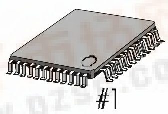
INTRODUCTION

48-LQFP-0707



PRODUCT SUMMARY

KS7332 is a digital image signal handling IC aimed at improving image contrast and counter light correction, applicable to CCD-using video camera systems such as camcorders and surveillance cameras. KS7332 receives the CCD output as digital data, analyzes the image's luminance distribution, then outputs a signal with improved dynamic range of luminance and color difference. It also uses a spatial adaptive filter to remove low intensity noise and output a stable image.

FEATURES

- NTSC/PAL, Normal/Hiband, DVC compatible
- 10-bit A/D input
- Digital clamp
- WDR expansion using non-linear histogram modification
- Look up table (LUT) transform using line memory
- S1, S2 signals' HUE component correction by look-up-table transform
- Built-in memory for histogram storage
- Image analysis with histogram LOG function as reference
- Color sensitivity correction
- Serial micom interface
- Built-in operation for connection with AE
- 10-bit S1, S2 signal output for DCP I/F
- Spatial adaptive noise removal filter for low intensity images
- Interpretation of image characteristic through graphic OSD

MANUFACTURING PROCESS AND PACKAGE

Manufacturing process: 0.35 um silicon gate 3 metals 3.3V CMOS (CSP7L)

APPLICATIONS

- Camcorder system
- Surveillance camera, PC camera

PIN DIAGRAM

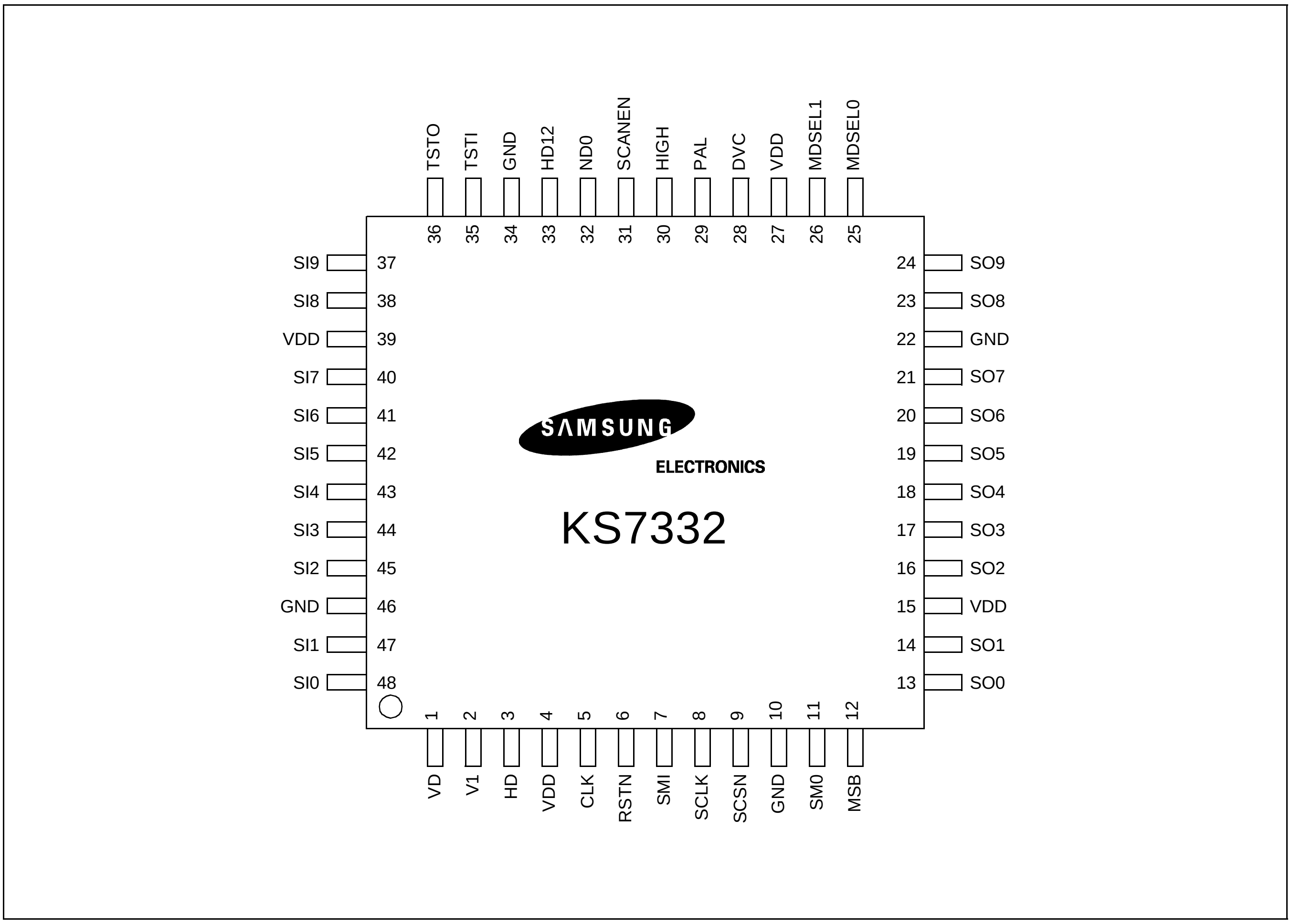


Figure 1. Pin Diagram

PIN DESCRIPTION

Table 1. Pin Description

No	Name	I/O	Description	Note
1	VD	I	Vertical driving pulse	CCD
2	V1	I	Vertical transfer pulse	
3	HD	I	horIzontal driving pulse	
4	VDD	P	Power	3.3 V
5	CLK	I	System clock	ADCK (KS7331)
6	RSTN	I	System reset	
7	SMI	I	Serial data input from system micom	
8	SCLK	I	System micom clock	
9	SCSN	I	System micom reset	
10	GND	P	Ground	
11	SMO	O	Serial data output to system micom	TRI-State out Scsn low ACT.
12	MSB	I	Micom data MSB order	"1" MSB first "0" LSB first
13	SO0	O	S1S2 data output 0 for DCP	
14	SO1	O	S1S2 data output 1 for DCP	
15	VDD	P	Power	
16	SO2	O	S1S2 data output 2 for DCP	
17	SO3	O	S1S2 data output 3 for DCP	
18	SO4	O	S1S2 data output 4 for DCP	
19	SO5	O	S1S2 data output 5 for DCP	
20	SO6	O	S1S2 data output 6 for DCP	
21	SO6	O	S1S2 data output 7 for DCP	
22	GND	P	Ground	
23	SO8	O	S1S2 data output 8 for DCP	
24	SO9	O	S1S2 data output 9 for DCP	
25	MDSEL0	I	Operation mode selection 0	Normal "0"
26	MDSEL1	I	Operation mode selection 1	Normal "0"
27	VDD	P	Power	
28	DVC	I	DVC mode enable signal	DVC "1" 8mm "0"
29	PAL	I	PAL mode enable signal	PAL "1" NTSC "0"
30	HIGH	I	High mode enable signal	High "1" Normal "0"
31	SCANEN	I	Scan enable signal	Normal “0”
32	NDO	O	Namd tree output	

Table 1. Pin Description(Continued)

No	Name	I/O	Description	Note
33	HD12	O	HD delay output	
34	GND	P	Ground	
35	TSTI	I	Test input	
36	TSTO	O	Test output	
37	SI9	I	S1S2 data input 9 from ADC	
38	SI8	I	S1S2 data input 8 from ADC	
39	VDD	P	Power	
40	SI7	I	S1S2 data input 7 from ADC	
41	SI6	I	S1S2 data input 6 from ADC	
42	SI5	I	S1S2 data input 5 from ADC	
43	SI4	I	S1S2 data input 4 from ADC	
44	SI3	I	S1S2 data input 3 from ADC	
45	SI2	I	S1S2 data input 2 from ADC	
46	GND	P	Ground	
47	SI1	I	S1S2 data input 1 from ADC	
48	SI0	I	S1S2 data input 0 from ADC	

BLOCK DIAGRAM

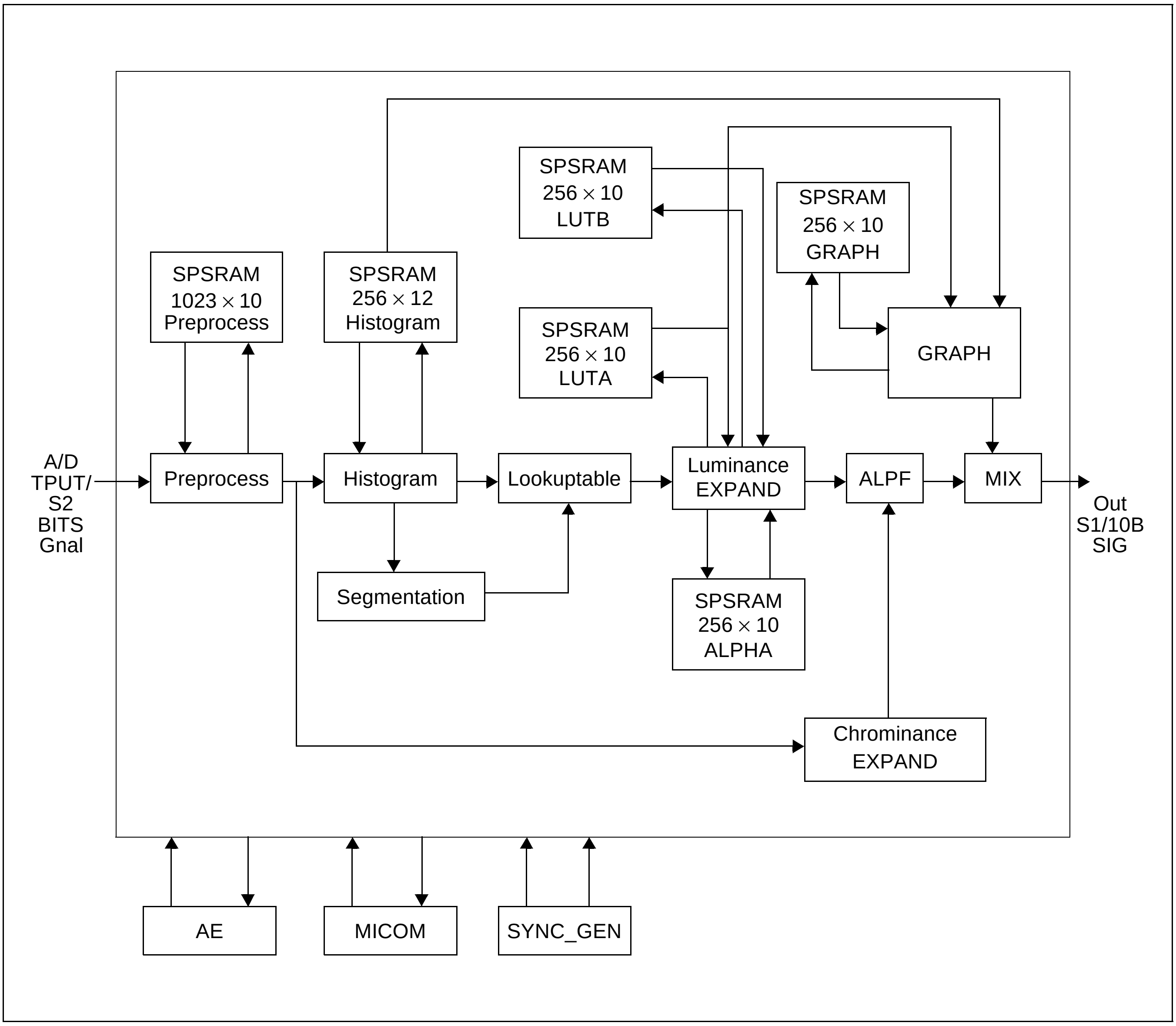


Figure 2. Block Diagram

DESIGN CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS

Table 2. Absolute Maximum Ratings

Item	Symbol	Rating	Unit	Remark
DC supply voltage (digital)	V_{DD}	-0.3 ~ 3.8	V	-
DC input voltage	V_{IN}	-0.3 ~ V_{DD} +0.3	V	-
Storage temperature	T_{STG}	-40 ~ 125	°C	-
Latch-up current	I_{LU}	±100	mA	-

OPERATING TEMPERATURE

KS7332 functions within 0 °C ~ +70°C Its AC and DC characteristics must satisfy specifications.

ELECTROSTATIC CHARACTERISTICS

Table 3. Electrostatic Characteristics

Item	Electrostatic Standard		Unit	Remark
	Pin No	Design Goal		
Human body model (HBM)	All	±2000	V	
Machine model (MM)		±300		
CDM		±800		

ELECTRICAL CHARACTERISTICS (DC)V_{SS} = 0V, V_{DD} = 3.3 ± 0.3V, Ta = 0 ~ 70 °C

Table 4. Electrical Characteristics (DC)

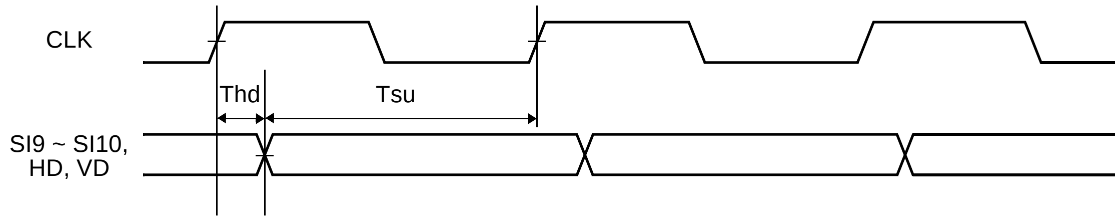
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
Supply voltage		V_{DD}	-	3.0	3.3	3.6	V	V_{DD}, V_{DDA}
Input voltage	High level	V_{IH}	-	2.0	-	-		1
	Low level	V_{IL}	-	-	-	0.8		
Output voltage	High level	V_{OH}	I_{OH} = -1mA	2.4	-	-		2
	Low level	V_{OL}	I_{OL} = 1mA	-	-	0.4		
Input current	High level	I_{IH}	V_{IN} = V_{DD}	-10	-	10	µA	1
	Low level	I_{IL}	V_{IN} = V_{SS}	-10	-	10		
Output leakage current	Tri-state	I_{OZ}	V_{OUT} = V_{SS} or V_{DD}	-10	-	10	µA	3
Operating current		I_{DD}	-	-	-	70	mA	-
Static current		I_{SS}	-	-	-	500	µA	-

[REMARK]
1: All Input pins
2: All output pins except 3
3: SMO (Tri-state)

ELECTRICAL CHARACTERISTICS (AC)

Table 5. Electrical Characteristics (AC)

Item	Signal	Symbol	Design Goal Characteristics			Unit	Remark
			Min	Typ	Max		
Input data setup time	I9 ~ SI0, HD, VD	Tsu	5	-	-	ns	V_{DD} = 3.3V ± 0.3V Ta = 0 ~ 70 °C
Input data hold time	SI9 ~ SI0, HD, VD	Thd	5	-	-	ns	V_{DD}= 3.3V ± 0.3V Ta = 0 ~ 70 °C



SYSTEM CONFIGURATION AND OPERATION DESCRIPTION

SYSTEM CONFIGURATION

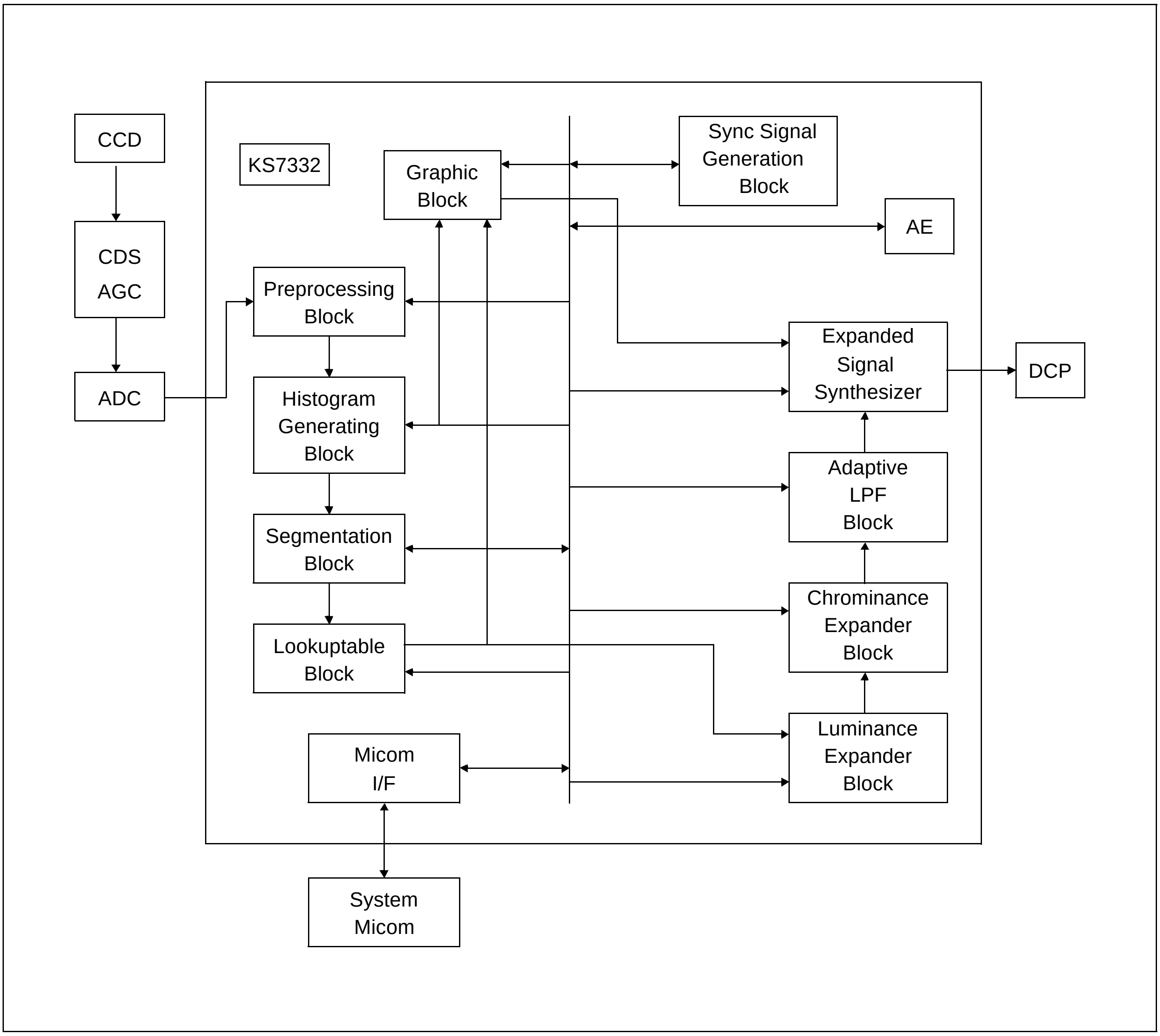


Figure 3. System Configuration

The preprocessing block receives the 10-bit ADC output, carries out digital clamping, black line detection & correction, and preprocess low pass filtering.

The histogram generating block uses the preprocessing block's output to generate a probability density function of the image signal luminance output, and stores it in line memory. It also generates a signal for adjusting luminance distribution and sends it to the segmentation block and the look-up-table generating block. The histogram generating block is composed of the active area selection block, luminance signal separation block that uses LPF, histogram accumulation block that uses line memory, and the histogram clip block.

The segmentation block uses the accumulated histogram to generate back bias impressing conditions and sends them to the MICOM I/F module for improvement of the dynamic range. The segmentation block is composed of a histogram organizing block, histogram integrating block, gamma adjusting block, back bias adjusting block, and a block that probes the minimum segment using accumulated histograms.

The look-up-table block uses the output of the histogram generating block and the segmentation block to generate a conversion function for the improvement of the dynamic range. It is composed of the histogram integrating block, the look-up-table generating block, and the look-up-table 2nd differentiation.

The luminance expander receives the LUT value from the look-up-table block and stores it in line memory. It also moves the address by 1 and stores it in a different line memory. The LUT values stored in the two line memories go through spatial and temporal interpolation to receive data with an expanded band zone for luminance signals. The luminance expander is composed of blocks that carry out the following functions: I/F function for LUT-storing line Memory, temporal interpolation function, spatial interpolation function, 8-bit division function for gain calculation, and expanded luminance signal output function.

The chrominance expander receives the outputs of the preprocessing block and the luminance expander, adjusts the color difference signal according to the ratio between the expanded and the non-expanded luminance signals, and outputs the expanded chrominance signal. It also adjusts the color data's sensitivity according to the the band zone of the luminance signal.

The adaptive LPF block receives the output of the chrominance expander, reduces the high frequency components such as noise in areas with little change in the grey level, and emphasizes edge and other minute details. It also uses a high pass filter to extract the edge of the image.

The graphic block receives the accumulated histogram and LUT data, and shows them as graphic data on the currently visible screen. Also, the graphic data is placed in the middle of the screen while 10-bit A/D signals, expanded brightness signals, expanded color signals, edge signals, and noiseless color signals are output to the background according to need.

The expanded signal synthesizer receives 10-bit A/D signals, expanded luminance signals, expanded color signals, edge signals, and noiseless color signals. It chooses the needed signals and outputs them to the exterior. It also carries out time delay for each signal so that it has the same delay as the final output.

SYSTEM OPERATION DESCRIPTION

Sync Signal Generating Block

The sync signal generating block generates horizontal/vertical count data using the sync signal from the Timing Generator (TG). It also generates SP (Start Point) data using DVC, HIGH, PAL, and AP_ADJ (Start Point Adjustment) from System MICOM, and FLD (Field) signals using HD, VD, and PAL signals.

- Internal vertical counter (VCNT: line counter)
- Internal horizontal counter (HCNT: pixel counter)
- Internal field signal (FLD)
- Internal horizontal active area signal (HACTIVE)
- Internal vertical active area signal (VACTIVE)

Preprocessing Block

The preprocessing block uses the CCD's A/D output to carry out digital clamping, black line detection & correction, and preprocess low pass filtering, then outputs to the histogram generating block.

- Digital clamping
- Black line detection & correction
- Preprocess low pass filtering

Histogram Generating Block

The histogram generating block uses the output from the preprocessing block to generate a probability density function for the video signal's luminance output and stores it in line memory. A signal for luminance distribution adjustment is generated and sent to the segmentation block and look-up-table block.

- ACTIVE Area Selection
- Luminance Signal Separation using LPF
- Histogram Accumulation using Line Memory
- Histogram Clip feature

Segmentation Block

The segmentation block uses the accumulated histogram from the histogram generating block for the improvement of dynamic range. back bias impressing conditions are generated and sent to the look-up-table block and the MICOM I/F module.

- Histogram segmentation
- Histogram integration
- Histogram minimum section probing feature
- Gamma control
- Back bias adjustment

Look-Up-Table Block

The look-up-table block uses the output of the histogram generating block and the segmentation block to generate a conversion function for the improvement of dynamic range. It is composed of the histogram integrating block, look-up-table generating block, and the look-up-table 2nd differentiation.

- Histogram Integration
- Look-Up-Table Generating ability
- Look-Up-Table 2nd Differentiation

Luminance Expander

The luminance expander receives the LUT value from the look-up-table block and stores it in line memory. It also moves the address by 1 and stores it in a different line memory. The LUT values stored in the two line memories are put through temporal and spatial interpolation to receive data with an expanded band zone for luminance signals.

- Line memory I/F function for look-up-table value storage
- Temporal interpolation
- Spatial interpolation
- 8-bit division for gain calculation
- Expanded luminance signal output feature

Chrominance Expander

The chrominance expander receives the outputs of the preprocessing block and the luminance expander, adjusts the color difference signal according to the ratio between the expanded and non-expanded luminance signals, and outputs the expanded chrominance signal. It also adjusts the color data's sensitivity according to the the band zone of the luminance signal.

- Color difference signal adjustment according to ratio between expanded and non-expanded luminance signals
- Color data sensitivity adjustment according to luminance signal band zone

Adaptive LPF Block

The adaptive LPF block receives the output of the chrominance expander, reduces high frequency components such as noise in areas with little change in the grey level, and emphasizes edge and other minute details. It also uses a high pass filter to extract the edge of the image.

- Horizontal signal delay
- Weight calculation of neighboring picture element pixels
- Adaptive noise elimination
- Edge emphasis and extraction

Graphic Block

The graphic block receives the accumulated histogram and LUT data, and shows them as graphic data on the currently visible screen. Also, the graphic data is placed in the middle of the screen while 10-bit A/D signals, expanded luminance signals, expanded color signals, edge signals, and noiseless color signals are output to the background according to need.

- Fixing graphic data to the middle
- Graphic data output
- Background screen selection output
- Graphic data status selection

Expanded Signal Synthesizer

The expanded signal synthesizer receives 10-bit A/D signals, expanded luminance signals, expanded color signals, edge signals, and noiseless color signals. It chooses the needed signals and outputs them to the exterior. It also carries out time delay for each signal so that it has the same delay as the final output.

- 10-bit A/D signal input feature
- Expanded luminance signal input feature
- Expanded color signal input feature
- Edge signal input feature
- Noiseless color signal input feature
- Selective input signal output
- Input signal delay feature

MICOM REGISTER TABLE

OPERATION DESCRIPTION

The start signal and clock operate in slave mode, so this part is nonsychronous to the rest of the system. The register setting is normally carried out for all segments within the field, and it is latched at negedge VD when scsn is restored to high.

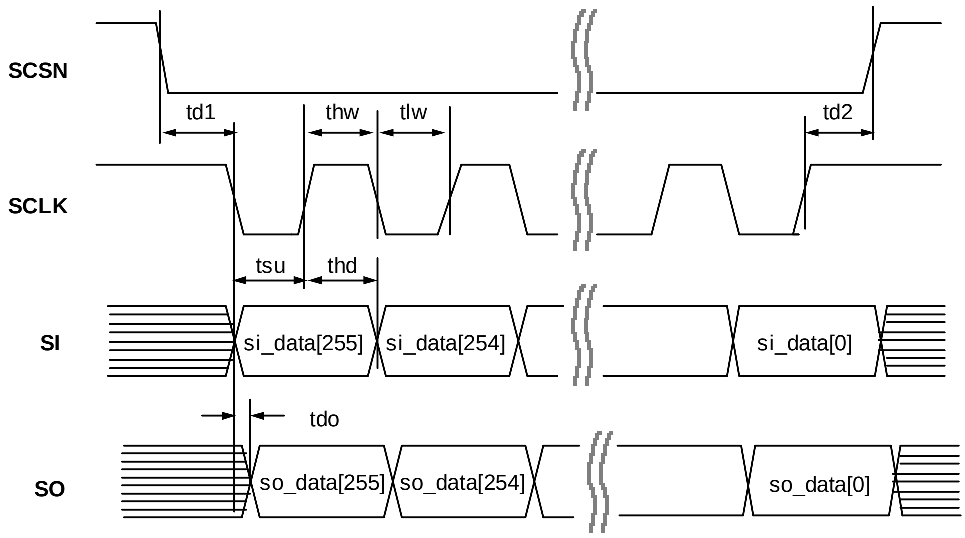


Figure 4. Operation Description

Symbol	Description	Standard (μs)	
		min	max
td1	SCSN low edge to SCLK low edge	0.2	-
td2	SCLK high edge to SCSN high edge	0.2	-
thw	SCLK high width	0.2	-
tlw	SCLK low width	0.2	-
tsu	SI data setup time	0.2	-
thd	SI data hold time	0.2	-
tdo	SO data out delay time	-	0.1

MICOM INPUT

Table 6. Micom Input

Register Bits	MICOM Command	Default Value
	Function	
[255:248]	OUT_MODE [2:0], DLY_MODE [4:0]	1 1 1 1 _ 0 0 0 1

¨ OUT_MODE: Output mode selection

OUT_MODE	MODE
0 0 0	Input
0 0 1	Preprocess module output
0 1 0	WDR output
0 1 1	Saturation output
1 0 0	Graphic output
1 0 1	EDGE output
Default	WDR + saturation + ALPF output

¦ DLY_MODE: Output delay mode selection
- For matching output's delay

DLY_MODE	MODE
0 0 0 0 0	No delay
0 0 0 0 1	1 clock delay
0 0 0 1 0	2 clock delay
1 0 1 0 0	20 clock delay
Default	21 clock delay

Table 6. Micom Input(Continued)

<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td rowspan="2">[247:240]</td><td>CLPEN, SORSL, V1_EXIST, GR_MODE [1:0], GRB_MODE [2:0]</td><td>1 1 1 X _ X X X X</td></tr>
<tr><td colspan="2">
<table><tr><td>CLPEN</td><td>SORSL</td><td>V1_EXIST</td><td>GR_MODE [1:0]</td><td>GRB_MODE [2:0]</td></tr></table>
¨ CLPEN: On/off of digital clamp operation; on = '1', off = '0'
¦ SORSL: On/off of preprocess LPF operation; on = '0', off = '1'
Æ V1_EXIST: V1 signal existence; yes = '0', no = 1'
Ø GR_MODE: Graphic mode
- GR_MODE[0]: Histogram CLIP feature (DO_HIST >> GR_MODE[0])
- GR_MODE[1]: DOT/White graphic selection feature
DOT = '1', WHITE = '0'
× GRB_MODE : Background screen in graphic mode
<table>
<tr><th>GRB_MODE</th><th>MODE</th></tr>
<tr><td>0 0 0</td><td>Black</td></tr>
<tr><td>0 0 1</td><td>Input</td></tr>
<tr><td>0 1 0</td><td>Preprocess module output</td></tr>
<tr><td>0 1 1</td><td>WDR output</td></tr>
<tr><td>1 0 0</td><td>Saturation output</td></tr>
<tr><td>1 0 1</td><td>EDGE output</td></tr>
<tr><td>Default</td><td>WDR + saturation + ALPF output</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">[239:232]</td><td>CMP_ADJ [3:0], SP_ADJ [3:0]</td><td>0 0 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">- CMP_ADJ: Digital clamp operating range adjustment
- SP_SDJ: Starting point adjustment of horizontal active area selection for AE</td></tr>
<tr><td rowspan="2">[231:224]</td><td>POFFSET [7:0]</td><td>0 0 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">
<table><tr><td>POFFSET [7:0]</td></tr></table>
- POFFSET: Used when adding or subtracting the OFFSET to the 8 picture element pixels, integrated and averaged over TCLP
</td></tr>
<tr><td rowspan="2">[223:216]</td><td>SP_H [7:0]</td><td>0 0 0 1 _ 1 0 0 1</td></tr>
<tr><td colspan="2">
<table><tr><td>SP_H [7:0]</td></tr></table>
- Horizontal active starting point for active area selection = SP_H << 2
</td></tr>
</table>

Table 6. Micom Input(Continued)

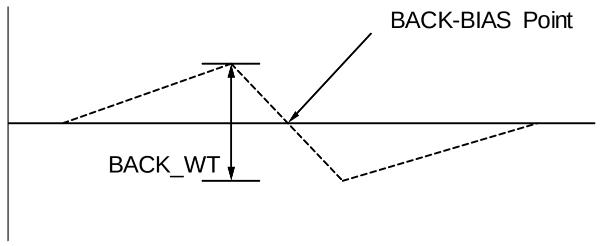
<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td rowspan="2">[215:208]</td><td>LP_H [7:0]</td><td>0 1 1 1 _ 1 1 0 1</td></tr>
<tr><td colspan="2"><table><tr><td>LP_H [7:0]</td></tr></table>- Horizontal active starting point for active area selection = LP_H << 2</td></tr>
<tr><td rowspan="2">[207:200]</td><td>SP_V [7:0]</td><td>0 0 0 1 _ 0 1 0 0</td></tr>
<tr><td colspan="2"><table><tr><td>LP_H [7:0]</td></tr></table>- Vertical active starting point for active area selection</td></tr>
<tr><td rowspan="2">[199:192]</td><td>LP_V [7:0]</td><td>1 1 1 1 _ 0 0 0 0</td></tr>
<tr><td colspan="2"><table><tr><td>LP_V [7:0]</td></tr></table>- Vertical active starting point for active area selection</td></tr>
<tr><td rowspan="2">[191:184]</td><td>EDGE_AMP [3:0], BACK_SP [3:0]</td><td>0 0 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2"><table><tr><td>EDGE_AMP [3:0]</td><td>BACK_SP [3:0]</td></tr></table>
¨ EDGE_AMP: EDGE amplification ratio
¦ BACK_SP: Back bias allocation conditions
<table>
<tr><th>BACK_SP</th><th>MODE</th></tr>
<tr><td>0000</td><td>No back bias</td></tr>
<tr><td>0001 - 1000</td><td>BACK_SP (1)</td></tr>
<tr><td>1111</td><td>Reserved (2)</td></tr>
<tr><td>Default</td><td>Reserved</td></tr>
</table>
NOTES:
1. Given value between 1 ~ 8
2. Back-bias point from hlog value</td></tr>
</table>

Table 6. Micom Input(Continued)

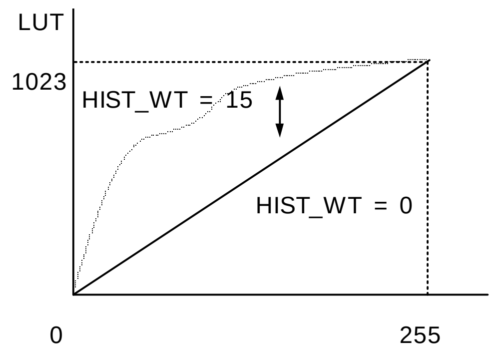
<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td rowspan="2">[183:176]</td><td>BACK_WT [3:0], HIST_WT [3:0]</td><td>0 0 0 0 _ 1 0 0 0</td></tr>
<tr><td colspan="2">

EDGE_AMP [3:0]	BACK_SP [3:0]

¨ BACK_WT: Back bias weight



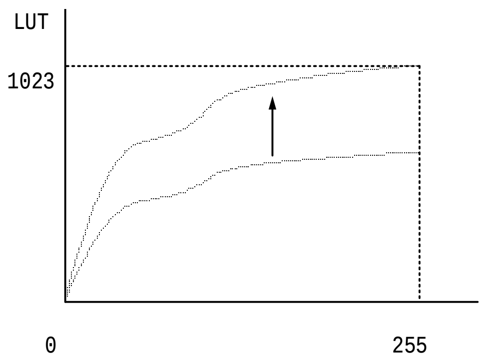
¦ HIST_WT: Histogram equalization and bypass weight
(0 ~ 15)



</td></tr>
<tr><td rowspan="2">[175:168]</td><td>LUT_GAIN [7:0]</td><td>0 1 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">

LUT_GAIN [7:0]

- Gain that makes the maximum LUT value = 1023
- LUT_GAIN = 2^{22} / (LP_H X LP_V)
  If 64 when Image area size is 256 X 256, maximum LUT value is 1023



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</table>

SAMSUNG ELECTRONICS

Table 6. Micom Input(Continued)

<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td>[167:160]</td><td>LTI_ON, LSI_ON, LUT_TAB [2:0], LUT_HPF_SFT [2:0]</td><td>1 1 1 0 _ 0 0 1 0</td></tr>
<tr><td></td><td colspan="2">

LTI_ON	LSI_ON	LUT_TAB [2:0]	LUT_HPF_SFT [2:0]

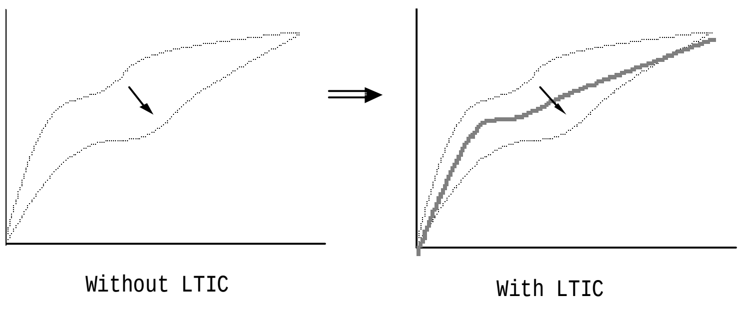
¨ LTI_ON: Temporal interpolation for LUT
on = '1', off = '0'
¦ LSI_ON: Spatial interpolation for LUT
on = '1', off = '0'
Æ LUT_TAB: TAB adjustment for LUT 2nd differentiation compensation

LUT_TAB	MODE
001	±1 TAB
010	±2 TAB
011	±3 TAB
100	±4 TAB
Default	0 TAB

Ø LUT_HPF_SFT:
- LUT 2nd differentiation compensation gain
- Noise reduction by relieving sudden temporal noise generator
</td></tr>
<tr><td rowspan="2">[159:152]</td><td>LTIC [3:0], CH_SEL [3:0]</td><td>0 0 0 0 _ 1 0 0 0</td></tr>
<tr><td colspan="2">

LTIC [3:0]	CH_SEL [3:0]

¨ LTIC:
- Temporal interpolation coefficient for LUT. Prevents LUT from changing suddenly over time.
- If TIC is closer to 0, follow the current LUT, and if closer to 255, follow the previous LUT.



</td></tr>
</table>

Table 6. Micom Input(Continued)

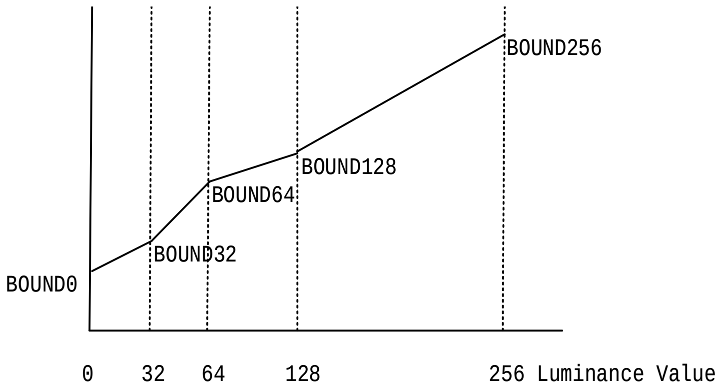
Register Bits	MICOM Command	Default Value
	Function	
[159:152]	¦ CH_SEL: Chroma LPF selection	

CH_SEL	MODE								
		S1	S2	S1	S2	S1	S2		
0 0 0 0	[		-1	1				]/	2
0 0 0 1	[				1	-1		]/	2
0 0 1 0	[	1	-2	1				]/	4
0 0 1 1	[		-1	2	-1			]/	4
0 1 0 0	[			1	-2	-1		]/	4
0 1 0 1	[	1	-1	1	-1			]/	4
0 1 1 0	[		-1	1	-1	1		]/	4
0 1 1 1	[		-1		-1	1	1	]/	4
Default	[			1	-1			]/	2

Processing point

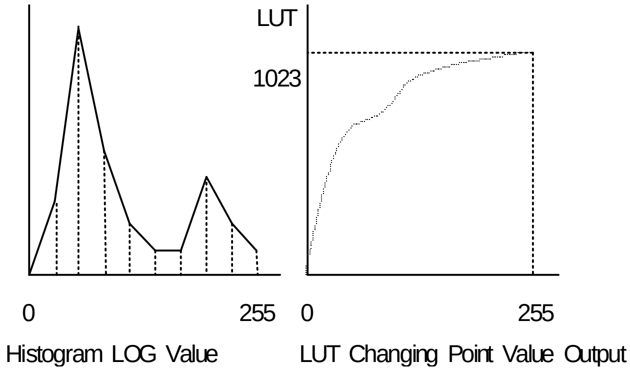
Register Bits	MICOM Command	Default Value
[151:144]	BOUND0 [7:0]	1 0 0 0 _ 0 0 0 0
	BOUND0 [7:0] - BOUND0: changing point value for luminance level 0's CHROMA gain adjustment.	
[143:136]	BOUND32 [3:0]	1 0 0 0 _ 0 0 0 0
	BOUND32 [7:0] - BOUND32: changing point value for luminance level 32's CHROMA gain adjustment	
[135:128]	BOUND64 [3:0]	1 0 0 0 _ 0 0 0 0
	BOUND64 [7:0] - BOUND64: changing point value for luminance level 64's CHROMA gain adjustment	
[127:120]	BOUND128 [3:0]	1 0 0 0 _ 0 0 0 0
	BOUND128 [7:0] - BOUND128: changing point value for luminance level 128's CHROMA gain adjustment	

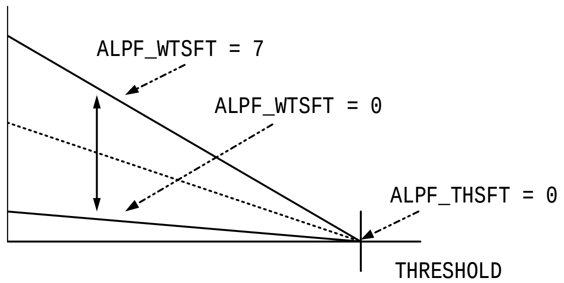
Table 6. Micom Input(Continued)

<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td rowspan="2">[119:112]</td><td>BOUND256 [3:0]</td><td>1 0 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">BOUND256 [7:0]
- BOUND256: changing point value for luminance level 256's CHROMA gain adjustment


NOTE: BOUND0, BOUND32, BOUND64, BOUND128, and BOUND256 are for adjusting color signal sensitivity, which strengthens the color suppress of all areas.</td></tr>
<tr><td></td><td>HLOG_ON, SAT_ON, ALPF_WTSFT [2:0], SHPF_SFT[2:0]</td><td>1 1 1 0 _ 0 0 0 1</td></tr>
</table>

Table 6. Micom Input(Continued)

<table>
<tr><th rowspan="2">Register Bits</th><th>MICOM Command</th><th>Default Value</th></tr>
<tr><th colspan="2">Function</th></tr>
<tr><td></td><td colspan="2">
<table><tr><td>HLOG_ON</td><td>SAT_ON</td><td>ALPF_WTSFT [2:0]</td><td>SHPF_SFT[2:0]</td></tr></table>
¨ HLOG_ON:
- 1: Histogram log accumulation output
- 0: LUT control point value output


¦ SAT_ON: Saturation block's on/off ; on = '1', off = '0'
Æ ALPF_WTSFT: Gain of slope for ALPF


Ø SHPF_SFT: HPF gain
</td></tr>
<tr><td rowspan="2">[103:96]</td><td>ALPF_THP [7:0]</td><td>1 0 0 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">
<table><tr><td>ALPF_THP [7:0]</td></tr></table>
- ALPF_THP: ALPF threshold
</td></tr>
<tr><td rowspan="2">[95:88]</td><td>AEW1HS [7:0]</td><td>0 0 1 0 _ 0 0 0 0</td></tr>
<tr><td colspan="2">
<table><tr><td>AEW1HS [7:0]</td></tr></table>
- Refer to KS7331's DCP ODM block
</td></tr>
</table>

Table 6. Micom Input(Continued)

Register Bits	MICOM Command	Default Value
	Function	
[87:80]	AEW1HE [7:0]	0 0 1 0 _ 1 0 1 0
	AEW1HE [7:0] - Refer to KS7331's DCP ODM block	
[79:72]	AEW1VS [7:0]	0 0 0 1 _ 0 0 0 0
	AEW1VS [7:0] - Refer to KS7331's DCP ODM block	
[71:64]	AEW1VE[7:0]	0 1 0 1 _ 0 0 0 0
	AEW1VE [7:0] - Refer to KS7331's DCP ODM block	
[63:56]	AEW2HS [7:0]	0 0 0 1 _ 0 0 0 0
	AEW2HS [7:0] - Refer to KS7331's DCP ODM block	
[55:48]	AEW2HE [7:0]	1 1 1 1 _ 1 1 1 0
	AEW2HE [7:0] - Refer to KS7331's DCP ODM block	
[47:40]	AEW2VS [7:0]	0 0 0 1 _ 0 0 0 0
	AEW2VS [7:0] - Refer to KS7331's DCP ODM block	
[39:32]	AEW2VE [7:0]	0 1 0 0 _ 0 0 1 0
	AEW2VE [7:0] - Refer to KS7331's DCP ODM block	
[31:24]	AEH_TH [7:0]	1 1 1 1 _ 1 1 1 1
	AEH_TH [7:0] - Refer to KS7331's DCP ODM block	

Table 6. Micom Input(Continued)

Register Bits	MICOM Command	Default Value
	Function	
[23:16]	AEL_TH [7:0]	0 0 0 0 _ 0 0 0 0
	AEH_TH [7:0] - Refer to KS7331's DCP ODM block	
[7:0]	AEINSEL, AELPFSEL	1 0 X X _ X X X X
	AEINSEL | AELPFSEL | X [5:0] - Refer to KS7331's DCP ODM block	
[255:248]	RESERVED [7:0]	1 1 1 1 _ 0 0 0 0
	RESERVED [7:0] - Reserved	
[247:240]	RESERVED [7:0]	0 0 0 0 _ 1 1 1 1
	RESERVED [7:0] - Reserved	
[239:232]	HLOG0 [7:0]	?
	HLOG0 [7:0] - Log scaling and accumulated value for histogram of luminance level 0 ~ 11	
[231:224]	HLOG1 [7:0]	?
	HLOG1 [7:0] - Log scaling and accumulated value for hIstogram of luminance level 12 ~ 16	
[223:216]	HLOG2 [7:0]	?
	HLOG2 [7:0] - Log scaling and accumulated value for histogram of luminance level 17 ~ 23	
[215:208]	HLOG3 [7:0]	?
	HLOG3 [7:0] - Log scaling and accumulated value for histogram of luminance level 24 ~ 32	

Table 6. Micom Input(Continued)

Register Bits	MICOM Command	Default Value
	Function	
[207:200]	HLOG4 [7:0]	?
	HLOG4 [7:0] - Log scaling and accumulation value for histogram of luminance level 33 ~ 45	
[199:192]	HLOG5 [7:0]	?
	HLOG5 [7:0] - Log scaling and accumulation value for histogram of luminance	
[191:184]	HLOG6 [7:0]	?
	HLOG5 [7:0] - Log scaling and accumulation value for histogram of luminance	
[183:176]	HLOG7 [7:0]	?
	HLOG7 [7:0] - Log scaling and accumulation value for histogram of luminance	
[175:168]	HLOG8 [7:0]	?
	HLOG8 [7:0] - Log scaling and accumulation value for histogram of luminance	
[167:160]	HLOG9 [7:0]	?
	HLOG9 [7:0] - Log scaling and accumulation value for histogram of luminance level 182 ~ 255	
[159:128]	RESERVED [31:0]	0 0 0 0 _ 0 0 0 0
	RESERVED [31:0] - Reserved	
[127:120]	AESUMH_W1 [7:0]	?
	AESUMH_W1 [7:0] - Refer to KS7331's DCP ODM block	

Table 6. Micom Input(Continued)

Register Bits	MICOM Command	Default Value
	Function	
[119:112]	AESUMM_W1 [7:0]	?
	AESUMH_W1 [7:0] - Refer to KS7331's DCP ODM block	
[111:104]	AESUML_W1 [7:0]	?
	AESUML_W1 [7:0] - Refer to KS7331's DCP ODM block	
[103:96]	AESUMH_W2 [7:0]	?
	AESUMH_W2 [7:0] - Refer to KS7331's DCP ODM block	
[95:88]	AESUMM_W2 [7:0]	0 0 0 0 _ 0 0 0 0
	AESUMM_W2 [7:0] - Refer to KS7331's DCP ODM block	
[87:80]	AESUML_W2 [7:0]	?
	AESUML_W2 [7:0] - Refer to KS7331's DCP ODM block	
[79:72]	AECLIPH [7:0]	?
	AECLIPH [7:0] - Refer to KS7331's DCP ODM block	
[71:64]	AECLIPL [7:0]	?
	AECLIPL [7:0] - Refer to KS7331's DCP ODM block	
[63:0]	RESERVED [63:0]	0 0 0 0 _ 0 0 0 0
	RESERVED [63:0] - Reserved	

APPLICATION CIRCUIT

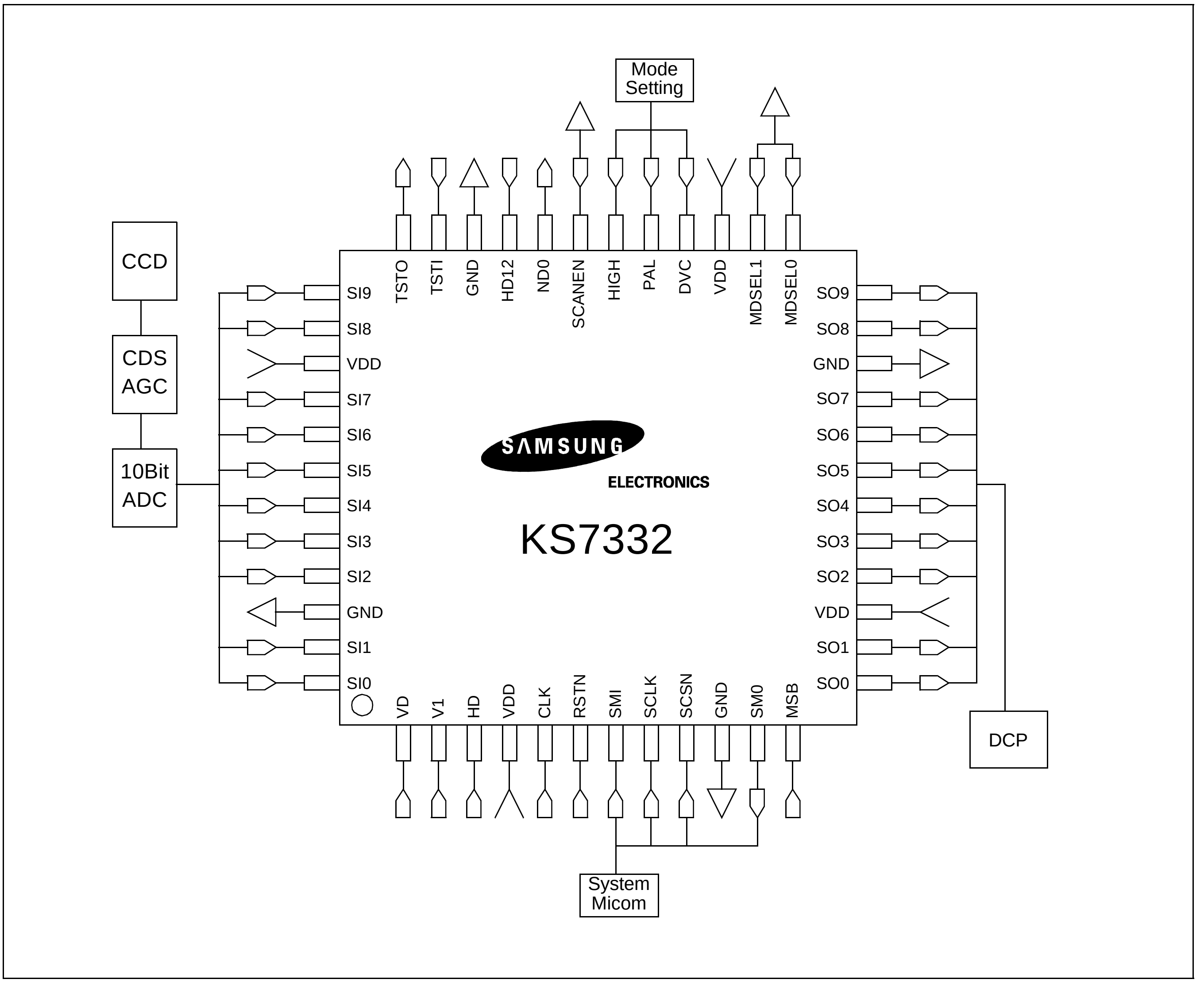


Figure 5. Application Circuit