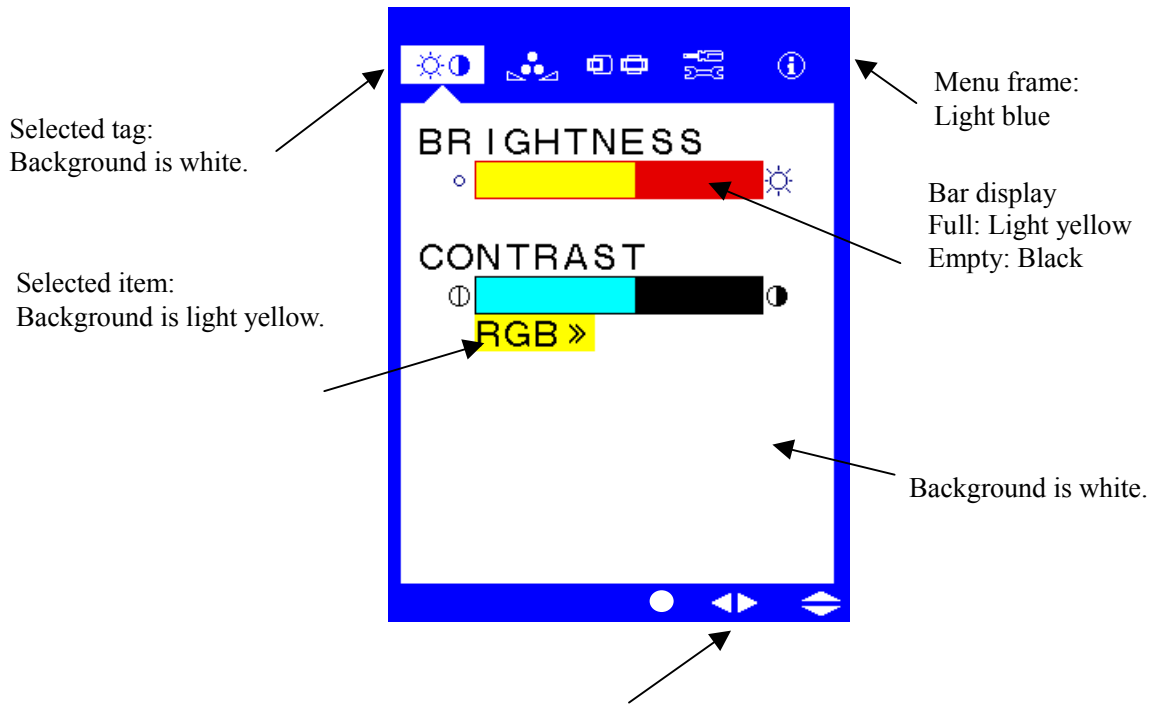
$Y = X + (A - 128)$ A: Valid range 0-255 (± 1 steps, Initial value = 128)

③GAMMA

$Y = X^A$ A: Valid range 0.6-1.4 (± 0.1 steps, Initial value = 1.0)

3.11.3 Flow chart of control functions

(1) Name and coloring in each part



Effective buttons are displayed with outline characters on the background.
 ○:SEL [S] , ◀:LEFT[←], ▶: RIGHT[→], △:UP[↑], ▽:DOWN[↓]

(2) Functions of adjustment buttons

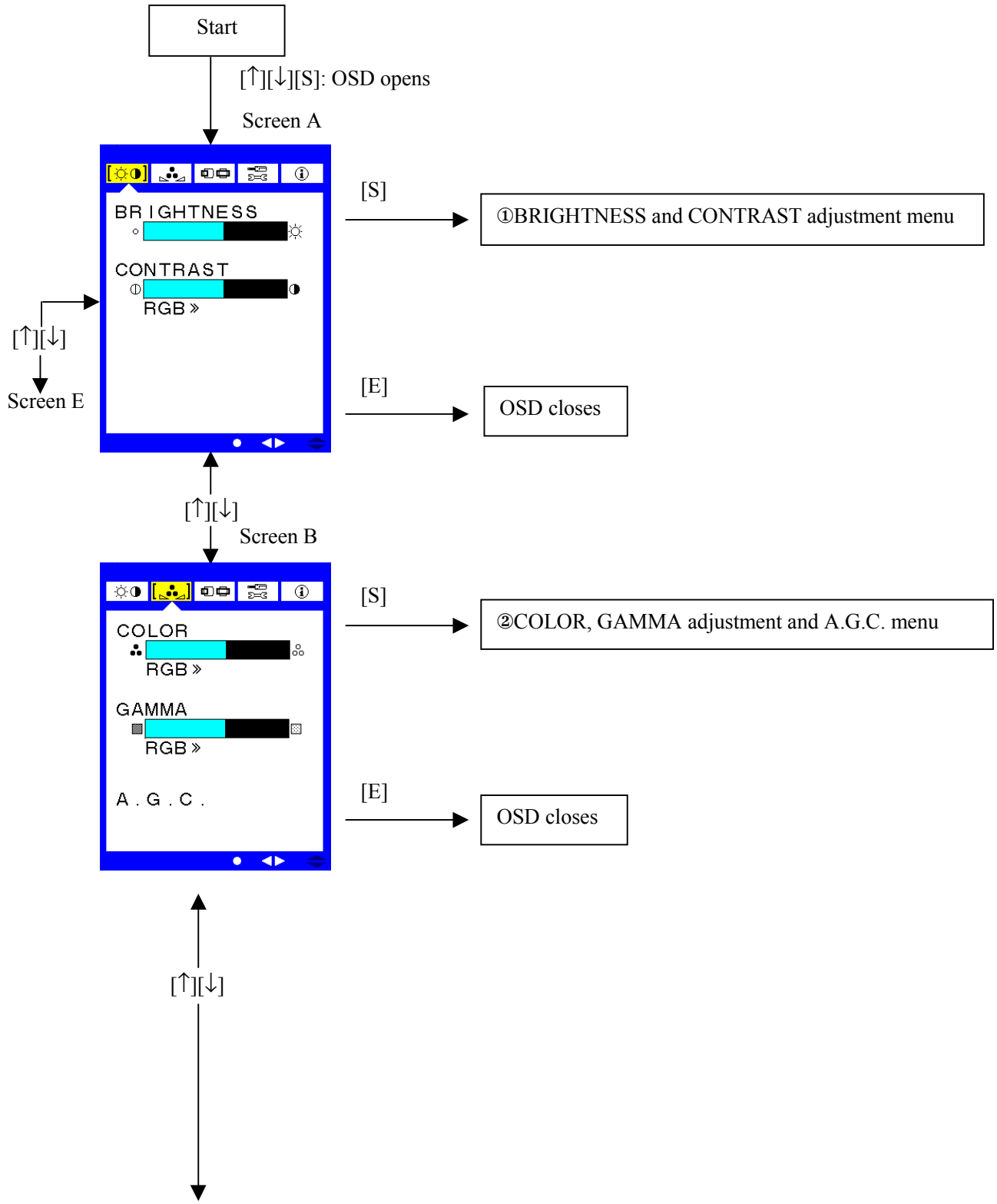
Pressing the button other than RESET and EXIT opens OSD.

- [→]: This button is used to raise the adjustment value and to select items to be set.
- [←]: This button is used to lower the adjustment value and to select items to be set.
- [↑]: This button is used to raise the adjustment value and to select items to be set.
- [↓]: This button is used to lower the adjustment value and to select items to be set.
- [S]: This button is used to execute the selected item.
- [R]: This button is used to initialize the selected item.
 (There are some non-initialized items. In this case this button is invalid.)
- [E]: This button is used to close OSD or return to upper item.

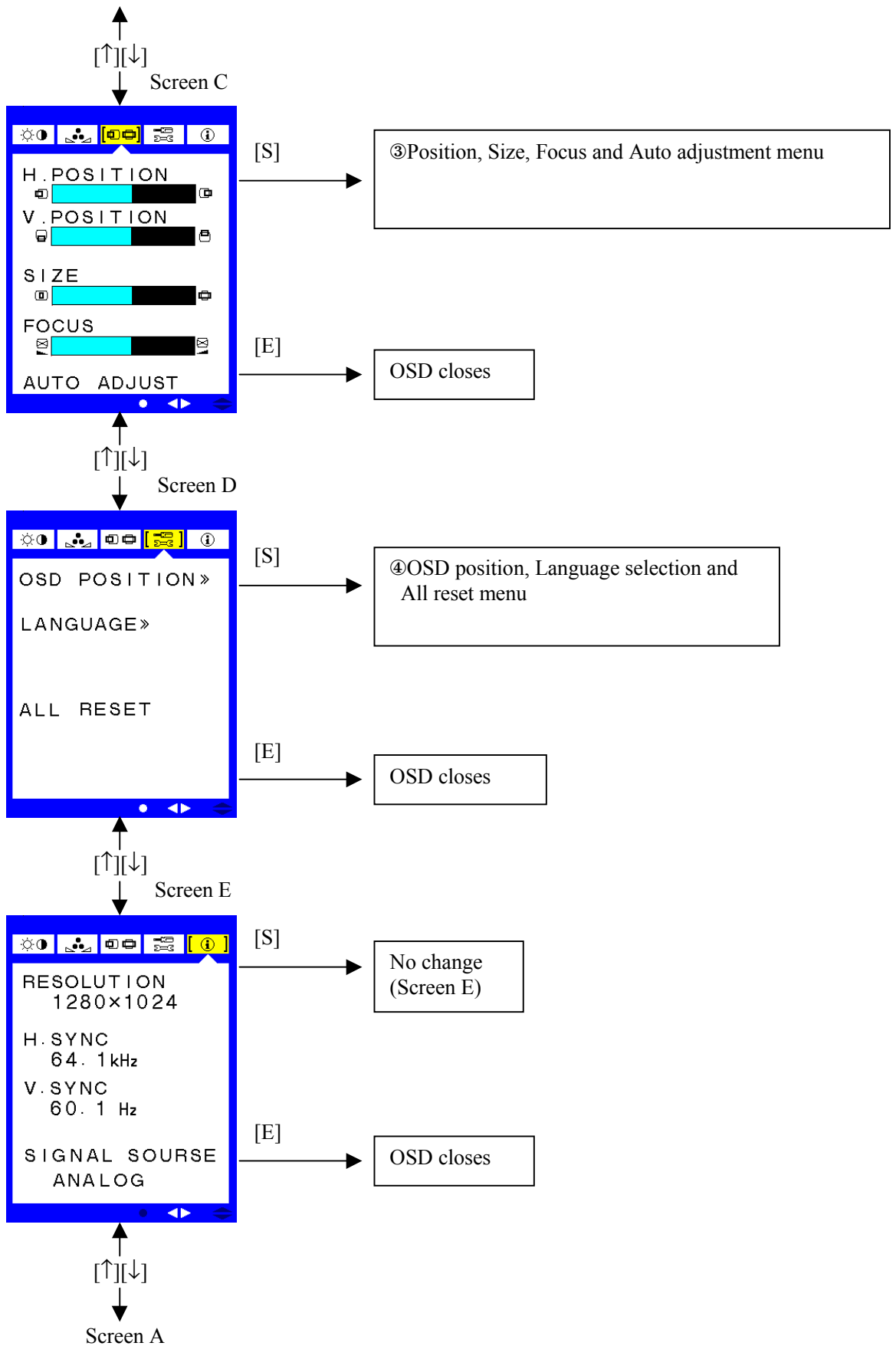
(3) Flow chart of control functions and OSD image

(3)-1 Adjustment by 4 buttons (SEL [S], UP[↑], DOWN[↓], EXIT[E])

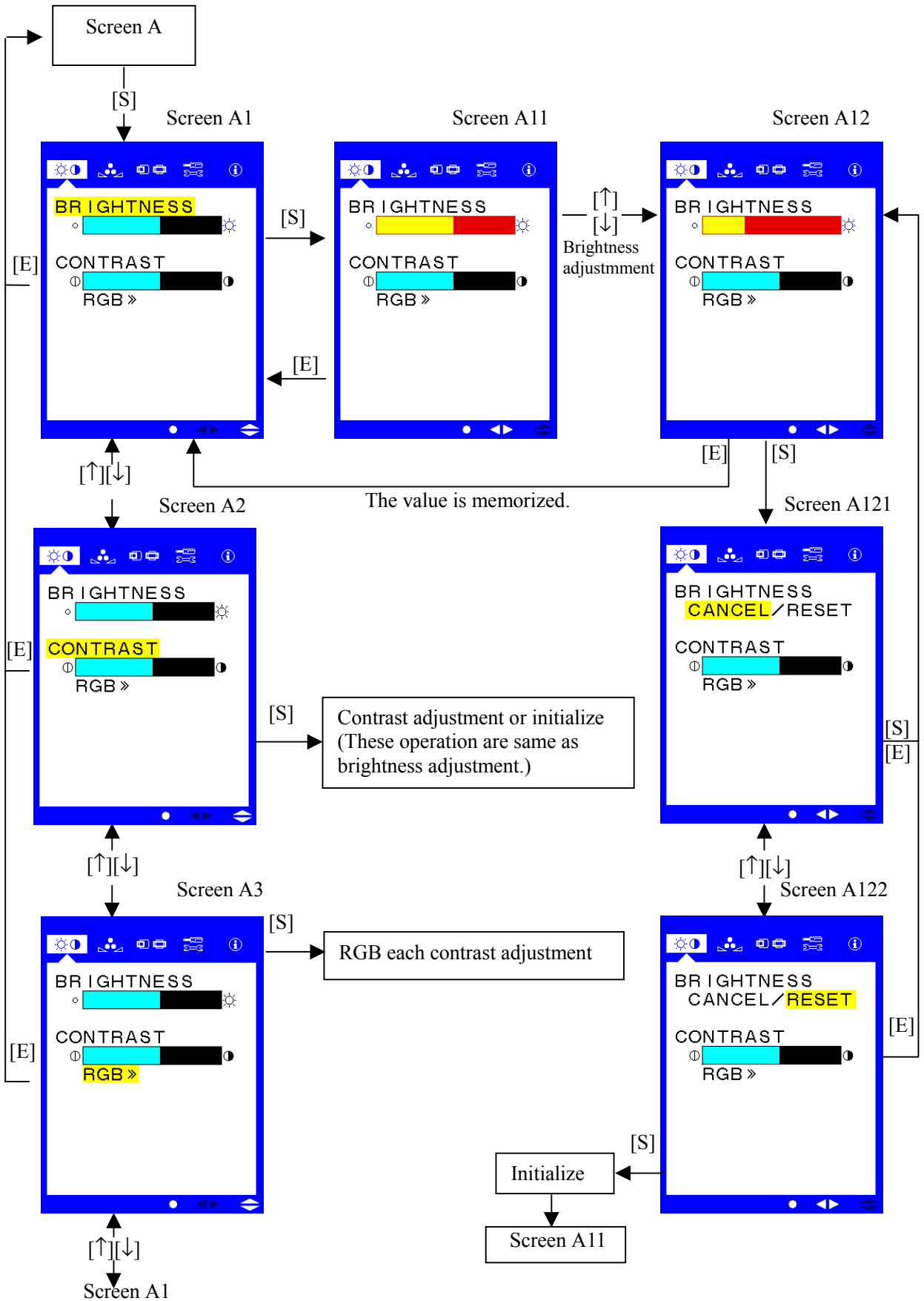
(UP and RIGHT are same functions. DOWN and LEFT are same functions.)

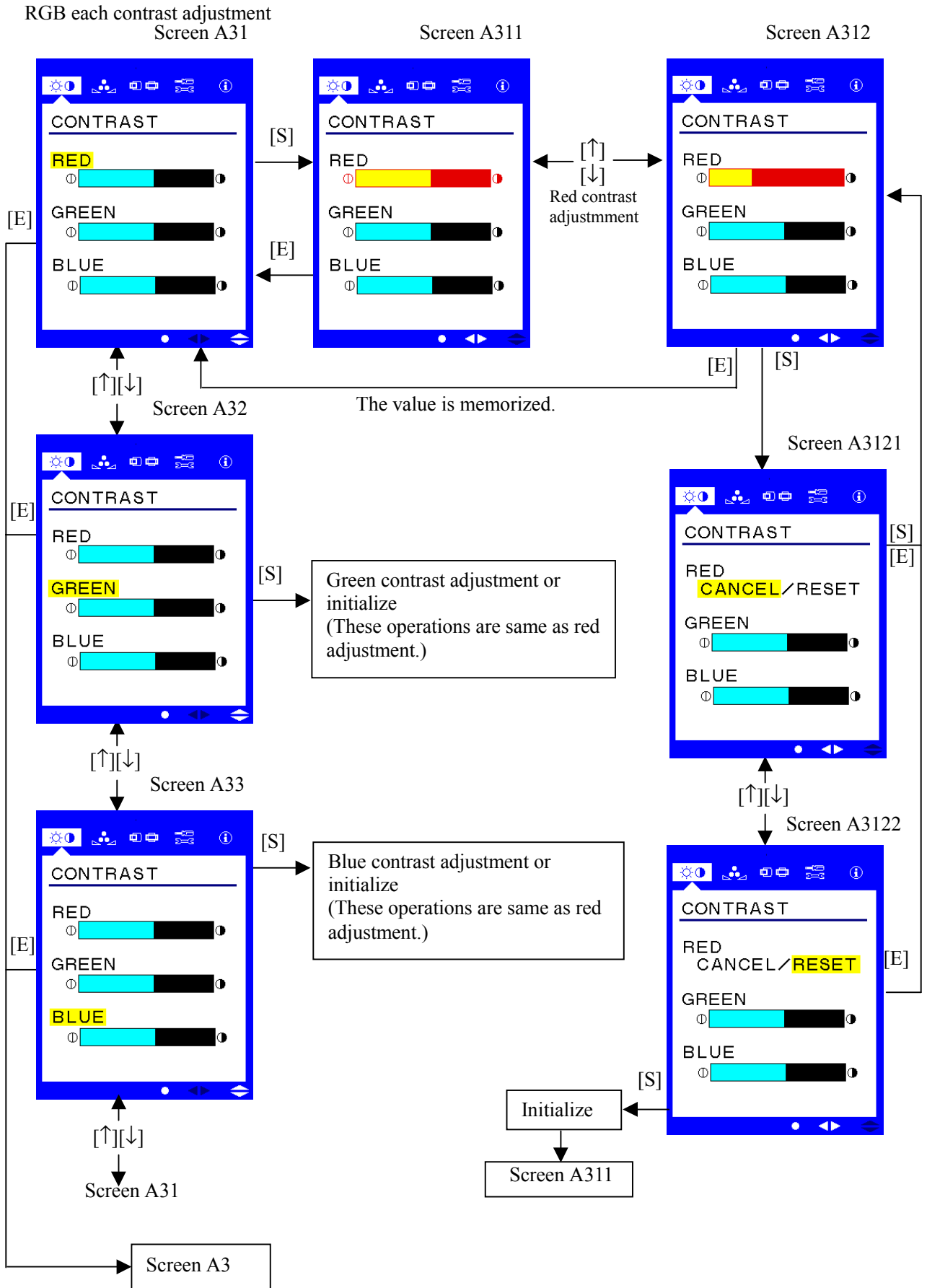


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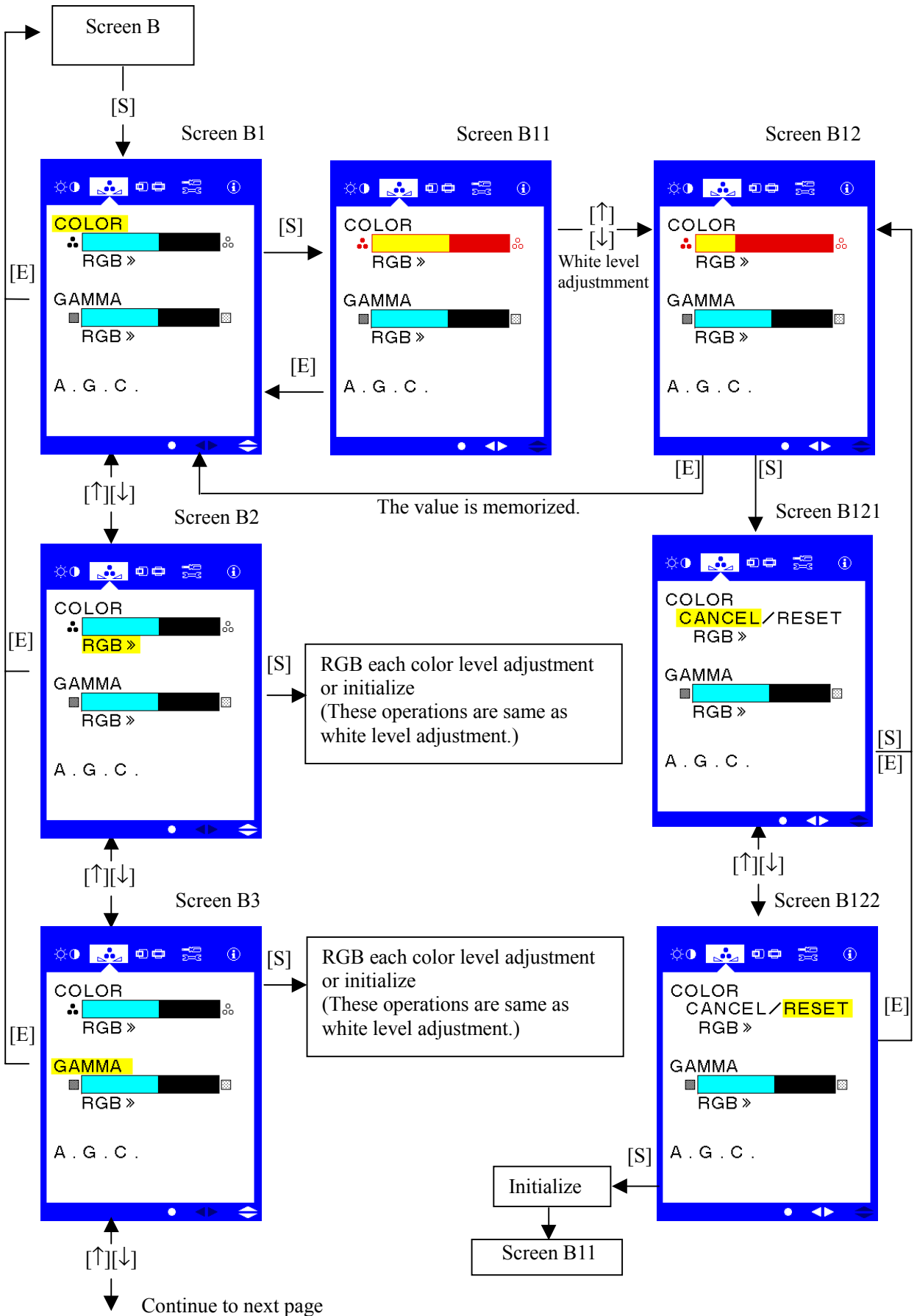


① BRIGHTNESS and CONTRAST adjustment

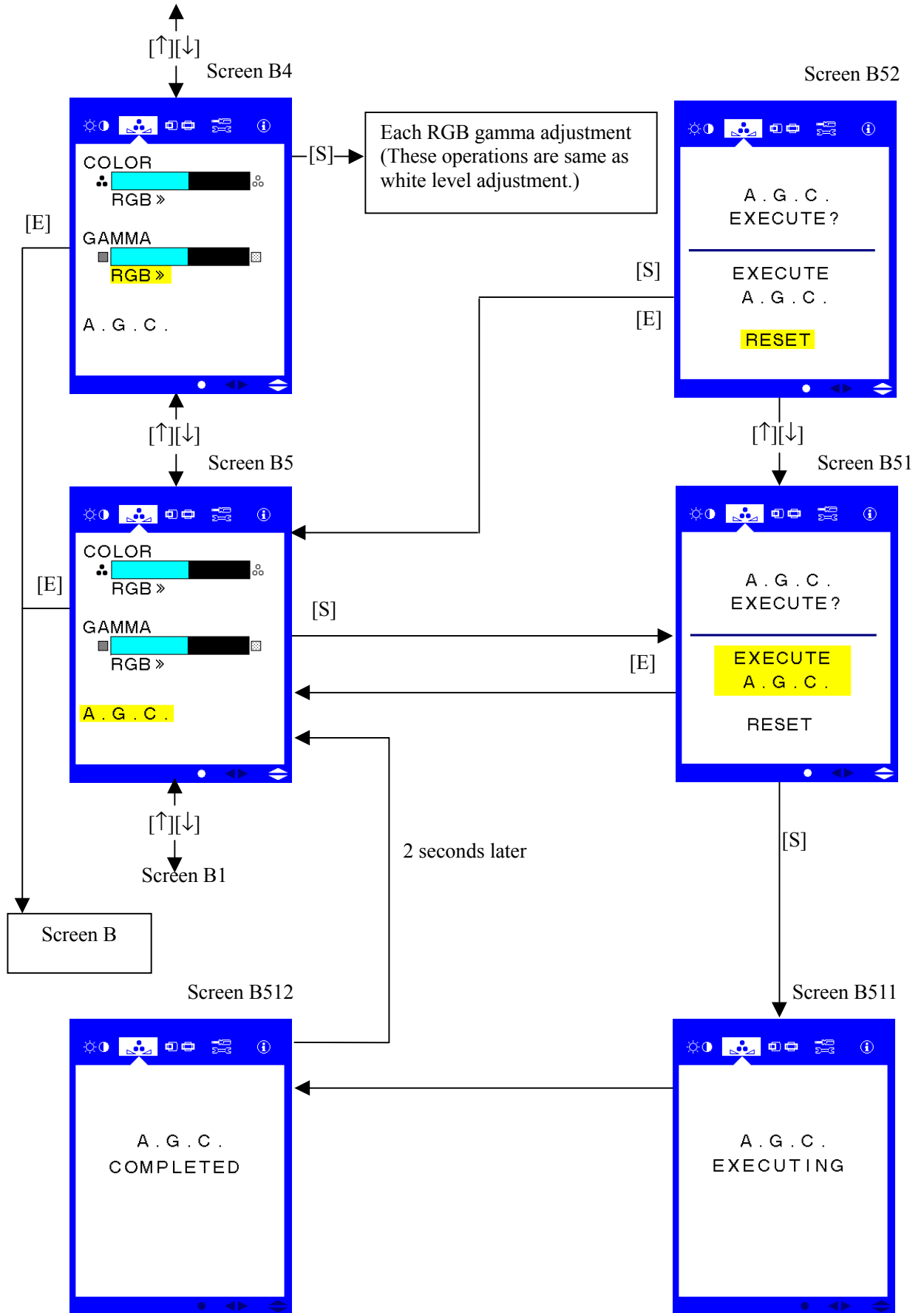




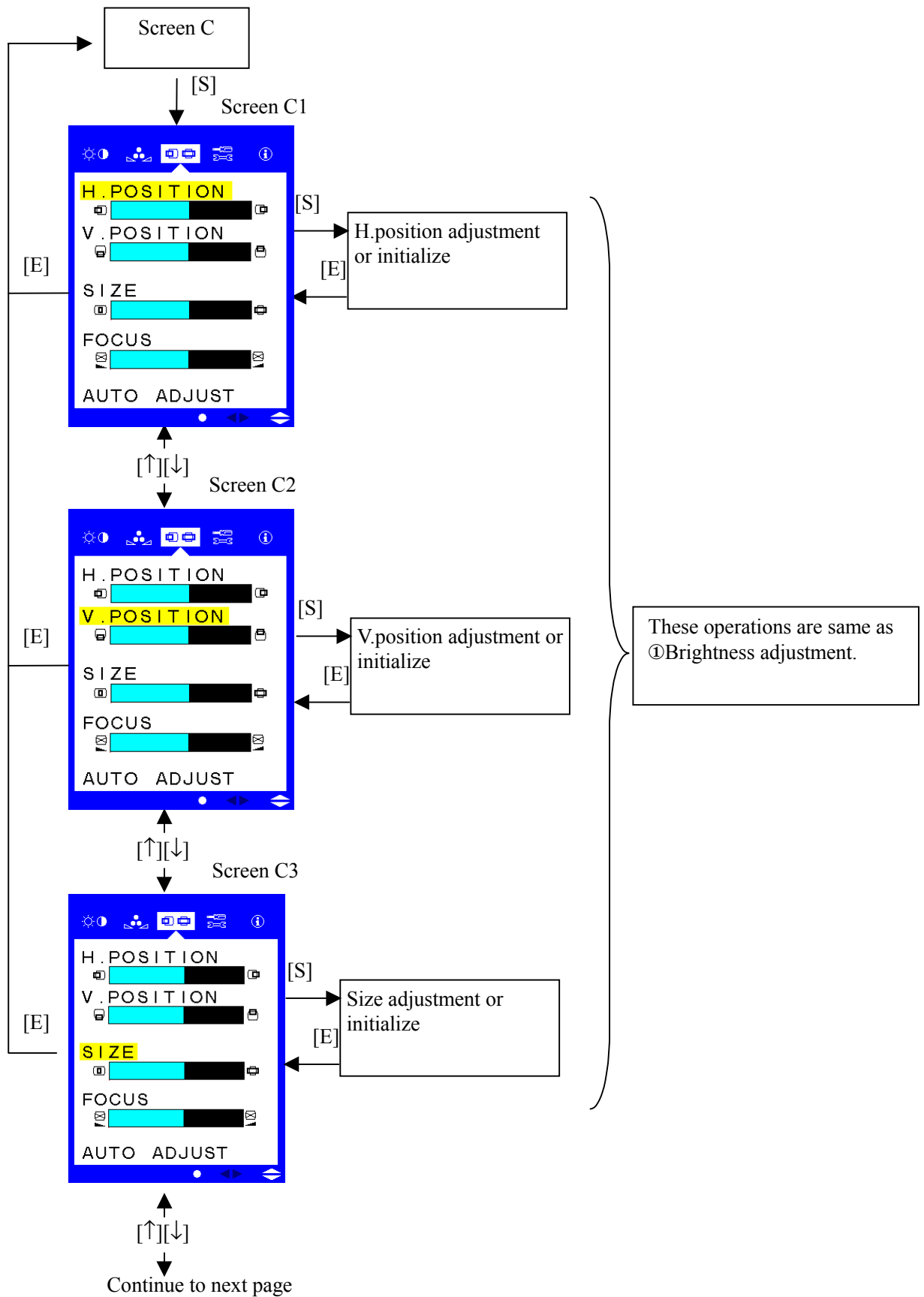
② COLOR, GAMMA adjustment and A.G.C.



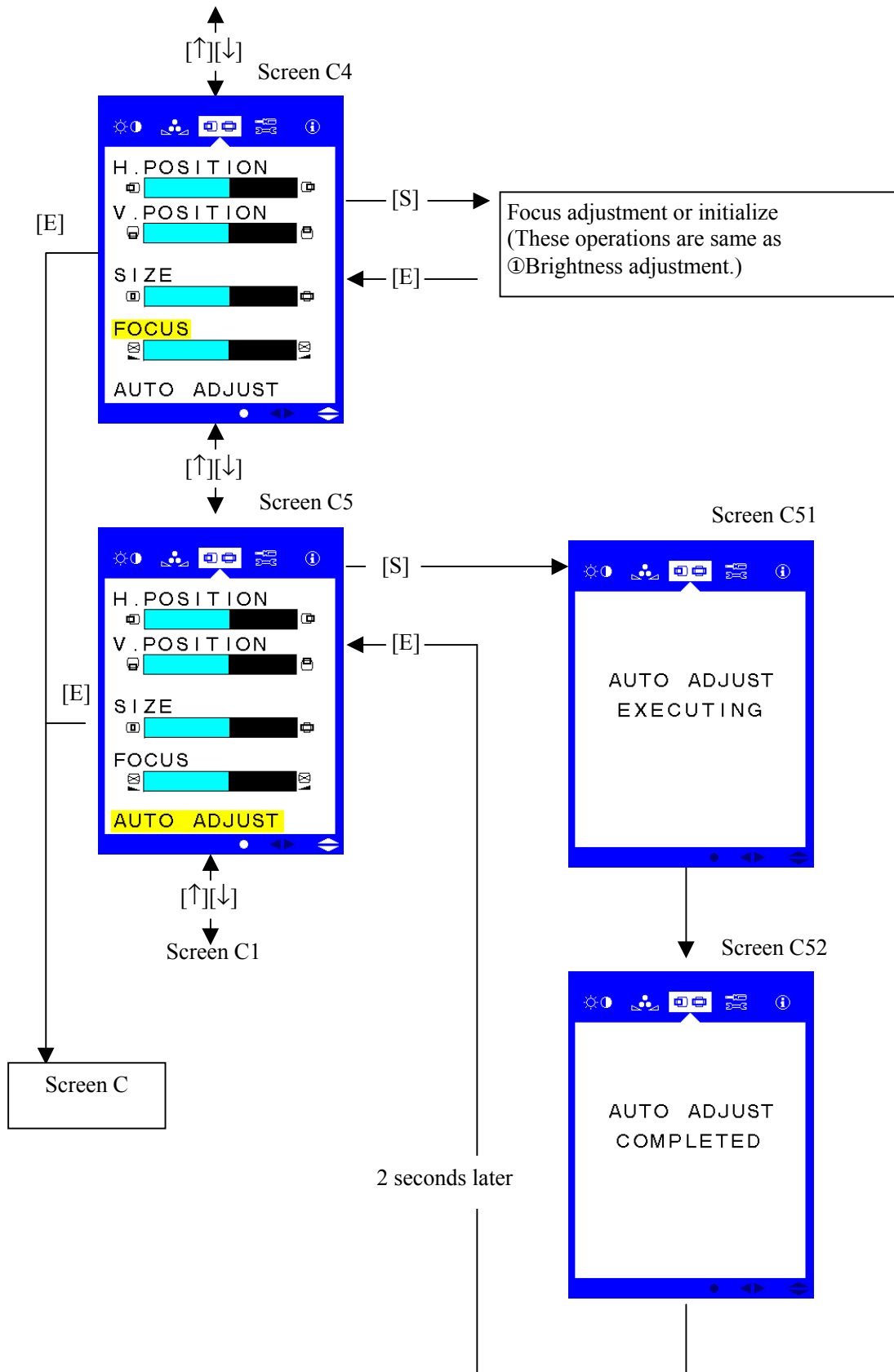
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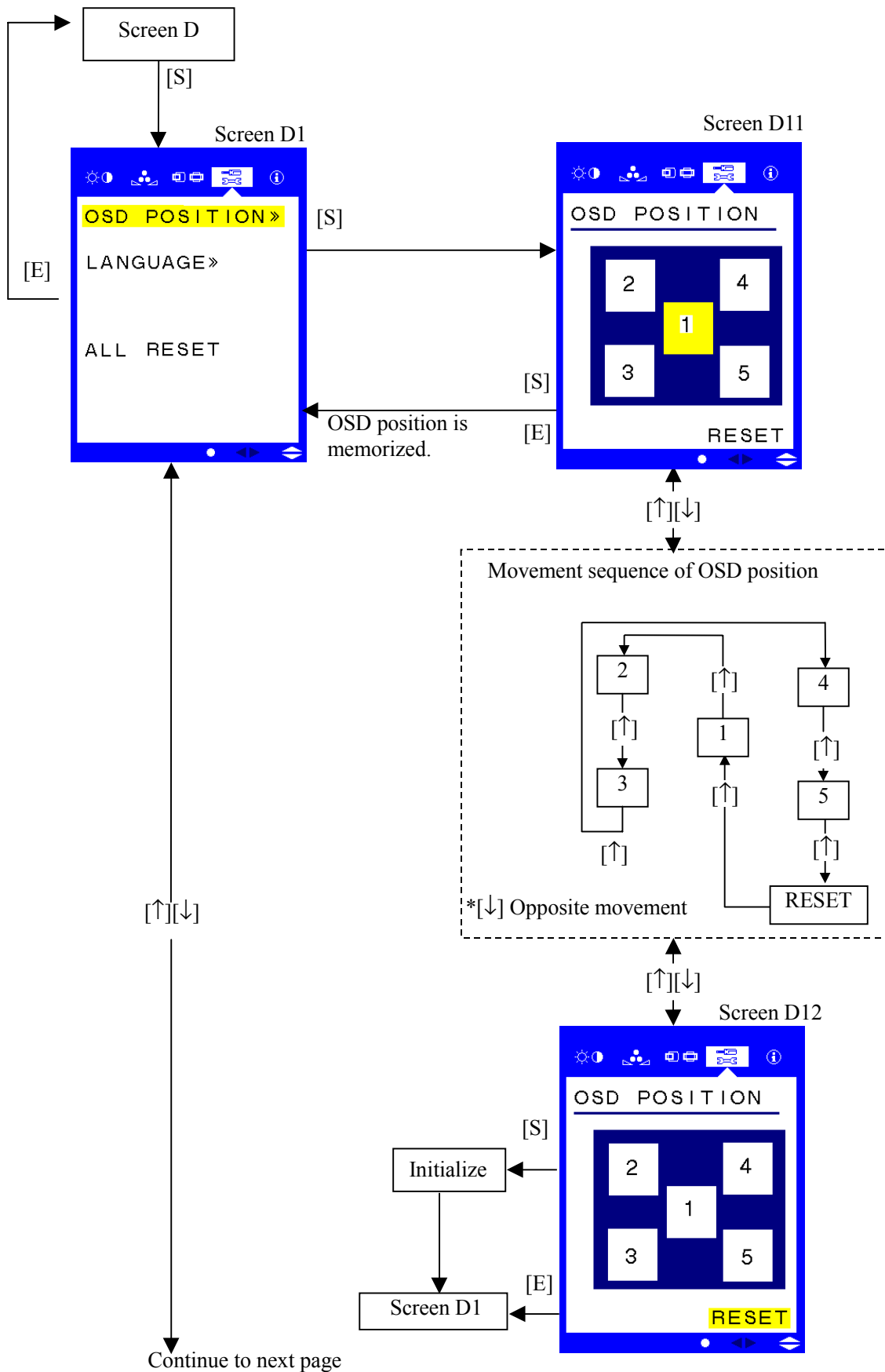
③Position, Size, Focus and Auto adjustment



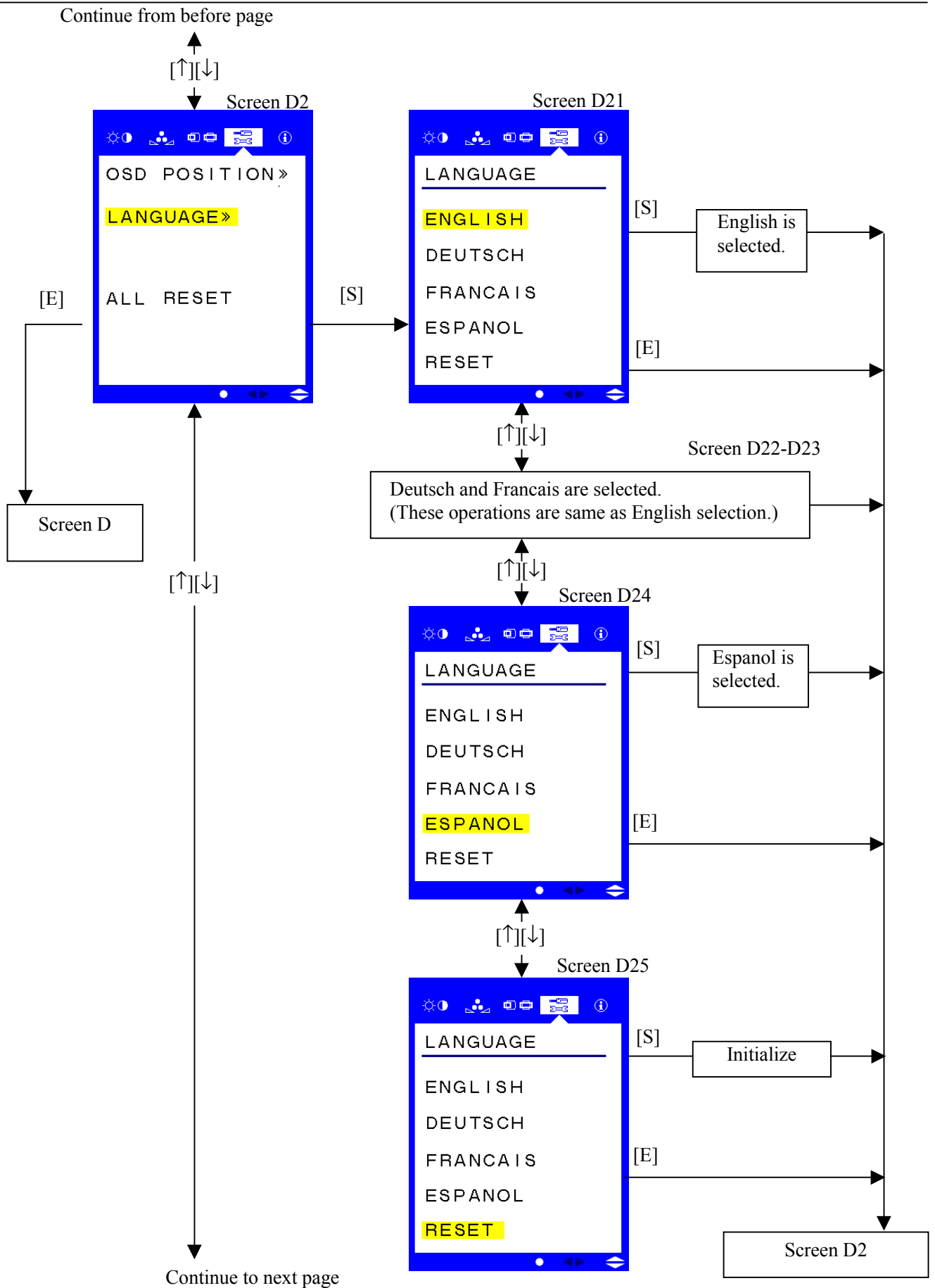
Continue from before page



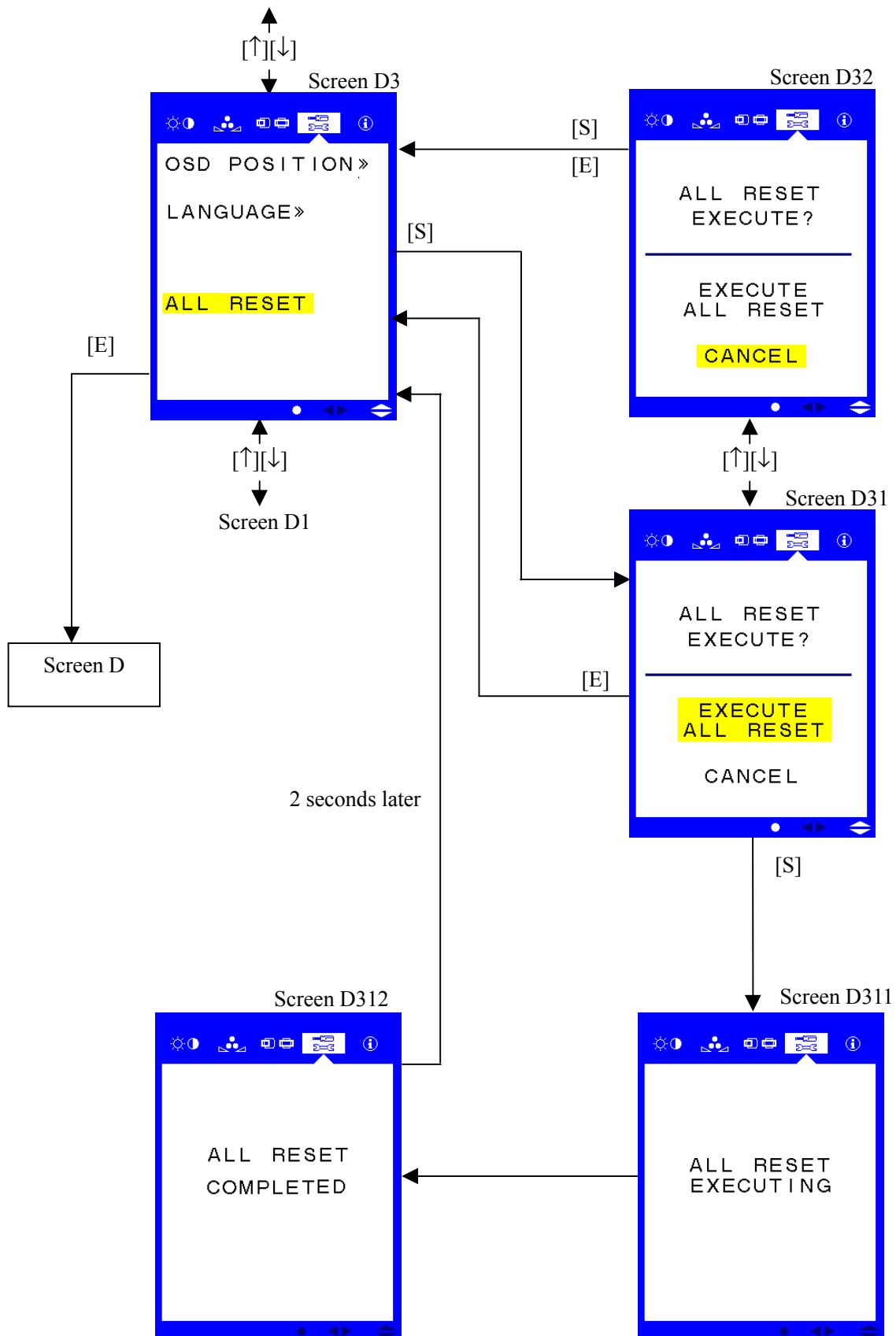
④OSD position, Language selection and All reset



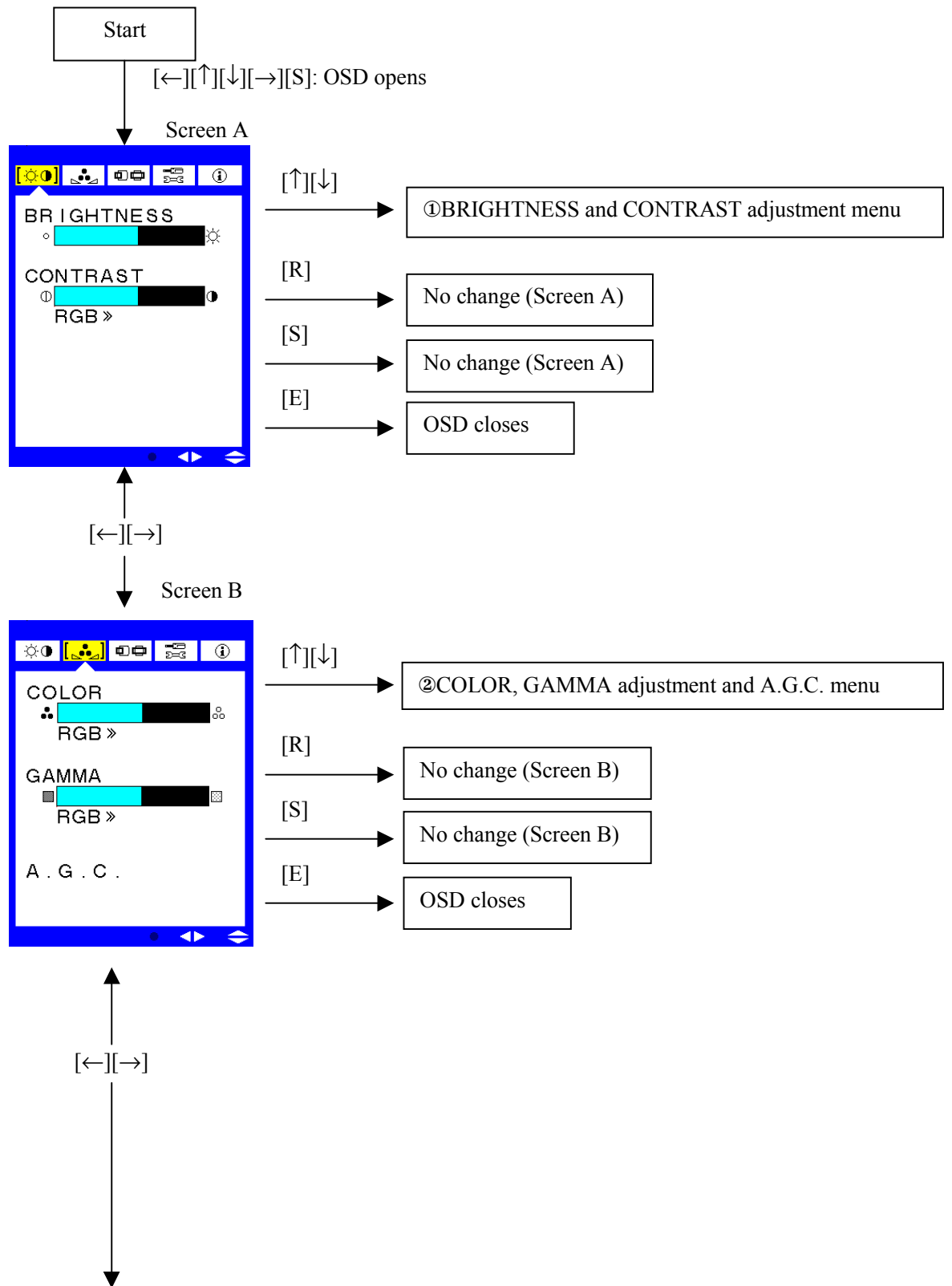
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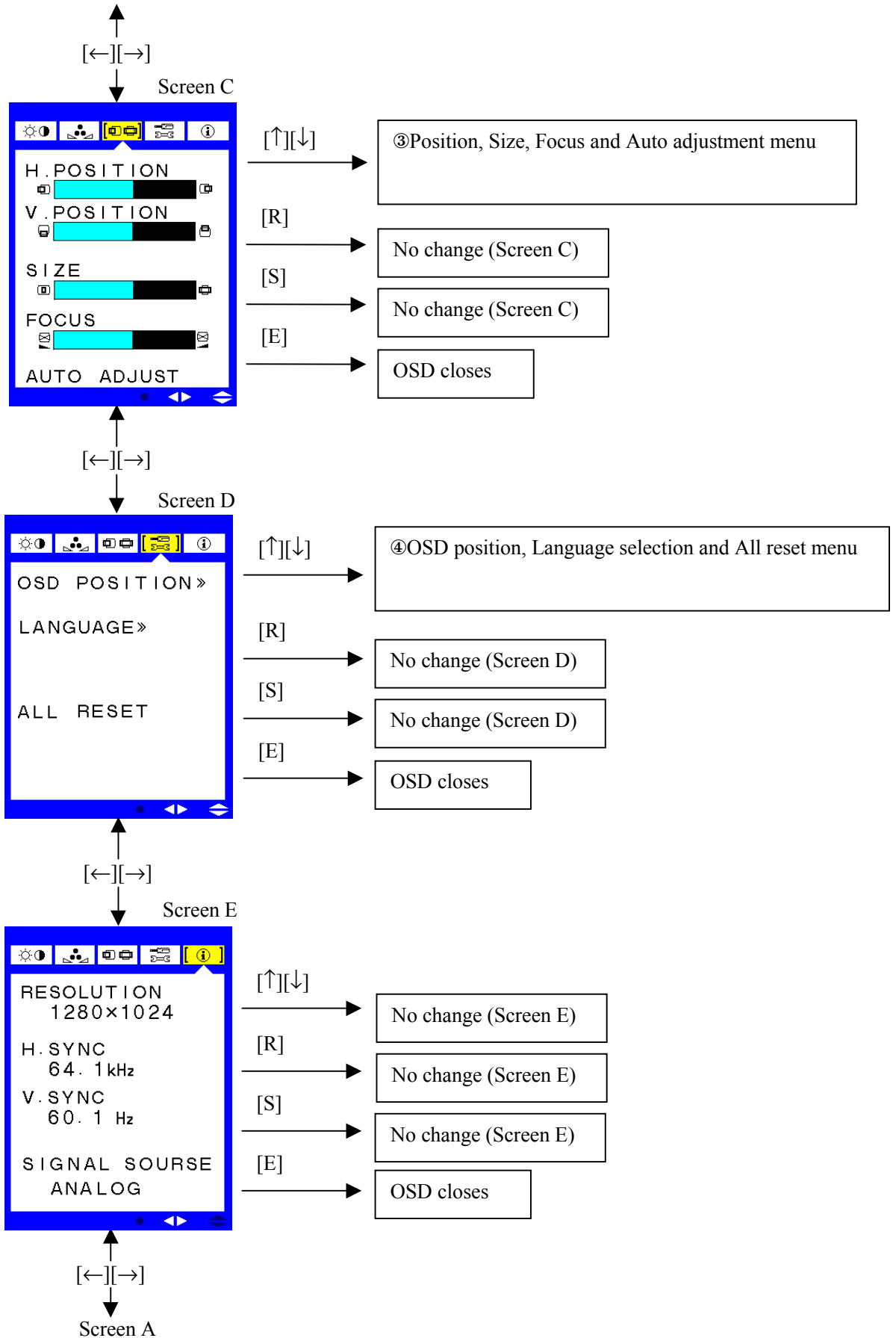


(3)-2 Adjustment by 7 buttons (SEL[S], UP[↑], DOWN[↓], LEFT[←], RIGHT[→], RESET[R], EXIT[E])

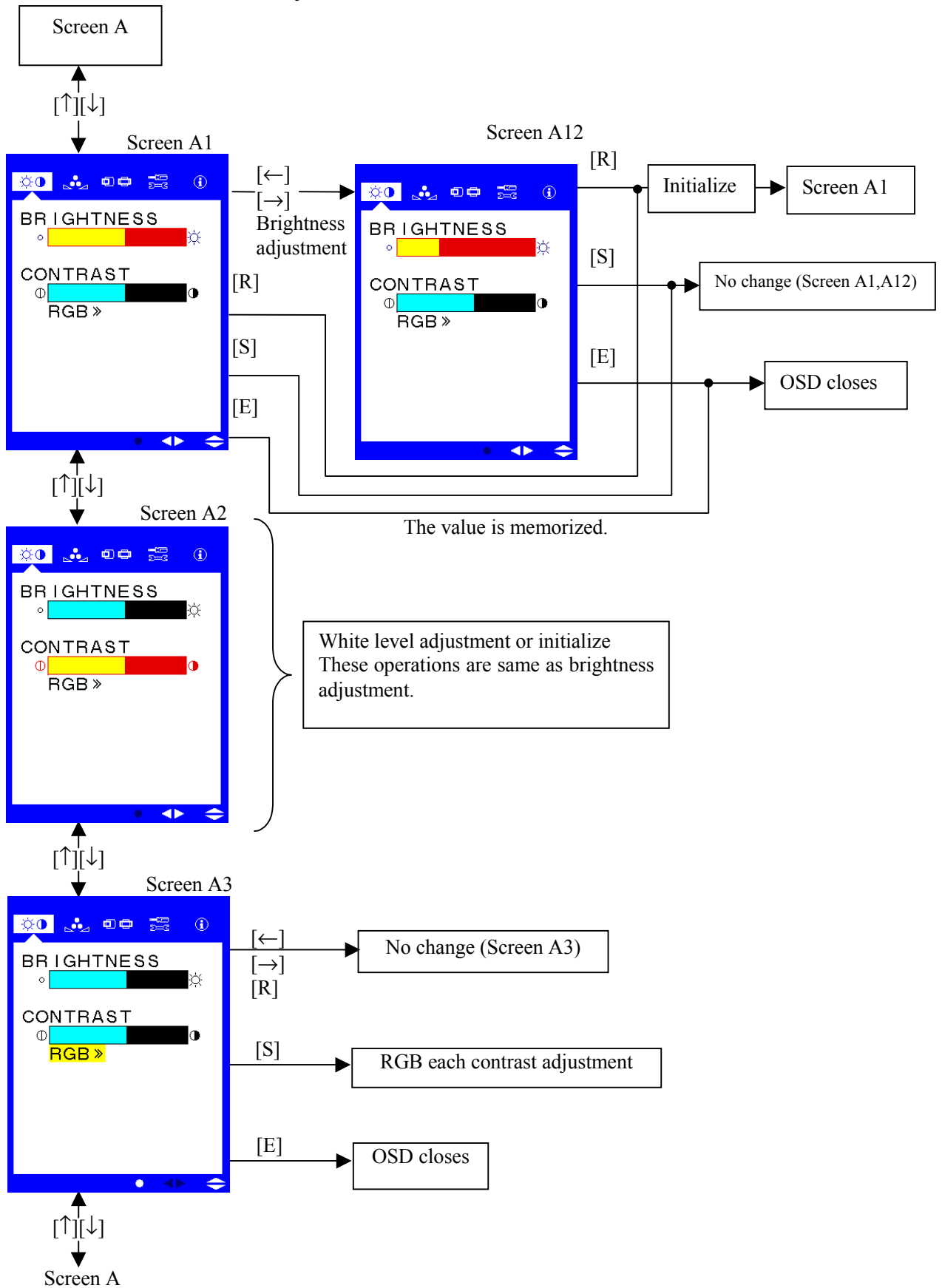


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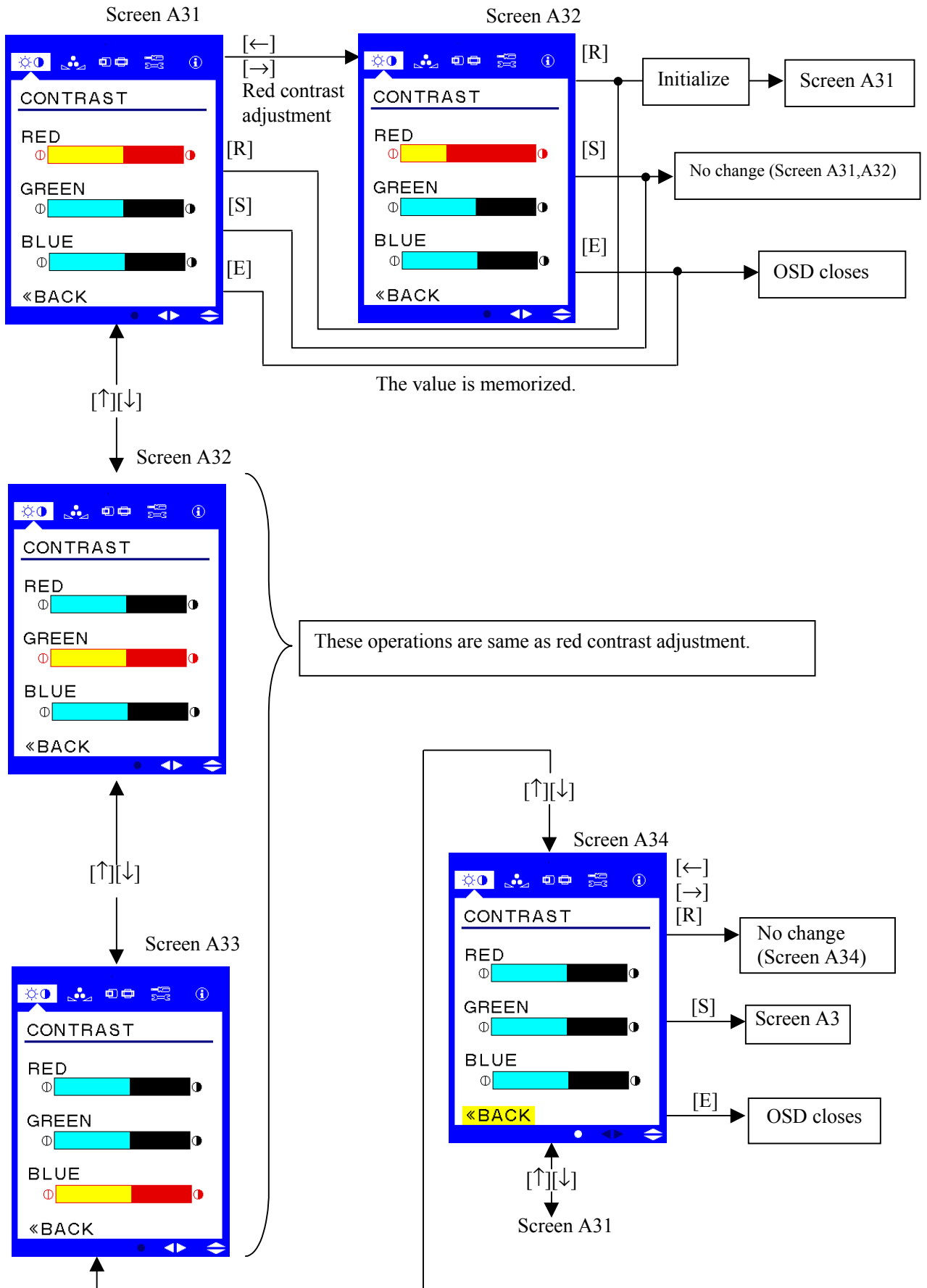
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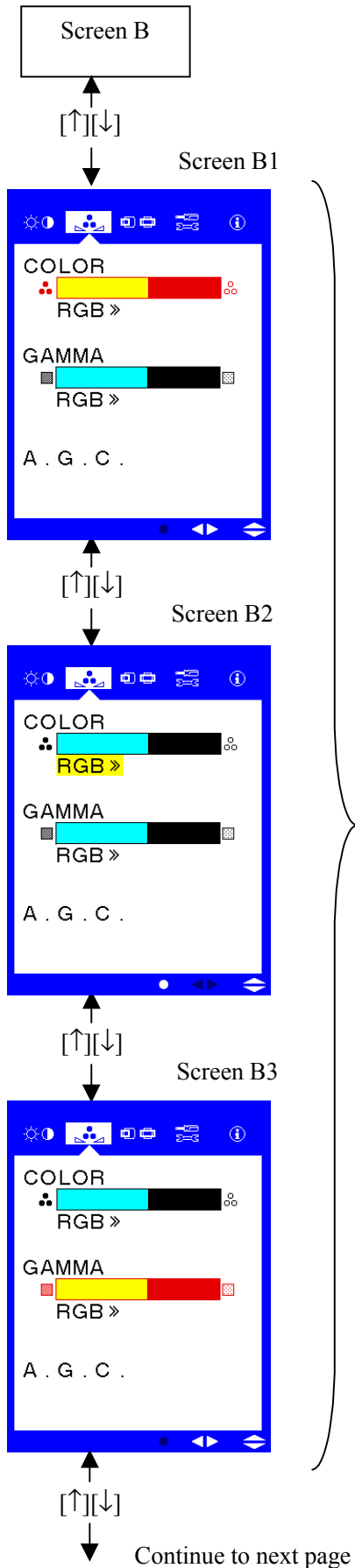
①BRIGHTNESS and CONTRAST adjustment



RGB each contrast adjustment

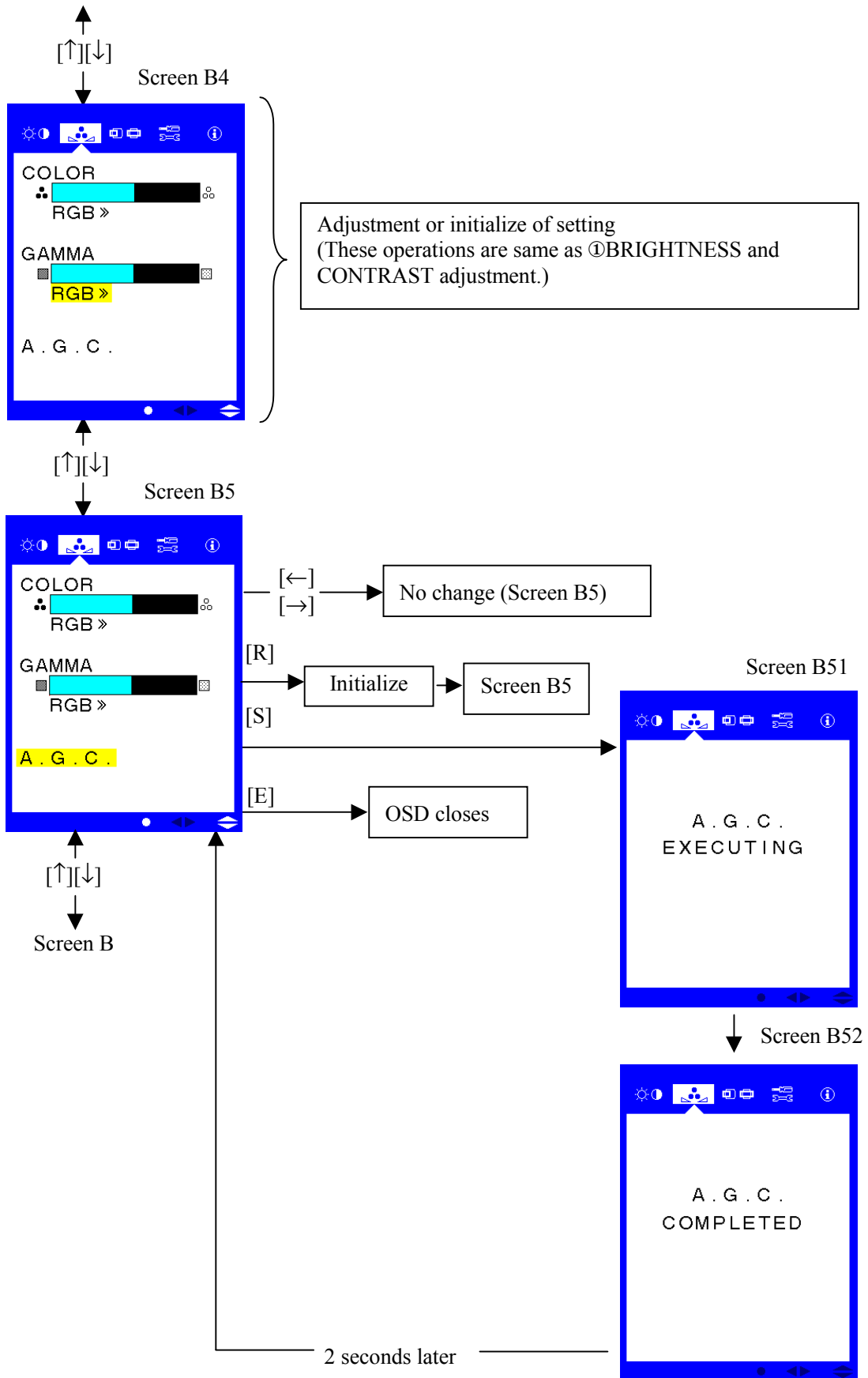


②COLOR, GAMMA adjustment and A.G.C.

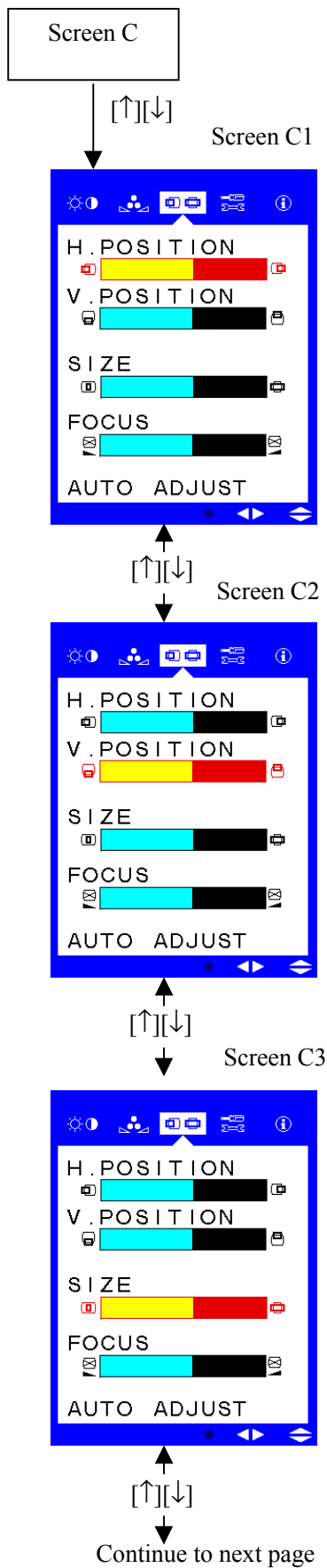


Adjustment or initialize of setting
(These operations are same as ①BRIGHTNESS and
CONTRAST adjustment.)

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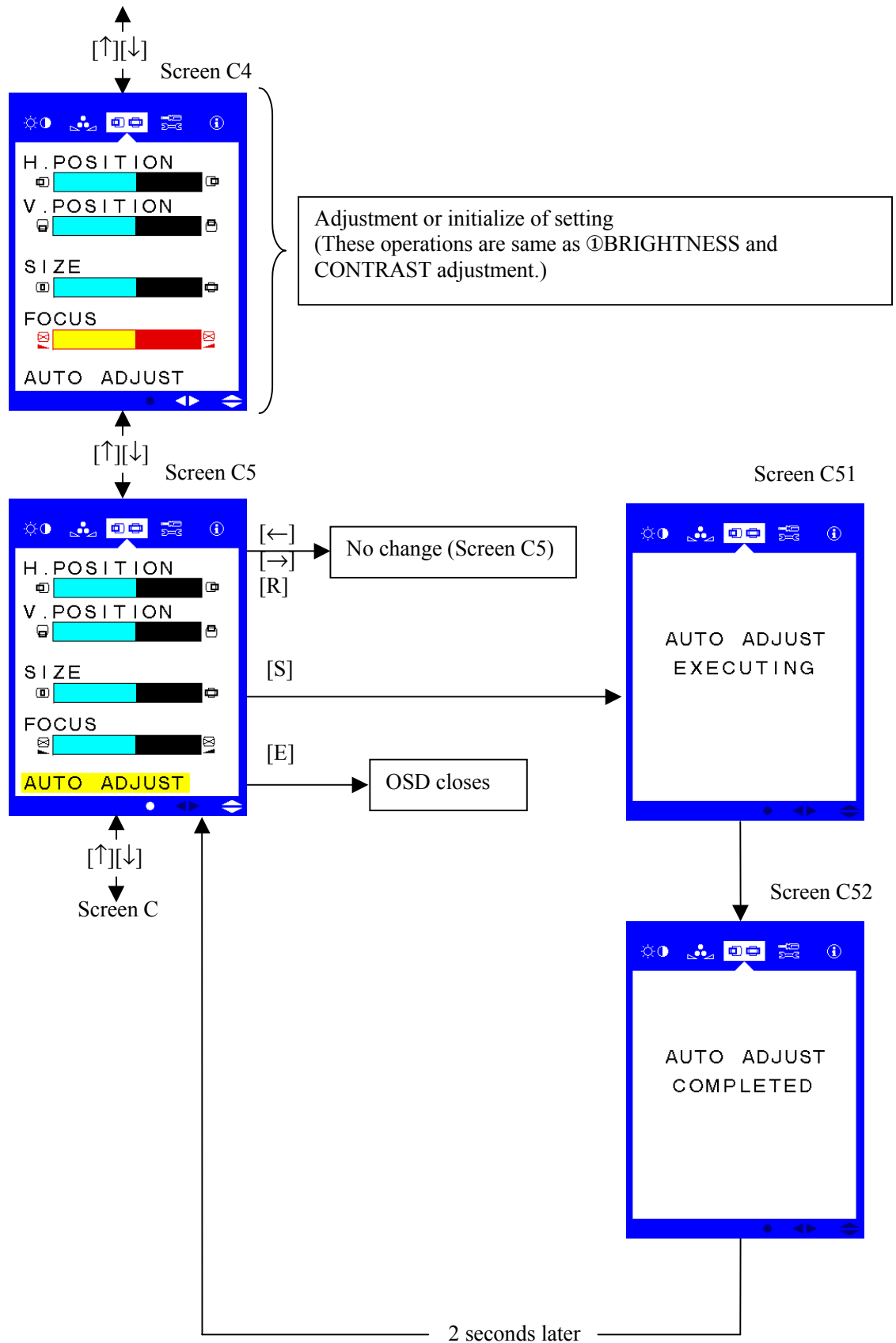


③Position, Size, Focus and Auto adjustment

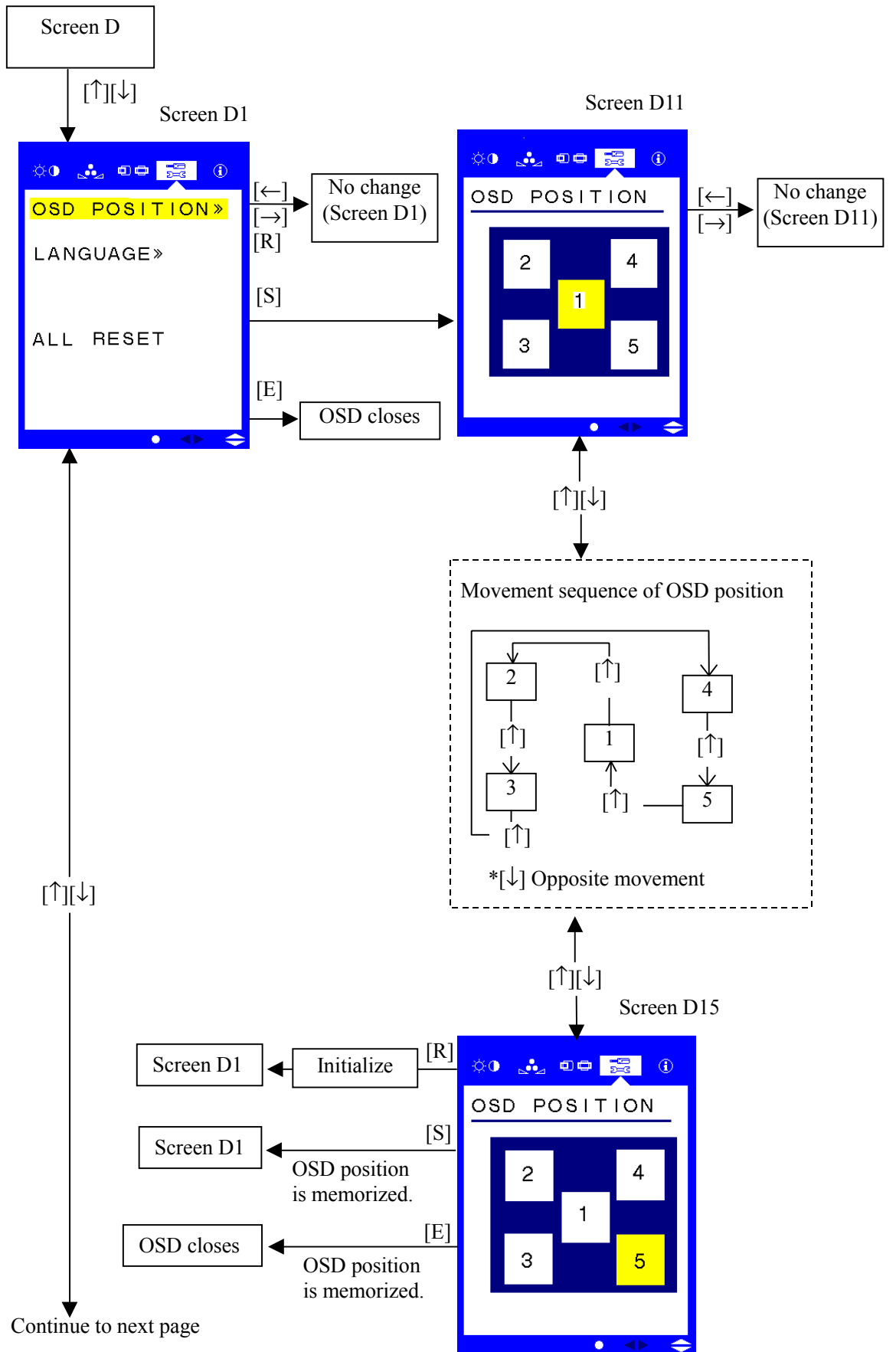


Adjustment or initialize of setting
 (These operations are same as ①BRIGHTNESS and
 CONTRAST adjustment.)

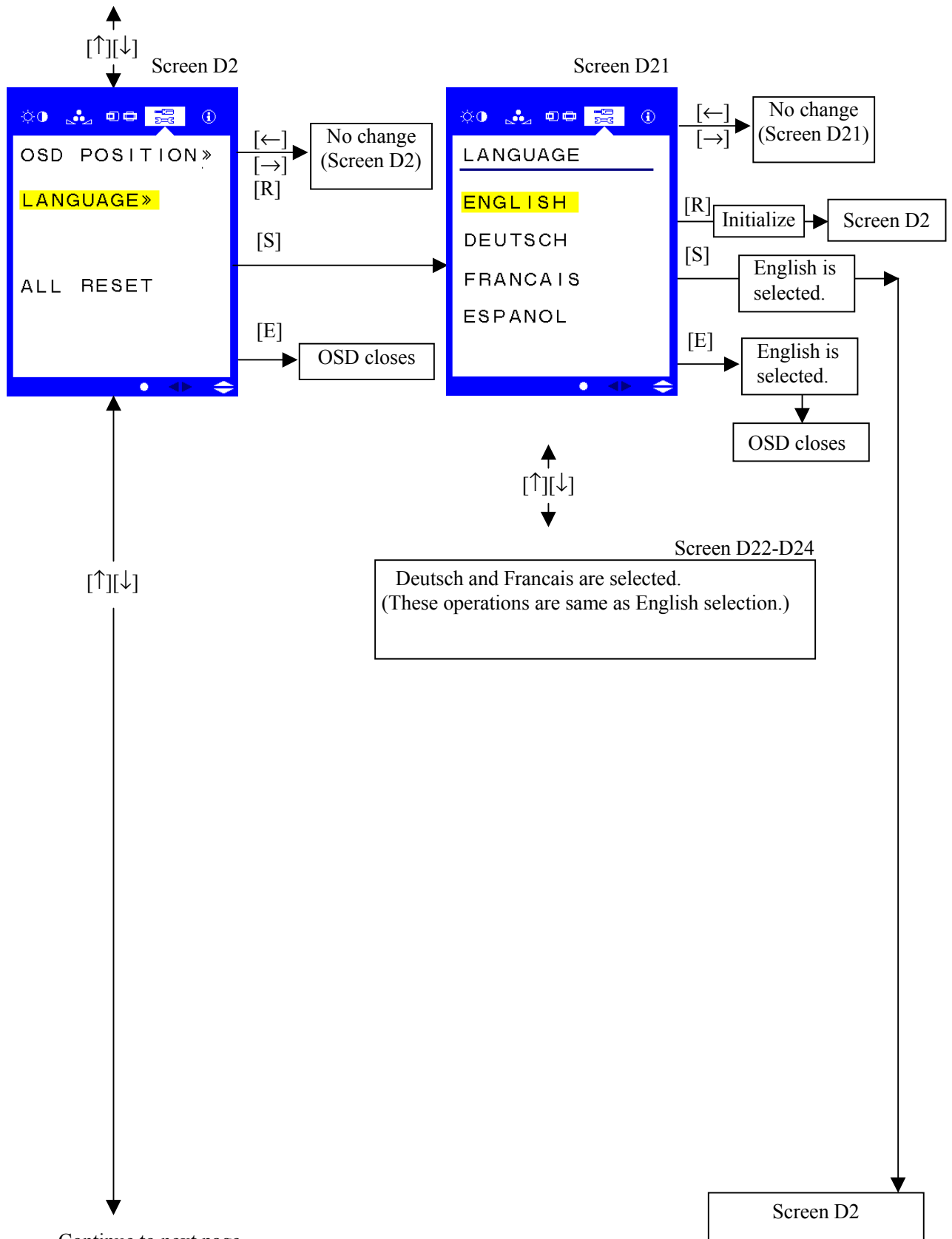
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④OSD position, Language selection and All reset menu

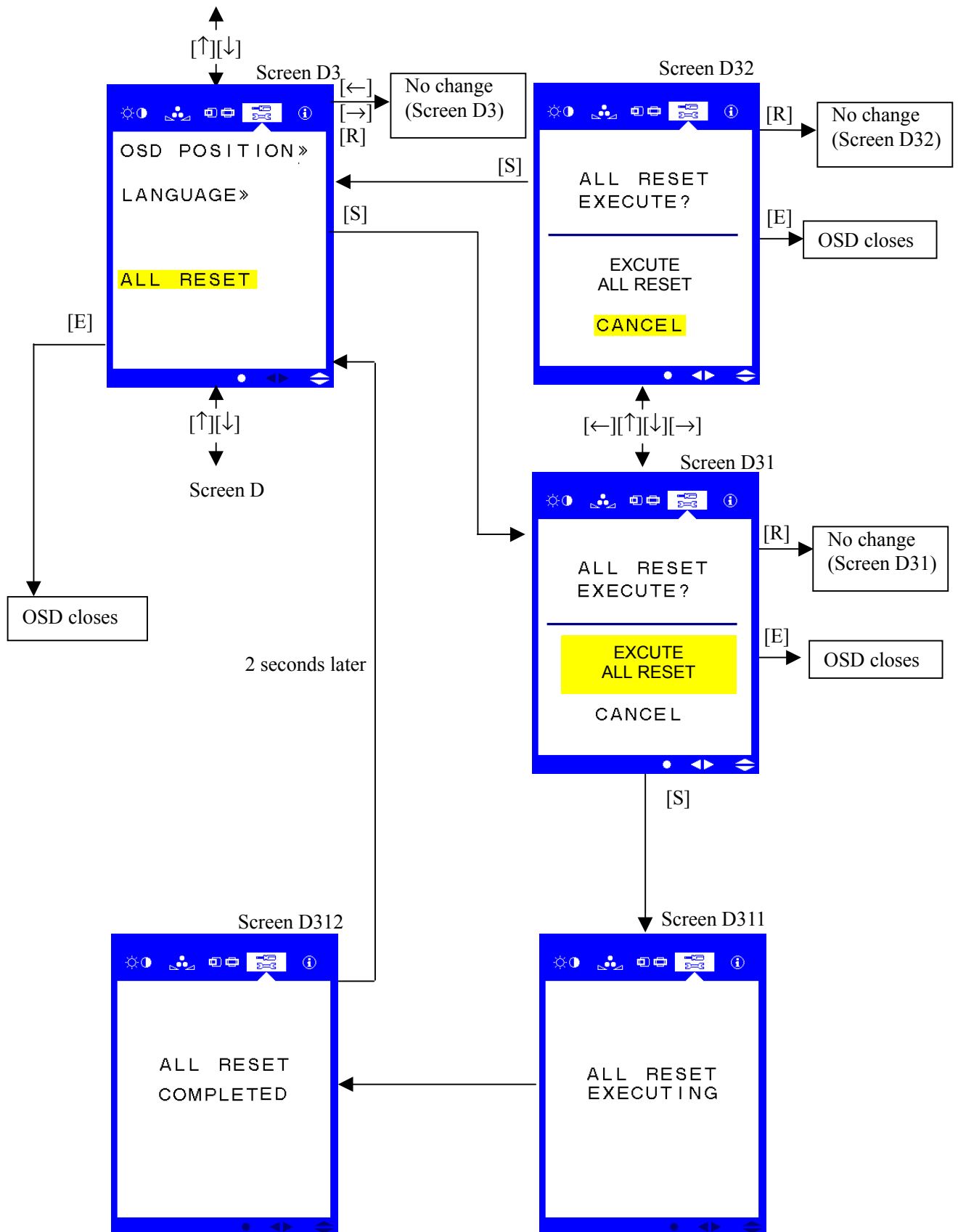


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- Note1: The value of the selected signals by LEFT, RIGHT, UP and DOWN button is continuously incremented if the input signal is held more than approx. one second. If it's less than one second, the value is incremented by one.
- Note2: RESET signal initializes the selected value. All reset function initializes all the values adjusted already.
- Note3: In case that there is no input for more than ten seconds, OSD is automatically closed.
- Note4: White contrast is synchronous red contrast, green contrast and blue contrast.
- Note5: White color level is synchronous red color level, green color level and blue color level.

(4) INITIAL VALUE CHANGE FUNCTIONS

This module changes initial value, OSD items, and so on in customers.
 The changed initial value becomes initial value in each preset timing, and is applicable when it is reset (including All Reset).

- How to transpose to initial value change mode.
 Connect UP to GND while SEL is connected to GND when OSD function is "information".
- Operation
 SEL, UP, DOWN and EXIT
- How to return to normal mode
 Connect EXIT to GND or turn off "Power" when OSD closes.

Item	Function
1.ADC CALIB	①AUTO GAIN According to the amplitude of the input signal, the gain can be automatically adjusted. (at analog signal input : valid, at digital signal input: invalid) ②AUTO GAIN RESET The values in ① are returned to the statuses when shipping from the factory.
2.BRIGHTNESS	The maximum value of brightness can change. Initial value: 100
3.COLOR	The initial value of white color level and RGB each color level can change. Initial value: 128
4.CONTRAST	The initial value of white contrast and RGB each contrast can change. Initial value: 128
5.LCD DATA	①MODE Preset timing No. is displayed. But it isn't identical with the number of the table of 3.7 PRESET TIMINGS. (There is no adjustment function.)
	②H.POSITION The initial value of the left/right position of the display position can change.
	③V.POSITION The initial value of the up/down position of the display position can change.
	④SIZE The initial value of the double value can change.

Item	Function
5.LCD Data	⑤FOCUS The value of the CLK delay can be changed.
	⑥AUTO ADJUST The values in ②-⑤ items are automatically adjusted, and the adjusted value is memorised as initial value of ②-⑤. There are no initial value.
	⑦LCD RESET The values in ②-⑤ are returned to the statuses when shipped from the factory.
6.GAMMA	The initial value of gamma can be changed. (RGB each color) Initial value: 4
7.SEL DATA	①SRC SEL Analog signal input and digital signal input can selecte. ADS: Corresponding to analog and digital signal input Input signals automatically recognized function: Valid AD: Corresponding to analog and digital signal input Input signals automatically recognized function: Invalid ANA: Corresponding to analog signal input only DIG: Corresponding to digital signal input only Initial value: ADS
	②LNG SEL The initial value of language can change. ENG: English GMN: Deutsch FRN: Francais SPA: Espanol Initial value: ENG
	③EXP SEL Display interpolation function at expansion mode EXP SEL=1:These is no display interpolation function. EXP SEL=2: There is display interpolation function. Initial value: 2
8.OSD POSITION	The initial value of the OSD position can change. C:Center, UL:Upper left, UR:Upper right, DL:Down left, DR:Down right Initial value: C
9.INFORMATION	Input signal information is displayed. (There is no adjustment function.)

Item	Function
10.USED TIME	Used time in the normal and power save statuses are displayed. Used time is recorded every five minutes. But it is not recorded when the LCD module's power is off within five minutes.
11.FULL RESET	All values are returned to the statuses when shipping from the factory. It takes about five seconds.

Note1: Selected adjustment items are displayed with OSD.

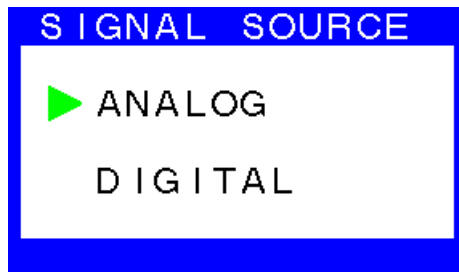
Note2: The values of 5.LCD Data ② to ⑤ are memorized in every preset timing.

Note3: Adjustment values except 5.⑥AUTO ADJUST is memorised at the moment when it is returned in the extreme upper menu. But it is not memorized when the LCD module's power is off during adjusting.

Adjustment values by AUTO ADJUST are memorized after finishing AUTO ADJUST.

(5) INFORMATION DISPLAY BY OSD

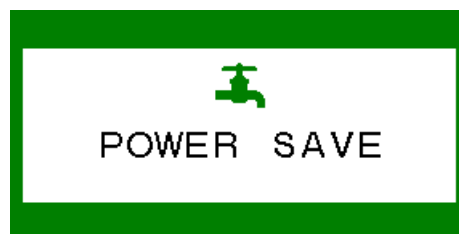
- ① Input signal changeover: Every time ADTSEL is “Low”, corresponding to an analog input or a digital input are changed.



- ② NO SIGNAL: "NO SIGNAL" is displayed for four seconds when signals are no input.



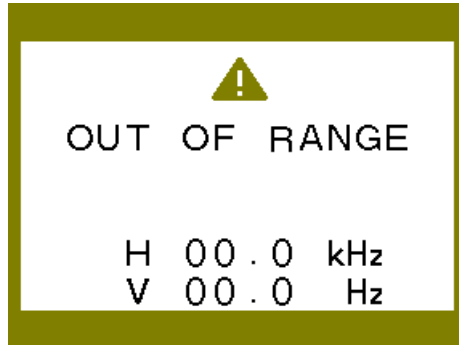
- ③ POWER SAVE: Frequency of horizontal and vertical synchronous signals are displayed for four seconds at the time of the Power Saving mode switchover.



*It is displayed when horizontal synchronous signal frequency (Hf) and vertical synchronous signal frequency (Vf) are the following statuses.

- ①: $Hf < 10 \text{ kHz}$
- ②: $Vf < 40 \text{ Hz}$
- ③: In case that the statuses are ① and ②.

- ④ OUT OF RANGE: Each frequency is displayed for four seconds when the horizontal and vertical synchronous signals of outside of the corresponding frequency range are inputted.



*It is displayed when horizontal synchronous signal frequency (Hf) and vertical synchronous signal frequency (Vf) are the following statuses.

- ①: $10\text{kHz} \leq Hf \leq 24\text{kHz}$ or $90\text{kHz} \leq Hf$
- ②: $40\text{Hz} \leq Vf < 50\text{Hz}$ or $200\text{kHz} \leq Vf$
- ③: In case that the statuses are ① and ②.

It is not displayed when either Hf or Vf is power saving mode.

Depending on input signal timings, the screen is distorted and may not display OSD.

- ⑤ KEY DISABLE: It is displayed for four seconds that the adjustment button is disabled status.



3.12 OPTICS

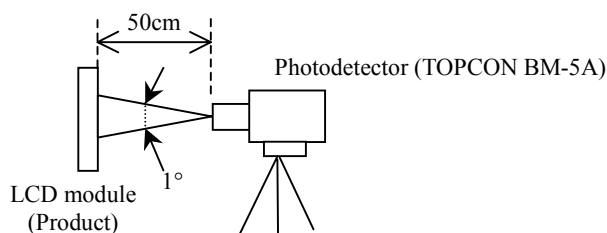
3.12.1 Optical characteristics

Parameter Note1	Symbol	Condition	min.	typ.	max.	Unit	Remarks		
Contrast ratio	CR	White/Black, at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	200	300	-	-	Note2		
Luminance	L	White, at center $\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$	200	250	-	cd/m ²	-		
Luminance uniformity	LU	-	-	1.1	1.3	-	Note3		
Chromaticity	W	White (x, y)	-	0.300, 0.315	-	-	-		
	R	Red (x, y)	-	0.615, 0.340	-	-			
	G	Green (x, y)	-	0.312, 0.585	-	-			
	B	Blue (x, y)	-	0.143, 0.093	-	-			
Color gamut	C	$\theta R = 0^\circ, \theta L = 0^\circ, \theta U = 0^\circ, \theta D = 0^\circ$ at center, against NTSC color space	50	60	-	%			
Response time Note4	Ton	Black to White	0%→90%	-	35	85	ms	Note5	
			10%→90%	-	30	-	ms		
	Toff	White to Black	100%→10%	-	25	55	ms		
			90%→10%	-	23	-	ms		
Viewing angle	CR = 10	Right	θR	$\theta U = 0^\circ, \theta D = 0^\circ$	70	85	-	$^\circ$	Note6
		Left	θL	$\theta U = 0^\circ, \theta D = 0^\circ$	70	85	-	$^\circ$	
		Up	θU	$\theta R = 0^\circ, \theta L = 0^\circ$	70	85	-	$^\circ$	
		Down	θD	$\theta R = 0^\circ, \theta L = 0^\circ$	70	85	-	$^\circ$	
	CR = 5	Right	θR	$\theta U = 0^\circ, \theta D = 0^\circ$	-	85	-	$^\circ$	
		Left	θL	$\theta U = 0^\circ, \theta D = 0^\circ$	-	85	-	$^\circ$	
		Up	θU	$\theta R = 0^\circ, \theta L = 0^\circ$	-	85	-	$^\circ$	
		Down	θD	$\theta R = 0^\circ, \theta L = 0^\circ$	-	85	-	$^\circ$	

Note1: Measurement conditions are as follows.

Ta = 25°C, VDD = 12.0V, VDDb = 12.0V, Display mode: SXGA-75Hz

Optical characteristics are measured at luminance saturation after 20minutes from working the product, in the dark room. Also measurement method for luminance is as follows.



Note2: See "3.12.2 Definition of contrast ratio".

Note3: See "3.12.3 Definition of luminance uniformity".

Note4: Product surface temperature: Top1 = 29°C

Note5: See "3.12.4 Definition of response times".

Note6: See "3.12.5 Definition of viewing angles".

3.12.2 Definition of contrast ratio

The contrast ratio is calculated by using the following formula.

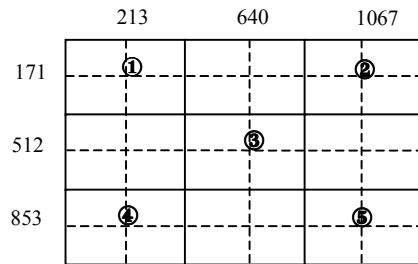
$$\text{Contrast ratio (CR)} = \frac{\text{Luminance of white screen}}{\text{Luminance of black screen}}$$

3.12.3 Definition of luminance uniformity

The luminance uniformity is calculated by using following formula.

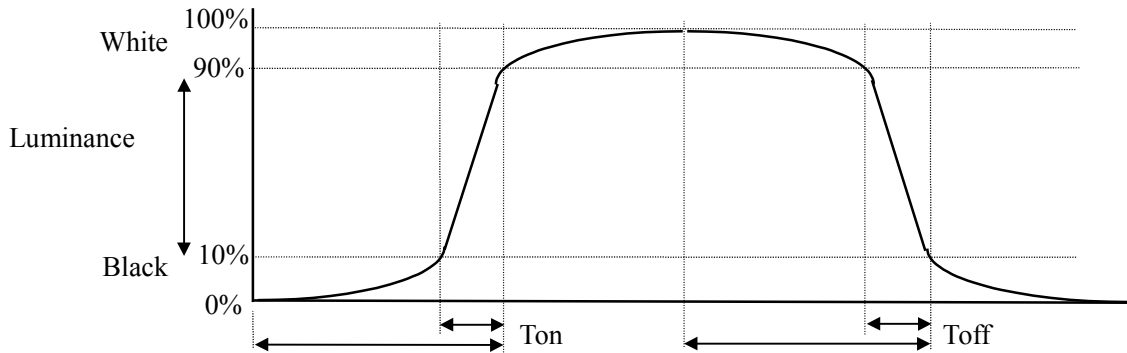
$$\text{Luminance uniformity (LU)} = \frac{\text{Maximum luminance from ① to ⑤}}{\text{Minimum luminance from ① to ⑤}}$$

The luminance is measured at near the 5 points shown below.

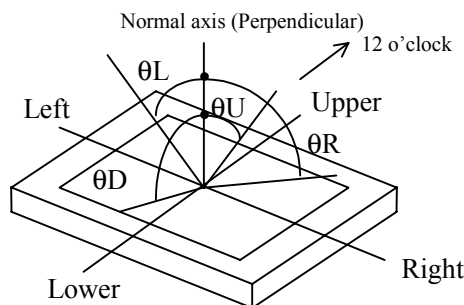


3.12.4 Definition of response times

Response time is measured, the luminance changes from "black" to "white" or "white" to "black", on the same screen point, by photo-detector. Ton is the time it takes the luminance change from 0% up to 90% and 10% up to 90%. Also Toff is the time it takes the luminance change from 100% down to 10% and 90% down to 10% (See the following diagram.).



3.12.5 Definition of viewing angles

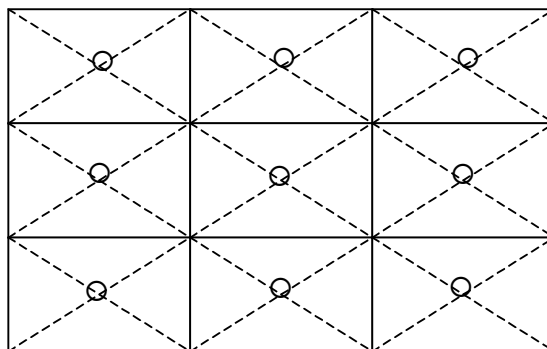


4.RELIABILITY TESTS

Test item	Condition	Judgement
High temperature and humidity (Operation)	① $60 \pm 2^{\circ}\text{C}$, RH = 60%, 240hours ② Display data is white.	No display malfunctions Note1
Heat cycle (Operation)	① $0 \pm 3^{\circ}\text{C}$...1hour $55 \pm 3^{\circ}\text{C}$...1hour ② 50cycles, 4hours/cycle ③ Display data is black.	
Thermal shock (Non operation)	① $-20 \pm 3^{\circ}\text{C}$...30minutes $60 \pm 3^{\circ}\text{C}$...30minutes ② 100cycles, 1hour/cycle ③ Temperature transition time is within 5 minutes.	
ESD (Operation)	① 150pF, 150Ω, ±10kV ② 9 places on a panel surface Note2 ③ 10 times each places at 1 sec interval	
Dust (Operation)	① 15 kinds of dust (by JIS-Z8901) ② 15 seconds stir ③ 8 times repeat at 1 hour interval	
Vibration (Non operation)	① 5 to 100Hz, 11.76m/s^2 ② 1 minute/cycle ③ X, Y, Z direction ④ 10 times each directions	No display malfunctions Note1 No physical damages
Mechanical shock (Non operation)	① 294m/s^2 , 11ms ② X, Y, Z direction ③ 3 times each directions	

Note1: Display functions are checked under the same conditions as product inspection.

Note2: See the following figure for discharge points.



5. PRECAUTIONS


5.1 MEANING OF CAUTION SIGNS


The following caution signs have very important meaning. **Be sure to read "5.2 CAUTIONS", after understanding this contents!**

 This sign has the meaning that customer will get an electrical shock, if customer has wrong operations.

 This sign has the meaning that customer will be injured by himself, if customer has wrong operations.

5.2 CAUTIONS

 **Do not touch HIGH VOLTAGE PART of the inverter while turned on! Danger of an electrical shock.**

 *** Pay attention to burn injury for the working backlight! It may be over 35°C from ambient temperature.**
*** Do not shock and press the LCD panel and the backlight! Danger of breaking, because they are made of glass. (Shock: To be not greater 294m/s² and to be not greater 11ms, Pressure: To be not greater 19.6N)**

5.3 ATTENTIONS

5.3.1 Handling of the product

- ① Take hold of both ends without touch the circuit board when customer pulls out products (LCD modules) from packing box. If customer touches it, products may be broken down or out of adjustment, because of stress to mounting parts.
- ② Do not hook cables nor pull connection cables such as flexible cable and so on, for fear of damage.
- ③ If customer puts down the product temporarily, the product puts on flat subsoil as a display side turns down.
- ④ Take the measures of electrostatic discharge such as earth band, ionic shower and so on, when customer deals with the product, because products may be damaged by electrostatic.
- ⑤ The torque for mounting screws must never exceed 0.392N·m. Higher torque values might result in distortion of the bezel.
- ⑥ Do not press or rub on the sensitive display surface. If customer cleans on the panel surface, NEC Corporation recommends using the cloth with ethanolic liquid such as screen cleaner for LCD.
- ⑦ Do not push-pull the interface connectors while the product is working, because wrong power sequence may break down the product.

5.3.2 Environment

- ① Do not operate in dewdrop atmosphere and corrosive gases.
- ② Do not operate or store in high temperature or high humidity atmosphere. Keep the product in antistatic pouch in room temperature, because of avoidance for dusts and sunlight, if customer stores the product.
- ③ Do not operate in high magnetic field. Circuit boards may be broken down by it.
- ④ Use an original protection sheet on the product surface (polarizer). Adhesive type protection sheet should be avoided, because it may change color or properties of the polarizer.

5.3.3 Characteristics

The following items are neither defects nor failures.

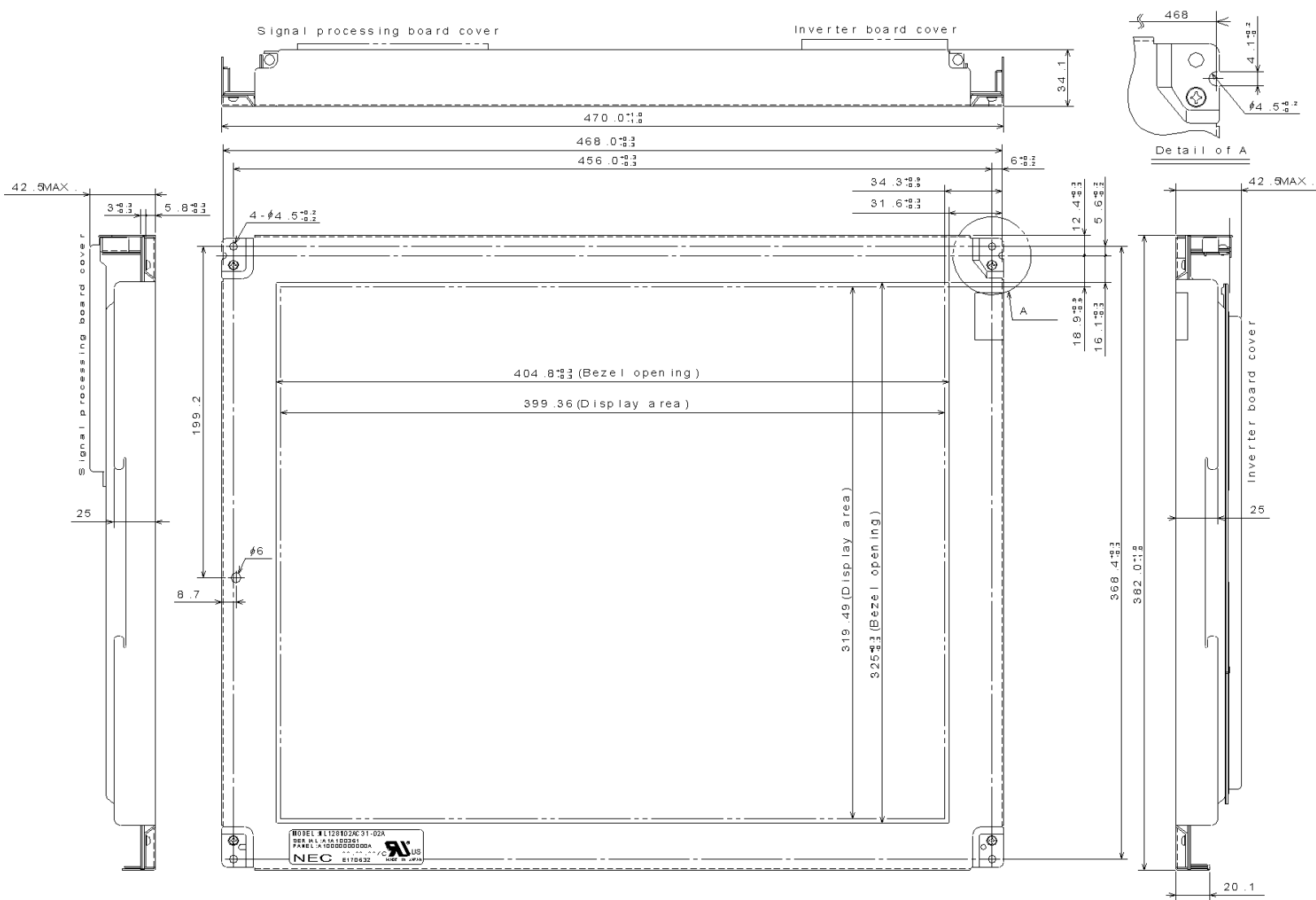
- ① Response time, luminance and color may be changed by ambient temperature.
- ② The LCD may be seemed luminance non-uniformity, flicker, vertical seam or small spot by display patterns.
- ③ Optical characteristics (e.g. luminance, display uniformity, etc.) gradually is going to change depending on operating time, and especially low temperature, because the LCD has cold cathode fluorescent lamps.
- ④ Do not display the fixed pattern for a long time because it may cause image sticking. Use a screen saver, if the fixed pattern is displayed on the screen.
- ⑤ The display color may be changed by viewing angle because of the use of condenser sheet in the backlight unit.
- ⑥ The luminance may be changed by voltage variation (voltage drop), even if power source applies recommended voltage to backlight inverter.
- ⑦ Optical characteristics may be changed by input signal timings.

5.3.4 Other

- ① All GND, GNDB, VDD and VDDB terminals should be used without a non-connected line.
- ② Do not disassemble a product or adjust volume without permission of NEC Corporation.
- ③ See "REPLACEMENT MANUAL FOR BACKLIGHT", if customer would like to replace backlight lamps.
- ④ Pay attention not to insert waste materials inside of products, if customer uses screwdrivers.
- ⑤ Pack the product with original shipping package, because of avoidance of some damages during transportation, when customer returns it to NEC Corporation for repair and so on.
- ⑥ Not only the module but also the equipment that used the module should be packed and transported as the module becomes vertical. Otherwise, there is the fear that a display dignity decreases by an impact or vibrations.

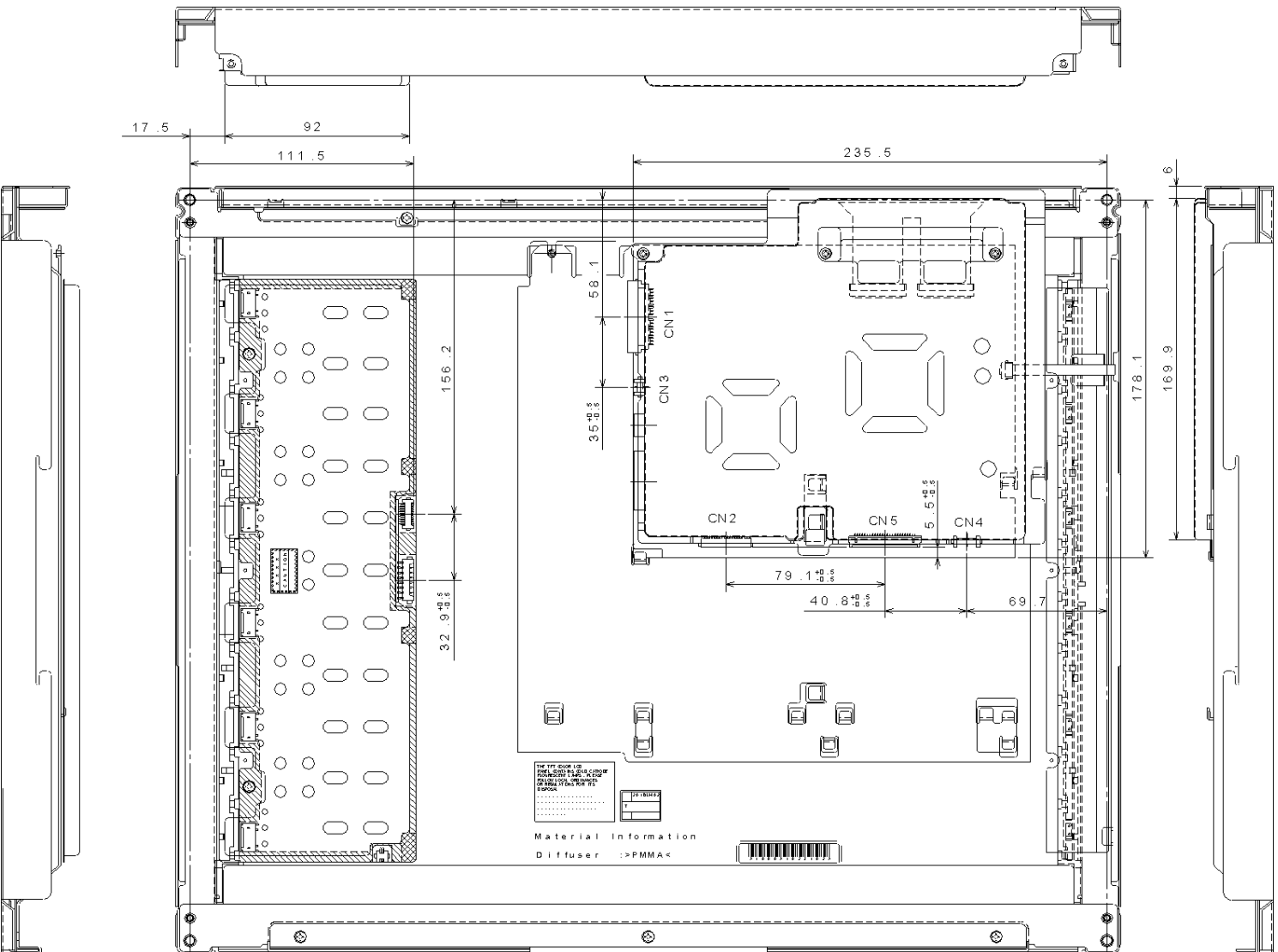
6. OUTLINE DRAWINGS

6.1 FRONT VIEW



Note1: Not shown tolerances of the dimensions are +/-0.5mm.
 Note2: The torque for mounting screw should never exceed 0.392N.m.

6.2 REAR VIEW



Note1: Not shown tolerances of the dimensions are +/-0.5mm.

Note2: The torque for mounting screw should never exceed 0.392N.m.

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"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.

(Note)

- (1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.
- (2) "NEC electronic component products" means any electronic component product developed or manufactured by or for NEC (as defined above).

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