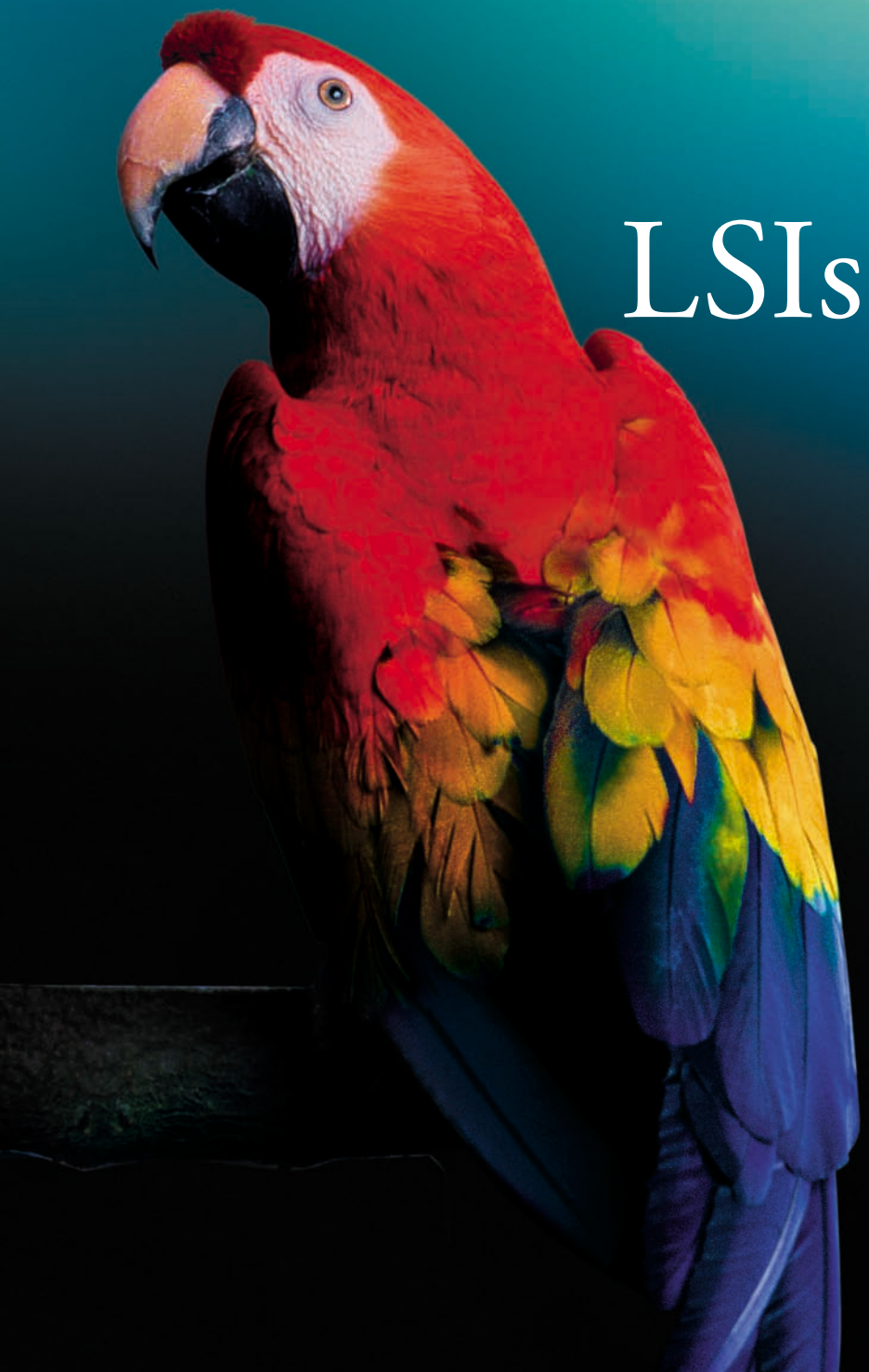
SHARP

LSIs for LCDs
AUG. 2002



LSIs for LCDs

Meeting the Many Needs of Wide-ranging Applications : SHARP's LSIs for LCDs

The performance of LCD panels has been enhanced by the expansion of LCD use,
and improvements are needed in their peripherals.
SHARP contributes to the design of highly functional applications through LSIs for LCDs,
such as LCD drivers, LCD controllers, video interface ICs, gray-scale ICs,
power supply ICs, etc. that satisfy needs across a wide range of applications.

[Notice : Applications above are not always available in all countries. Screen images are simulated.]

LSIs for LCDs

Fundamental Technology of LCD Drivers that Supports LCD Panels

Technology of TFT LCD drivers TFT
Technology of STN LCD drivers STN

LCD Drivers

LCD Panels

Smaller and Thinner Outline

High-density mounting
- Several types of TCP and SOF (System On Film)
- COG

Twin LCD drive single-chip driver STN

Color Display

Multi level gray scale : 256-level gray scale (16 780 thousand colors) TFT
Multi color : 65 536 colors STN

Lower Power Consumption

Low voltage/ Low power consumption
- 1.8 V low voltage drive TFT
- Wide variety of power save mode
- Prechargeless output TFT
- Partial drive mode STN

Higher Quality

Shadowingless drive STN
Lower output deviation TFT
Dot inversion drive TFT

Lower EMI

Decrease in frequency
- Dual-edge 1-port input TFT
- Single-edge 2-port input TFT

RSDS™ input TFT

Larger Panel/ Higher Definition

Highter output pin counts : 480 outputs TFT
Higher speed : 85 MHz TFT (equivalent to 160 MHz)

Fundamental Technology of LCD Drivers

RSDS™*1 input TFT

contributes to lower EMI*2 of LCDs, lower power consumption and higher-density mounting.

*1 RSDS™ : Reduced Swing Differential Signaling
RSDS is a trademark of National Semiconductor Corporation.
*2 EMI : Electro-Magnetic Interference

Partial drive mode STN

contributes to low power consumption of LCDs by partially displaying a cellular phone's LCD at standby.

Twin LCD drive single-chip driver STN

can operate as a single-chip LCD driver with fully built-in functions required for LCDs, such as LCD controller, power supply circuit and display RAM.
In addition, to share the use of an LCD driver and a backlight, twin LCDs (main LCD and sub LCD) allow to reduce the size and weight of the products.

Shadowingless drive STN

can create high quality LCDs by suppressing the generation of uneven brightness along with characters and patterns.

Lower output deviation TFT

can suppress uneven output voltage thanks to SHARP's unique off-set cancel function when displaying on the LCDs and by making the brightness of each pixel uniform.

Dot inversion drive TFT

can create high-quality display LCDs by decreasing shadowing and flicker of adjacent dots on the LCDs.

Dual-edge 1-port input and single-edge 2-port input TFT

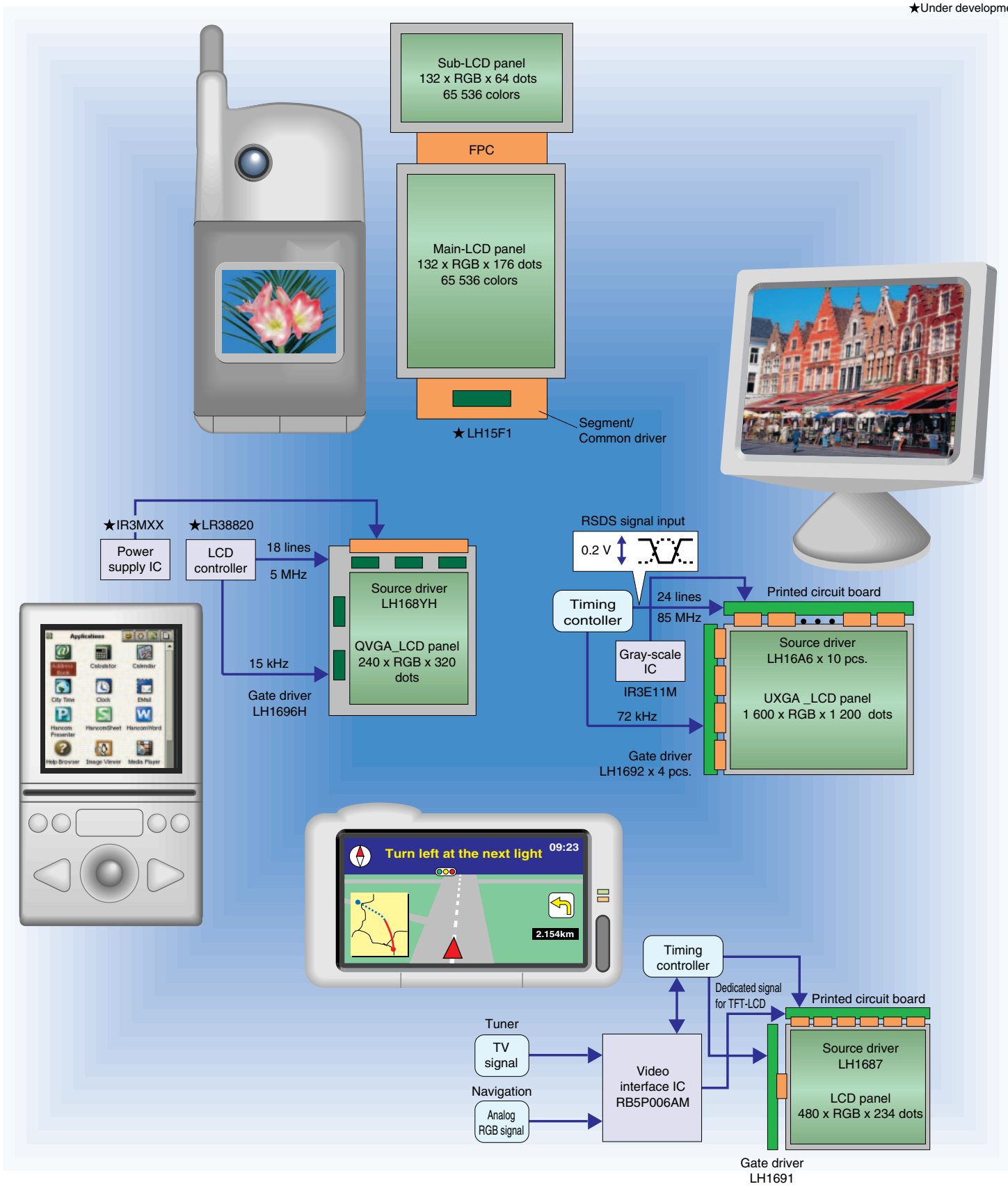
are made possible decreasing in frequency. At dual-edge 1-port input, the data are sampled at both the rising edge and the falling edge of clocks. At single-edge 2-port input, the data are sampled as 2-pixel data simultaneously at the rising edge or the falling edge of clocks.

[Notice : All company and product names are trademarks of their respective holders.]

SHARP's LSIs for LCDs Providing a System Solution

SHARP's LSIs for LCDs can provide a system solution in combination with an LCD driver, LCD controller, LCD video interface IC, gray-scale IC and power supply IC, depending on use. SHARP also has contributed to creating smaller sizes and multi-functional products by integrating LCD peripheral LSIs in a stacked package.

★Under development



Lineup of LCD Drivers

★Under development

◆ For TFT LCDs

Drive function	Drive technology	Model No.	Gray scale	No. of LCD drive outputs	Display voltage (V)MAX.	Reference page
Source Drive	Dot Inversion Drive	LH168K	64 levels (6-bit)	309/312/321/324	12	4, 7, 8
		LH168M*1		384	13	
		LH168T			13.5	
		LH168S*2		402/420		
		★LH16A3*1				
		★LH16A4*1				
		LH168R	256 levels (8-bit)	384	13	
		★LH16A5*1			15	
		LH168V		480	13	
		★LH16A6*1			15	3, 4, 7, 8
	Line Inversion Drive	LH168YH	64 levels (6-bit)	240	5.5	3, 4, 9, 10
		LH168P		300/309		4, 7, 8
		LH16A1		384		
		LH1684	Analog	240		4, 9, 10
		LH1687				3, 4, 9, 10
Gate Drive		LH1696H	—	164	33	3, 4, 9, 10
		LH1691		240		
		LH1694		256	42	4, 7, 8
		LH1692		300		3, 4, 7, 8

*1 Low EMI using RSDS™
EMI : Electro-Magnetic Interference
RSDS™ : Reduced Swing Differential Signaling. RSDS is a trademark of National Semiconductor Corporation.
*2 LH168S is a pin assignment variation of LH168T.

◆ For STN LCDs (For Medium/Small Panels)

Type	Drive function	Model No.	No. of LCD drive outputs Segment/Common	Duty ratio	Display voltage (V)MAX.	Supply voltage (V)	Reference page
For Color Graphics (With a built-in display RAM)	Segment and Common	★LH15H1	288/66	1/10, 1/18, 1/26, 1/34, 1/42, 1/50, 1/58, 1/66	+13.2	1.8 to 3.3	4, 5, 6, 12, 13, 14
		LH15A1	384/82	1/17, 1/32, 1/47, 1/62, 1/77, 1/82	+15	1.7 to 3.3	4, 5, 6, 13, 14
		LH15B1*1	396/88	to 1/88 (Selectable per 1 line)	+18		4, 6
		LH15D1*1	396/176	to 1/176 (Selectable per 1 line)			
		★LH15E1			+19	1.8 to 3.3	4, 5, 6
		★LH15F1	396/176 + 64				3, 4, 5, 6
For Graphics (With a built-in display RAM)	Segment and Common	LH155K	128/64	1/16, 1/32, 1/48, 1/64	+13.2	1.8 to 3.3	4, 5, 6
		LH155P	134/66	1/10, 1/18, 1/26, 1/34, 1/42, 1/50, 1/58, 1/66			
		LH155R	128/93	1/41, 1/93	+16.5		
		LH155T	128/109	1/41, 1/109			
		LH155G	248/68	1/67, 1/68	+14	1.8 to 5.5	

*1 Without display RAM and LCD controller

◆ For STN LCDs (For Large/Medium Panels)

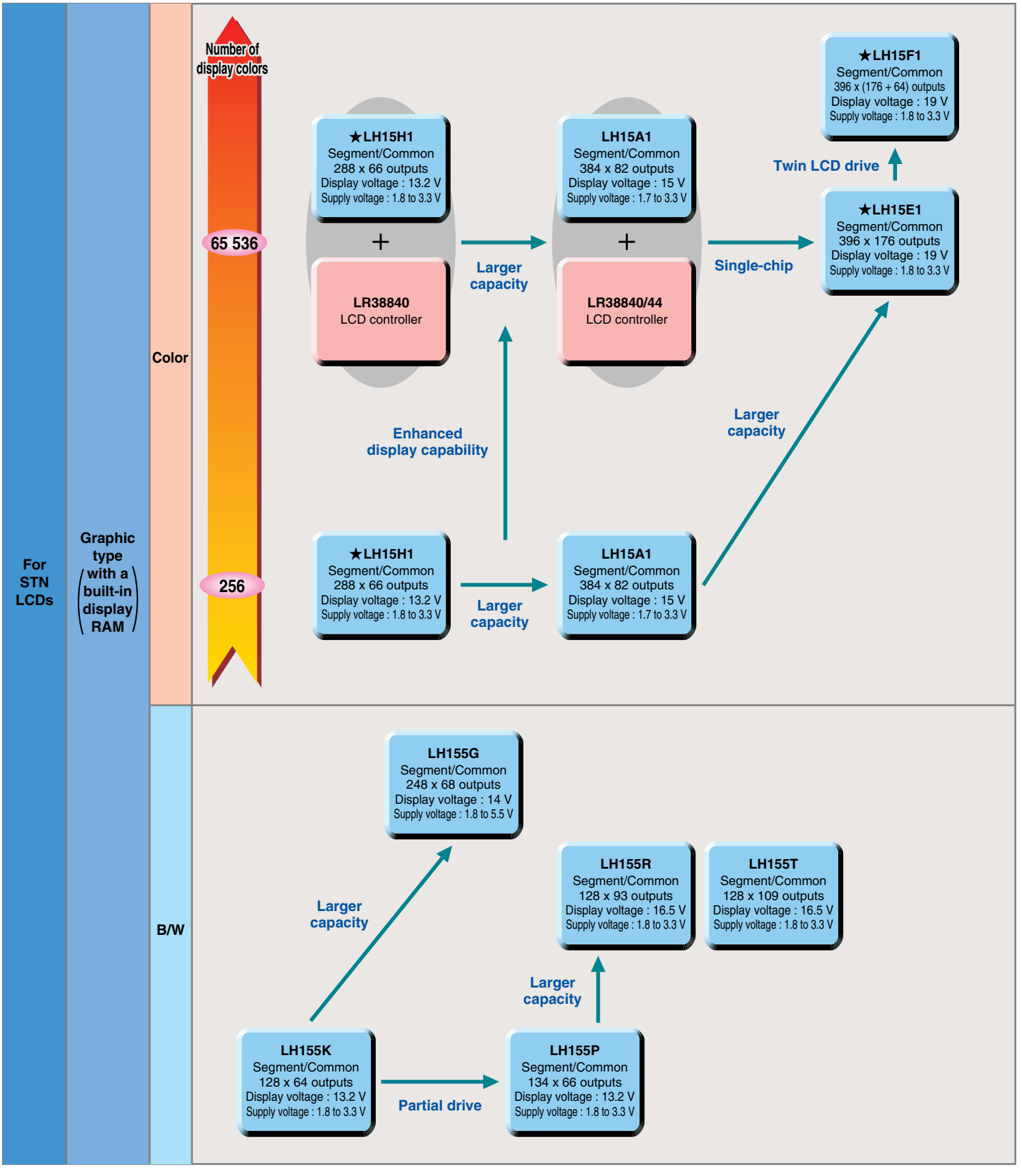
Drive technology	Drive function	Model No.	No. of LCD drive outputs	Duty ratio	Display voltage (V)MAX.	Reference page
New Drive Technology*1	Segment (5 V drive)	LH155E*3	160	1/100, 1/120, 1/128, 1/200, 1/240, 1/256	+5.5	4, 9, 10
		LH1583		to 1/240		
		LH1580	240	to 1/480		
		LH1581				
	Common	LH153D	120/160	1/160	+45	4, 9, 10
		LH1537	200/240	1/200, 1/240		
		LH1538	120/128	to 1/480	+80	
Conventional Drive Technology*2	Segment	LH1542	80	to 1/240	+30	4, 9, 10
		LH1549	160	to 1/480	+42	
		LH1548	240			
	Common	LH1532	100	to 1/240	+30	4, 9, 10
		LH1530	120	to 1/480	+42	
	Segment or Common	LH1565	160	to 1/240	+30	4, 9, 10
		LH1560		to 1/480	+42	
		LH1562	240			

*1 New drive technology : A drive technology which drives LCDs with low voltage of 5 V on segment side, and drives LCDs with high voltage on common side. Driving with low voltage on segment side enables LCDs to reduce power consumption and shadowing.
*2 Conventional drive technology : A drive technology which drives LCDs with high voltage on both segment and common sides.
*3 With a built-in display RAM

For Cellular Phones

★Under development

For Cellular Phones



: STN-LCD driver : LCD controller

★Under development

STN-LCD Drivers for Cellular Phones

Type		Drive function	Model No.	No. of LCD drive outputs		Duty ratio	Display voltage (V) MAX.	Data input	Clock frequency (MHz) MAX.	Supply voltage (V)	Package
				Segment	Common						
For color graphics (With a built-in display RAM)	256 colors	Segment and Common	★LH15H1	288	66	1/10, 1/18, 1/26, 1/34, 1/42, 1/50, 1/58, 1/66	+13.2	8/16-bit parallel/serial	4 (at 3 V)	1.8 to 3.3	SOF
			LH15A1	384	82	1/17, 1/32, 1/47, 1/62, 1/77, 1/82	+15		5 (at 3 V)	1.7 to 3.3	TCP/SOF
	65 536 colors		LH15B1*1	396	88	to 1/88 (Selectable per 1 line)	+18	[Display data] 12-bit parallel [Command data] Serial			
			LH15D1*1		176	to 1/176 (Selectable per 1 line)					
			★LH15E1				+19	8/16-bit parallel/serial	4 (at 3 V)	1.8 to 3.3	SOF
			★LH15F1		176 + 64						
For graphics (With a built-in display RAM)			LH155K	128	64	1/16, 1/32, 1/48, 1/64	+13.2	8-bit parallel/serial	2 (at 3 V)	1.8 to 3.3	TCP
			LH155P	134	66	1/10, 1/18, 1/26, 1/34, 1/42, 1/50, 1/58, 1/66			3.3 (at 3 V)		
			LH155R	128	93	1/41, 1/93	+16.5		4.5 (at 3 V)		
			LH155T		109	1/41, 1/109					
			LH155G	248	68	1/67, 1/68	+14		3 (at 5 V)	1.8 to 5.5	

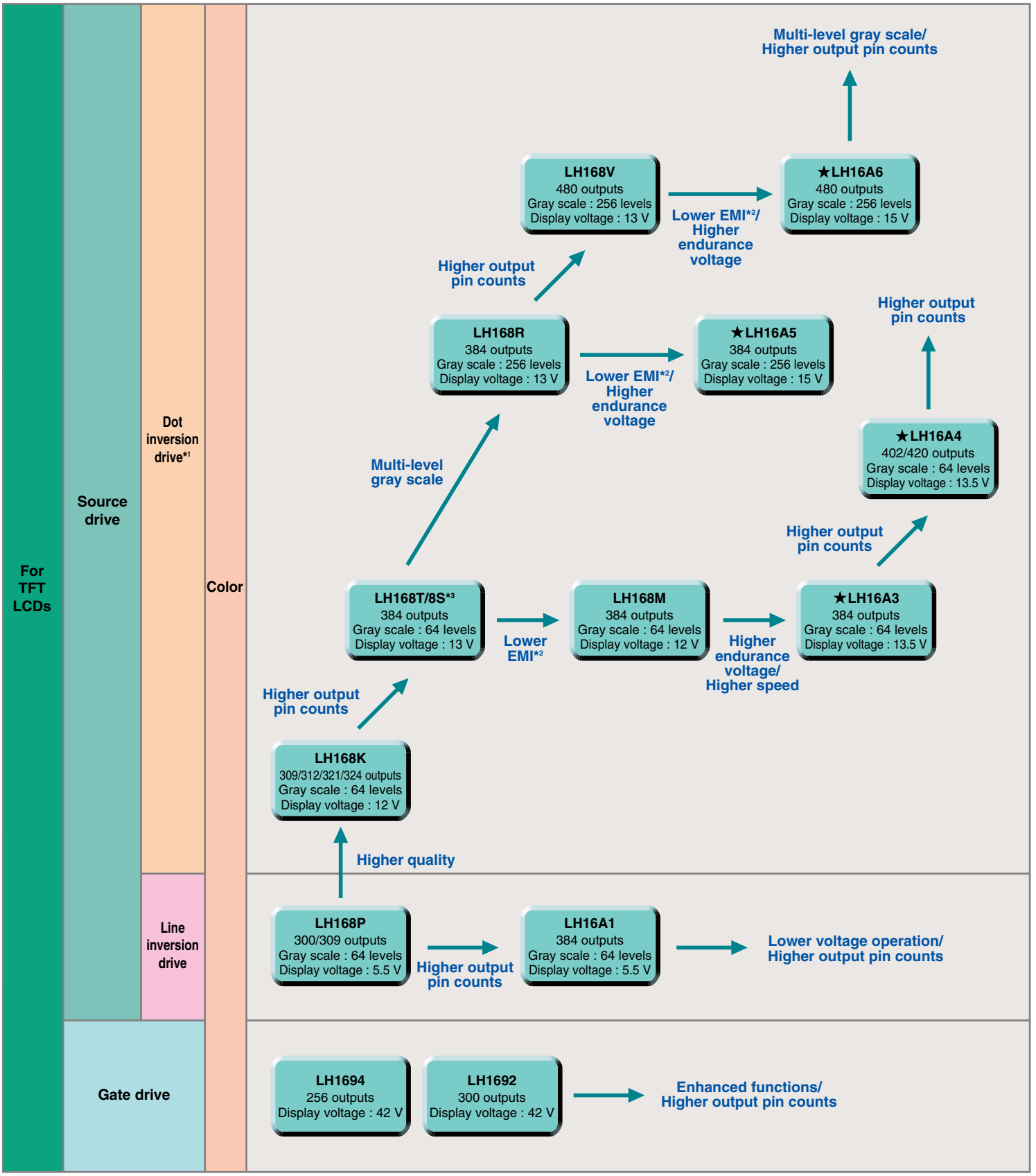
*1 Without display RAM and LCD controller

TCP : Tape Carrier Package SOF : System On Film

For Notebook PCs and PC Monitors

★Under development

For Notebook PCs and PC Monitors



*1 Low output deviation dot inversion drive
*2 EMI : Electro-Magnetic Interference
*3 LH168S is a pin assignment variation of LH168T.

: TFT-LCD driver

★Under development

TFT-LCD Drivers for Notebook PCs and PC Monitors

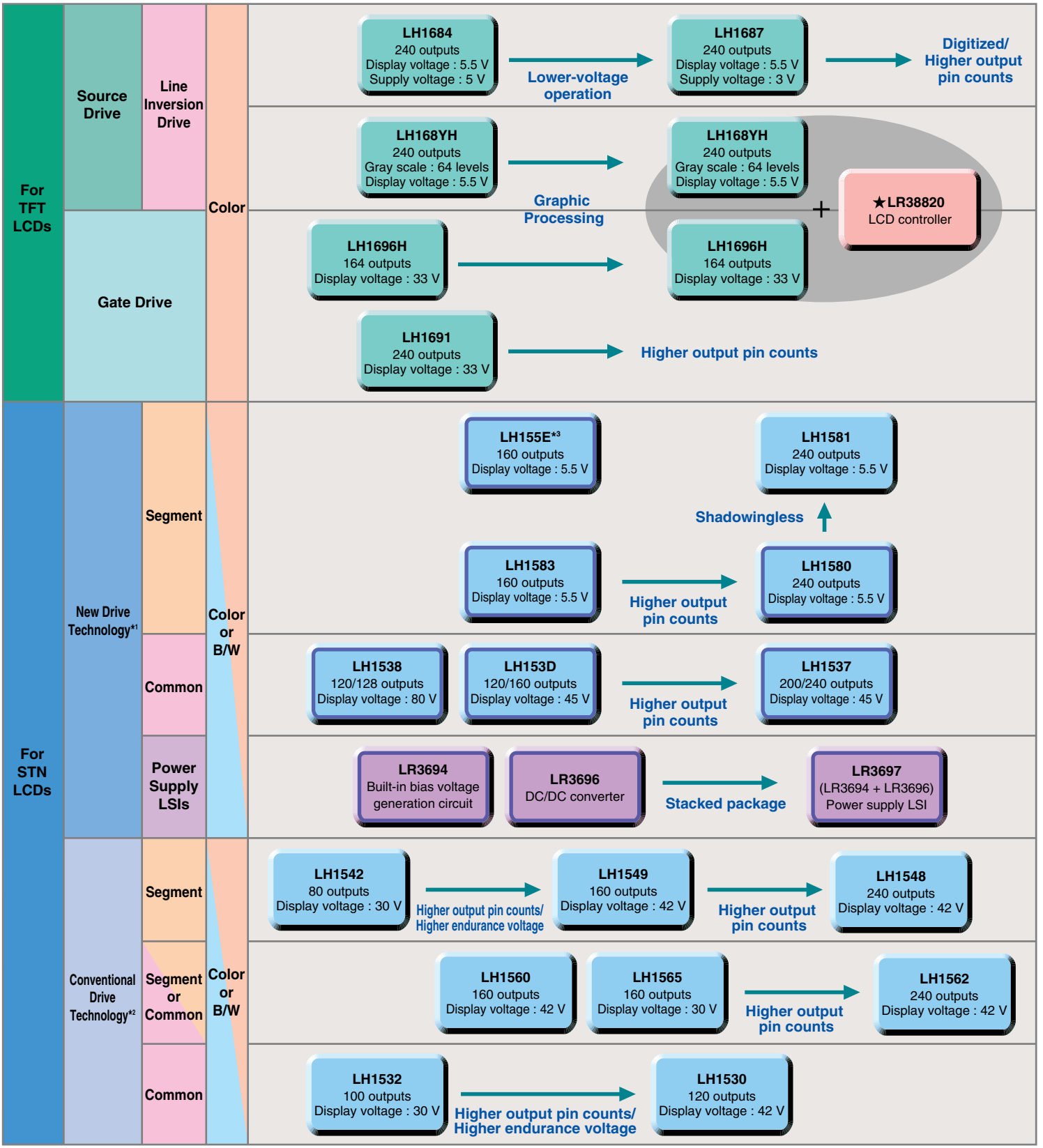
Drive function	Model No.	Gray scale	No of LCD drive outputs	Display voltage (V) MAX.	Clock frequency (MHz) MAX.	Supply voltage (V)	Function	Package
Source drive (Dot inversion drive*1)	LH168K	64 levels (6-bit)	309/312/321/324	12	55	2.7 to 3.6	Data input port selectable : 1 port/2 ports*2, built-in reference voltage generation circuit, R-DAC system	TCP/SOF
	LH168T		384	13	65		2-port data input, built-in reference voltage generation circuit, R-DAC system	
	LH168S*3							
	LH168M			12	68	3.0 to 3.6	Low EMI*4 using RSDS™*5, built-in reference voltage generation circuit, R-DAC system	
	★LH16A3			13.5	85	2.7 to 3.6		
	★LH16A4		402/420					
	LH168R	256 levels (8-bit)	384	13	65		2-port data input, built-in reference voltage generation circuit, R-DAC system	
	★LH16A5			15	85		Low EMI*4 using RSDS™*5, built-in reference voltage generation circuit, R-DAC system	
	LH168V		480	13	65	2.5 to 3.6	Clock single-edge (2-port input) or clock dual-edge (1-port input) selectable (built-in data sampling switching function), built-in reference voltage generation circuit, R-DAC system	
	★LH16A6			15	85	2.7 to 3.6	Low EMI*4 using RSDS™*5, built-in reference voltage generation circuit, R-DAC system	
Source drive (Line inversion drive)	LH168P	64-levels (6-bit)	300/309	5.5	55	3.0 to 5.5	Built-in reference voltage generation circuit, R-DAC system	
	LH16A1		384		57	2.7 to 3.6	2-port data input, built-in reference voltage generation circuit, R-DAC system	
Gate drive	LH1694	–	256	42	0.1	2.7 to 3.6	Output signal masking function, usable with both positive/negative power supplies, enables chain connection	
	LH1692		300			3.0 to 5.5	1-pulse (normal) or 2-pulse (continuous/jumping) scanning selectable, usable with both positive/negative power supplies	

TCP : Tape Carrier Package SOF : System On Film

*1 Low output deviation dot inversion drive
*2 1-port data input at 309/321 outputs, 2-port data input at 312/324 outputs.
*3 LH168S is a pin assignment variation of LH168T.
*4 EMI : Electro-Magnetic Interference
*5 RSDS™ : Reduced Swing Differential Signaling
RSDS is a trademark of National Semiconductor Corporation.

For Applications with Medium LCD Panels

For Applications with Medium LCD Panels



*1 New drive technology : A drive technology which drives LCDs with low voltage of 5 V on segment side, and drives LCDs with high voltage on common side. Driving with low voltage on segment side enables LCDs to reduce power consumption and shadowing.
*2 Conventional drive technology : A drive technology which drives LCDs with high voltage on both segment and common sides.
*3 With a built-in display RAM

: STN-LCD driver : TFT-LCD driver : LCD peripheral LSI
: LCD controller : Usable in combination

TFT-LCD Drivers for Applications with Medium LCD Panels

Drive function	Model No.	Gray scale	No of LCD drive outputs	Display voltage (V) MAX.	Clock frequency (MHz) MAX.	Supply voltage (V)	Function	Package	Applications
Source drive (Line inversion drive)	LH168YH	64 levels (6-bit)	240	5.5	35	2.3 to 5.5	Built-in reference voltage generation circuit, R-DAC system, power saving function, polarity inversion of input data	COG	Personal digital assistants
	LH1684	Analog			10	4.5 to 5.5	Three-point simultaneous or normal sampling selectable (Sampling frequency : 20 MHz)	TCP	Automobile navigation systems
	LH1687				12.5	3.0 to 5.5	Three-point simultaneous or normal sampling selectable (Sampling frequency : 25 MHz), power saving function, 3 V drive (MIN.), prechargeless output	TCP/COG	
Gate drive	LH1696H	–	164	33	0.1	2.3 to 5.5	1-pulse scanning, all "Low" mode	COG	Personal digital assistants
	LH1691		240			3.0 to 5.5	1-pulse (normal) or 2-pulse (continuous/jumping) scanning selectable, usable with both positive/negative power supplies	TCP/COG	Automobile navigation systems

TCP : Tape Carrier Package COG : Chip On Glass

STN-LCD Drivers for Applications with Medium LCD Panels

Drive technology	Drive function	Model No.	No. of LCD drive outputs	Duty ratio	Display voltage (V) MAX.	Data input	Clock frequency (MHz) MAX.	Supply voltage (V)	Package	Applications
New drive technology*1	Segment	LH155E*3	160	1/100, 1/120, 1/128, 1/200, 1/240, 1/256	+ 5.5	8-bit parallel/serial	2 (at 3 V)	2.4 to 3.3	TCP	Personal digital assistants
		LH1583		to 1/240		4/8-bit parallel	12 (at 2.4 V)/ 20 (at 5 V)	2.4 to 5.5		
		LH1580	240	to 1/480		8/12-bit parallel	30 (at 2.5 V)/ 55 (at 5 V)	2.5 to 5.5		
		LH1581								
	Common	LH153D	120/160	1/160	+ 45	–	3 (at 2.4 V)/ 4 (at 5 V)	2.4 to 5.5		
		LH1537	200/240	1/200, 1/240						
		LH1538	120/128	to 1/480	+ 80		3 (at 2.5 V)/ 4 (at 5 V)	2.5 to 5.5		
Conventional drive technology*2	Segment	LH1542	80	to 1/240	+ 30	4-bit parallel	8			
		LH1549	160	to 1/480	+ 42	4/8-bit parallel	12 (at 2.5 V)/ 20 (at 5 V)			
		LH1548	240			8/12-bit parallel	12 (at 2.5 V)/ 25 (at 5 V)			
	Common	LH1532	100	to 1/240	+ 30	–	4			
		LH1530	120	to 1/480	+ 42		3 (at 2.5 V)/ 4 (at 5 V)			
	Segment or Common	LH1565	160	to 1/240	+ 30	4/8-bit parallel (at segment drive)	[Segment mode] 8 [Common mode] 4			
		LH1560		to 1/480	+ 42		[Segment mode] 8 (at 2.5 V)/14 (at 5 V) [Common mode] 4			
		LH1562	240				[Segment mode] 12 (at 2.5 V)/20 (at 5 V) [Common mode] 4			

*1 New drive technology : A drive technology which drives LCDs with low voltage of 5 V on segment side, and drives LCDs with high voltage on common side. Driving with low voltage on segment side enables LCDs to reduce power consumption and shadowing.
*2 Conventional drive technology : A drive technology which drives LCDs with high voltage on both segment and common sides.
*3 With a built-in display RAM

TCP : Tape Carrier Package

Power Supply LSIs for Medium STN-LCD Panels

Model No.	Description		Supply voltage (V)	Package
LR3694	Bias voltage generation circuit for LCD drive, electronic volume control circuit	For LH155E, LH1583, LH1580, LH153D, LH1537, LH1538	2.4 to 3.3 (V_{DD}, V_P), 14.4 to 19.8 (V_{H6}), −16.5 to −12.0 (V_{L6})	P-TQFP048-0707
LR3696	DC/DC converter for LCD drive power supply		2.4 to 3.3 (V_{DD}, V_P)	P-QFP032-0707
LR3697	DC/DC converter for LCD drive power supply, bias voltage generation circuit for LCD drive, electronic volume control circuit			P-QFP072-1010

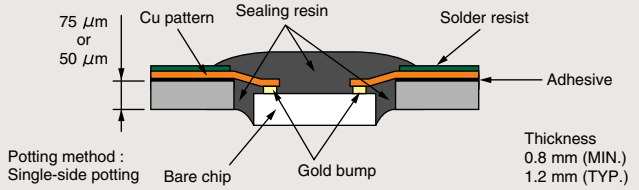
Package Technologies for LCD Drivers

Improvements in SHARP's original packaging technology, as well as in design and wafer process technologies, make possible smaller, thinner and more highly-functional LCD drivers. SHARP can provide two types of packages, TCP and SOF, which can be selected depending on customer needs.

TCP (Tape Carrier Package)

This is a package which can easily achieve higher pin counts, finer pin pitches and reduced dimensions. It allows flexible pattern design of outer lead shapes and pitches, to accept different pin connections. Depending on use, SHARP's TCPs are available in a variety of tape patterns, coatings, and other options. We can customize our TCPs to accommodate our customers' needs.

Cross Section



Features

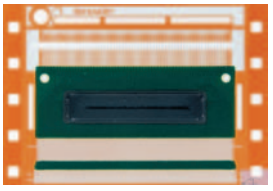
- Both face-up or face-down chip mounting are available.
- Alignment can be easily determined on user side by adopting overhang pattern.
- Capable of incorporating passive components.

TCP Varieties

UST (Ultra-Slim TCP)

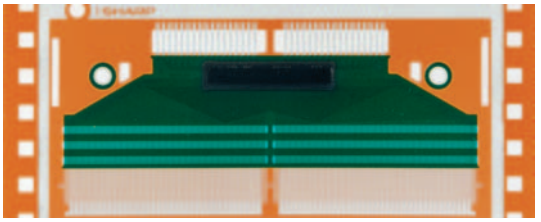
The UST combines ultra-slim chip technology and TCP technology to achieve an external TCP size of 5.5 mm.

High-Pin-Count Fine-Pitch TCP



Using fine-pitch technology, a 35 mm-wide tape, 480-output (pad pitch 50 μm; outer lead pitch 55 μm), high-pin-count and fine-pitch TCP has been developed.

Super Soft Flexible TCP

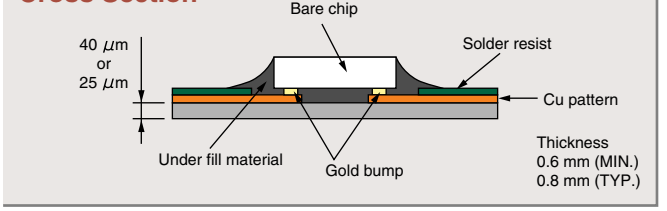


The enhancement of our own TCP assembly technology and tape materials has resulted in the development of a super-soft flexible TCP, a product that has improved bendability and three times as much bending strength as existing products.

SOF(System On Film)

This package enables mounting of various components including bare chips, such as LCD drivers and LCD controllers, and peripheral circuit components onto film. It contributes to the realization of higher-level functions in applications. This package is mainly used in small LCD panels and contributes to making smaller and thinner portable equipment.

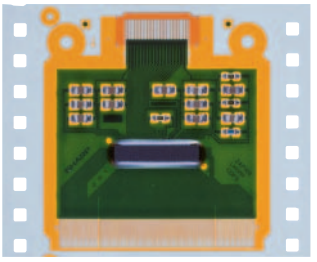
Cross Section



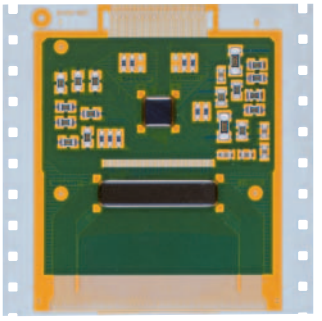
Features

- Capable of mounting various components including bare chips, such as LCD drivers and LCD controllers, and peripheral circuit components.
- Contributes to the design of thin and compact products thanks to highly flexible and thin film package which can be bent freely, such as by angle-bending.
- Suitable for finer pin pitches due to absence of flying lead.
- Flexible pattern design can be achieved by designing patterns on a film under the chip.

Single chip SOF



Multi chip SOF



SOF Modules

★Under development

SHARP offers SOF (System On Film) modules with LCD drivers mounted on film. As multiple chip mounting is possible, they enable mounting of various components including bare chips, such as LCD drivers and LCD controllers, LCD panels, and peripheral circuit components. Therefore, they can help create system modules for a range of applications, and make possible higher-level functions in applications. We can provide a standard product, LR0G918A, suitable for sub LCD display of a cellular phone, a toy camera, etc.

Features

●Multiple chip mounting

Enables mounting of various components including bare chips, such as LCD drivers and LCD controllers, LCD panels, and peripheral circuit components, and thereby contributes to the realization of higher-level functions in applications.

●Fully custom-designed package

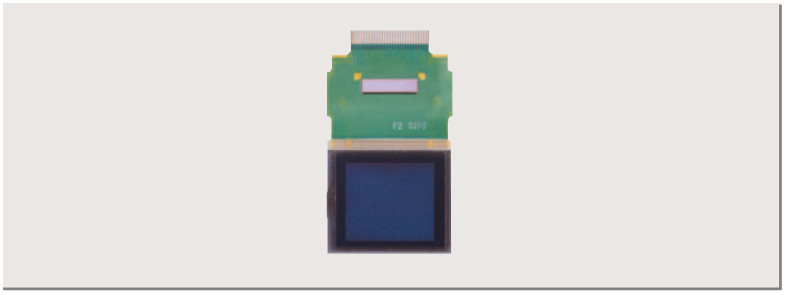
●Highly flexible and thin film package

By using highly flexible and thin film, SOF modules contribute to the design of thin and compact products. They can also easily achieve finer pin pitches and higher output pin counts.

LCD Module

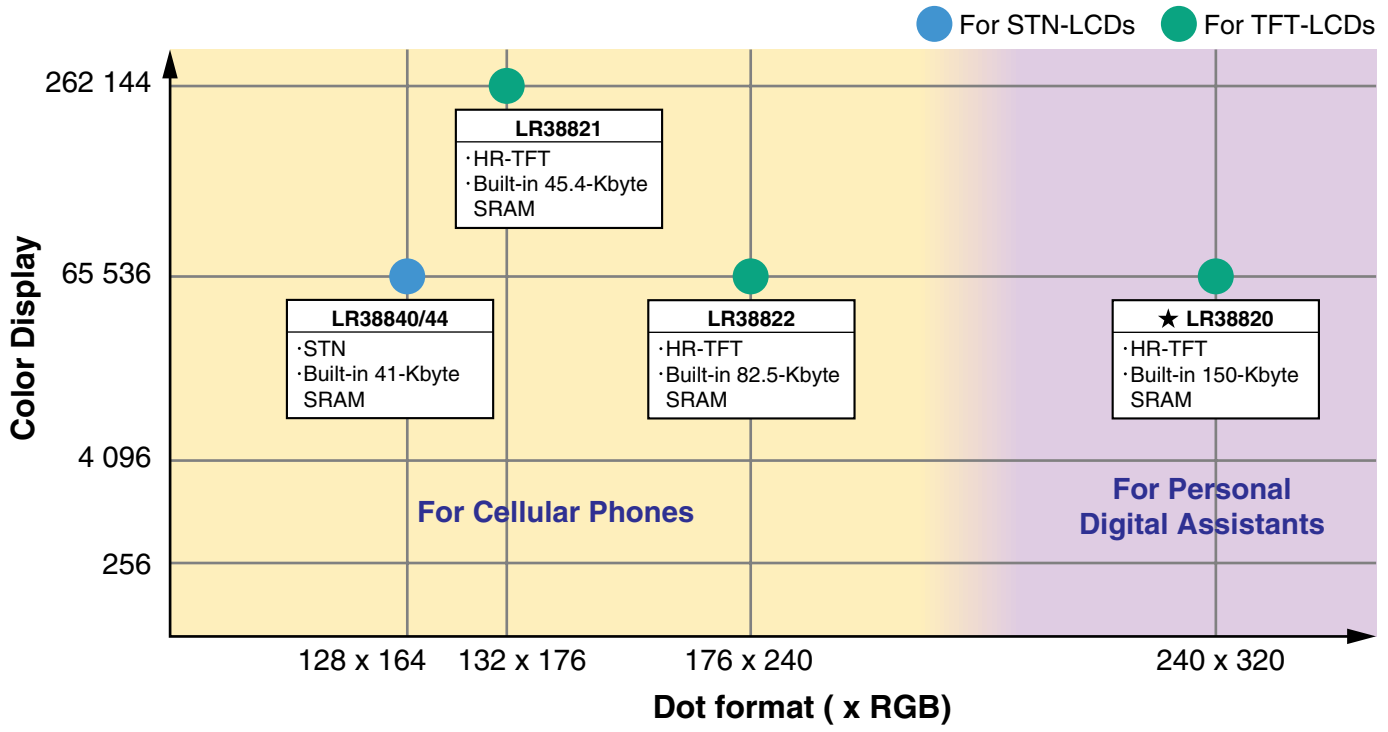
Model No.	★LR0G918A
Module structure	• LCD panel + SOF (with an LCD driver) • Built-in LCD drive power supply circuit and oscillator
LCD panel	Color STN, transflective
Dot format H x V (dot)	72 x RGB x 64
Active area W x H (mm)	17.268 x 15.345
Dot size W x H (mm)	0.068 x 0.24
LCD driver	★LH15H1
Duty ratio	1/10, 1/18, 1/26, 1/34, 1/42, 1/50, 1/58, 1/66
LCD drive power supply	Built-in booster circuit (x 2, x 3, x 4)
Outline dimensions W x H x D (mm)	25 x 44.34 x approx. 1.47*1
MPU Interface	8/16-bit parallel (68-family/80-family)
Supply voltage (V)	V_{DD} = V_{EE} = 3.0 (recommended)
Operating temp. (°C)	−20 to +70
Storage temp. (°C)	−30 to +80

*1 W : Not including the burr of plastic mold resin. H : Indicates the size before SOF bending.
D : Indicates the thickness of LCD panel.
Module without LCD panel is also available.



Road Map for LCD Controllers

★ Under development

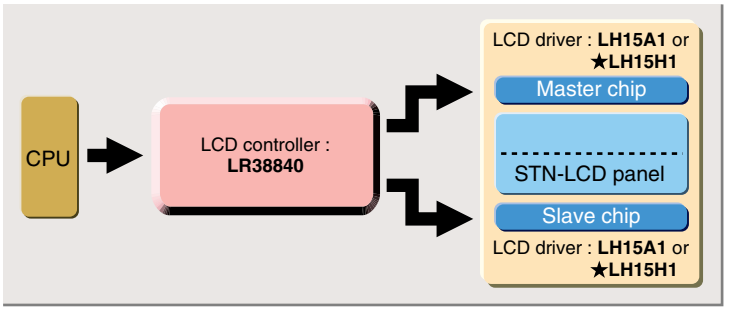


Features of LCD Controllers

★ Under development

STN-LCD Controllers for Cellular Phones (LR38840/LR38844)

- Provides 65 536-color display
- Display color selectable : 256/4 096/ 65 536 colors
- Low power consumption
- CPU interface : 68-family or 80-family selectable
- Bus width : 8-bit or 16-bit selectable
- For LH15A1 or ★LH15H1 (LR38840)
  For LH15A1 (LR38844)
- LCD size : up to 20 992 (128 x 164) dots



TFT-LCD Controllers for Cellular Phones (LR38821/LR38822)

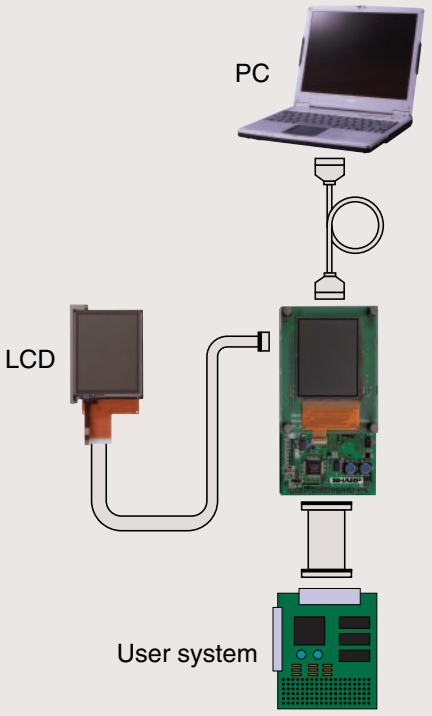
- Provides 262 144-color display (LR38821)
  Provides 65 536-color display (LR38822)
- Low power consumption
- CPU interface : 80-family (LR38821)
  68-family and 80-family selectable (LR38822)
- Bus width : 8-bit or 16-bit selectable
- LCD size : up to 23 232 (132 x 176) dots (LR38821)
  up to 42 240 (176 x 240) dots (LR38822)

TFT-LCD Controller for Personal Digital Assistants (★LR38820)

- Built-in simple graphic processing functions, such as copying, mirror imaging, painting out and rotation, which places a minimal load on the main CPU.
- Provides 65 536-color display
- Low power consumption
- CPU interface : 80-family
- Bus width : 16-bit
- LCD size : up to 76 800 (240 x 320) dots

LCD Controller Evaluation Tools

SHARP can provide whole-system evaluation boards that work through linkage to user systems.



[LCD controller evaluation kit]

- Evaluation board :
  Includes LCD controller chip and demo host.
- PCI general interface card
- PCI host interface cable
- MPI interface cable

For further details, contact a SHARP sales office.

Specifications for LCD Controllers

★ Under development

STN-LCD Controllers for Cellular Phones

Model No.	Display area (Dot) MAX.	Display color [MAX.]	Function/Feature		CPU interface	Frame memory size	Supply voltage (V) TYP.	Power consumption*1 (mW) TYP. 256-color display	Power consumption*1 (mW) TYP. 65 536-color display	Package
LR38840	128 x RGB x 164	65 536	• Provides 65 536-color display • Display colors selectable : 256/4 096/65 536 colors • Power saving function, reducing the power consumption in standby mode • Built-in CPU interface, LCD interface, clock generator, display memory	For LH15A1, ★LH15H1	68-family/ 80-family (8/16-bit)	41 Kbytes	2.5	1.5	7	T-TFBGA081-0808
LR38844			• High-speed host access • Higher performance model • Provides 65 536-color display • Display colors selectable : 256/4 096/65 536 colors • Power saving function, reducing the power consumption in standby mode • Built-in CPU interface, LCD interface, clock generator, display memory	For LH15A1					6	

*1 When connected to 8-bit bus at 5.4 MHz.

TFT-LCD Controllers for Cellular Phones

Model No.	Display area (Dot) MAX.	Display color [MAX.]	Function	CPU interface	Frame memory size	Supply voltage (V) TYP. Core	Supply voltage (V) TYP. I/O	Power consumption (mW) TYP.	Package
LR38821	132 x RGB x 176	262 144	• Built-in CPU interface, LCD interface, timing generator, clock generator, display memory	80-family (8/16-bit)	45.4 Kbytes	2.5	3.3	3	T-TFBGA112-1010
LR38822	176 x RGB x 240	65 536		68-family/ 80-family (8/16-bit)	82.5 Kbytes			5	

TFT-LCD Controller for Personal Digital Assistants

Model No.	Display area (Dot) MAX.	Display color [MAX.]	Function	CPU interface	Frame memory size	Supply voltage (V) TYP. Core	Supply voltage (V) TYP. I/O	Power consumption (mW) TYP.	Package
★LR38820	240 x RGB x 320	65 536	• Simple graphic processing function*1 • Built-in CPU interface, LCD interface, timing generator, clock generator, display memory	80-family (16-bit)	150 Kbytes	2.5	3.3	25	P-LQFP120-1414/ T-TFBGA112-1010

*1 It enables simple graphic processing, such as copying, mirror imaging, painting out and rotation, which places a minimal load on the main CPU.

ICs for TFT-LCDs

★Under development

Gray-scale ICs for TFT-LCDs

Model No.	Panel type	Function	No. of output circuits	Output current (mA) MAX.	Common output current (mA) MAX.	Supply voltage (V) TYP.	Package
IR3E201N/ IR3E204N	·Small panels ·Line inversion drive	Gray-scale voltage generator for LCD drivers, built-in dividing resistors	10	±1	±1	5	P-MFP018
IR3E3XX			5	±1	±1	5	P-SSOP012-0225
IR3E08M1	·Medium/Large panels ·Line inversion drive	Gray-scale voltage generator for LCD drivers	9	±10	±10	5	P-TQFP048-0707
IR3E11M	·Large panels ·Up to 20-type panels ·SXGA/UXGA ·Dot inversion drive		10	±15	±150	10.5	
★IR3E12M			18	±15	±150	10.5	

Features

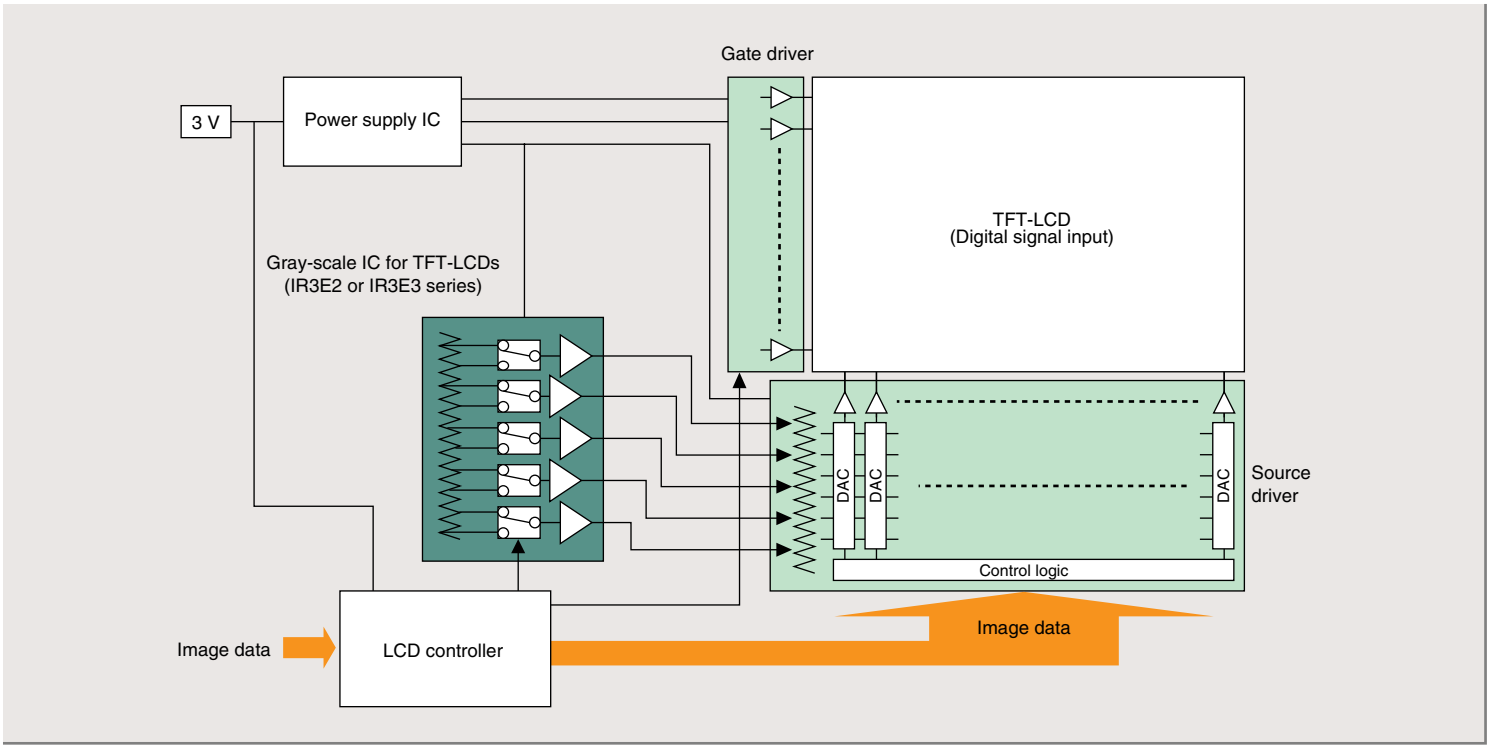
● For small TFT-LCD panels : IR3E2 series and IR3E3 series

·Ideal for mobile equipment thanks to low-power-consumption design.
·Integrating regulator and resistance array dramatically reduces the number of external components.
·The setting of output voltage can be customized, depending on the LCD characteristics.

● For large TFT-LCD panels with dot inversion drive : IR3E11M and ★IR3E12M

·Available for up to 20-type SXGA or UXGA panels with large common output current (±150 mA [MAX.]).
·External volume and gray-scale adjustment are not required by integrated high-definition regulator.
·The number of LCD components can be decreased.

System Configration Example : Small TFT-LCDs (IR3E2 series and IR3E3 series)



Power Supply IC for TFT-LCDs

Model No.	Supply voltage(V)	Output voltage (V)TYP.			Load current (mA)			Package
		V_{DD}	V_{OUT1}	V_{OUT2}	V_{DD}	V_{OUT1}	V_{OUT2}	
★IR3MXX	2.7 to 3.6	5.1	15.3	−10.2	0 to −10	0 to −0.2	0 to 0.2	P-VQFN020-0404

★Under development

Video Interface ICs for TFT-LCDs

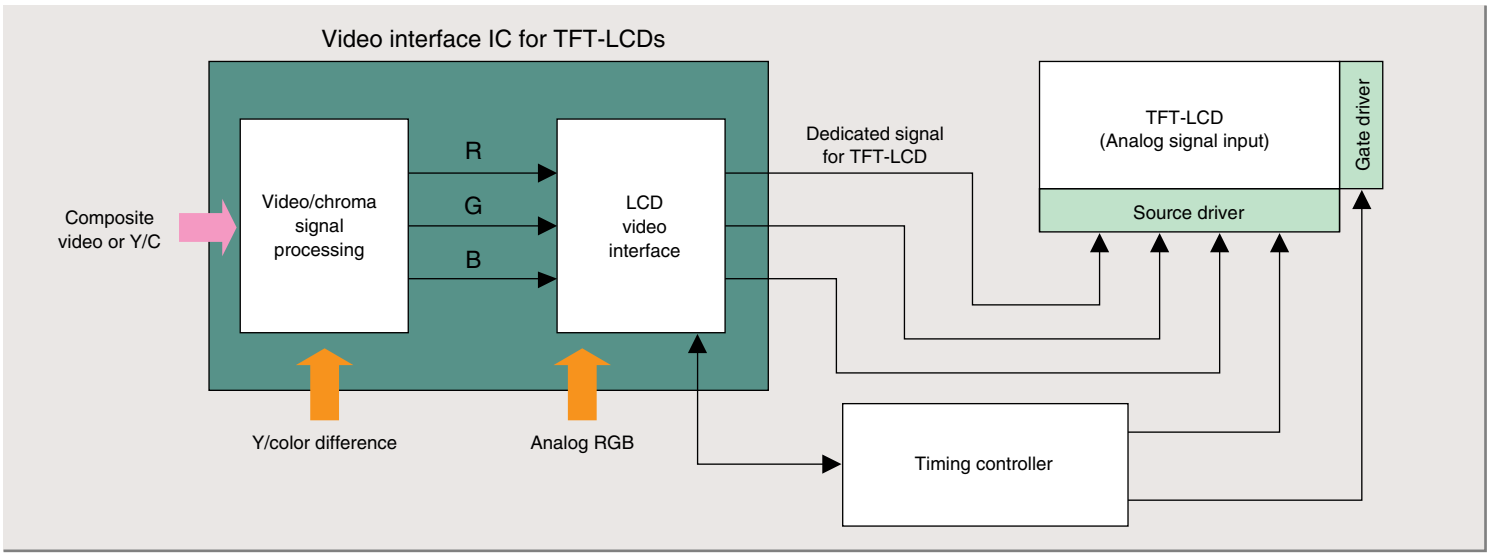
Model No.	Input signal				Color decode	LCD panel				Serial data control	Supply voltage (V)	Power consumption (mW) TYP.	Package
	Composite video	Y/C	Y/color difference	Analog RGB		±power source	+power source	Low voltage source	Digital input				
IR3Y18A		○			NTSC/PAL	○	○				4.5/12 or 4.5/−7.5	130	P-QFP048-0707
IR3Y26A/A1				○	–			○			5/7.5	140	P-QFP048-1010/ P-QFP048-0707
IR3Y29AM/BM	○	○		○	NTSC/PAL			○				190	P-QFP048-0707
IR3Y31M	○	○		○	NTSC/PAL	○	○				4.5/12 or 4.5/−7.5	160	
IR3Y34M			○	○	–		○				3/12	88	
IR3Y35M			○	○	–		○					91	
IR3Y37M			○	○	–			○			3/6.5	95/77*2	
IR3Y37AM			○	○	–			○				106/88*2	
RB5P0010M				○	–	○	○			○	3/12 or 3/4.5/−7.5	92	
RB5P0020M			○	○	–			○			3/5	70/57*2	
RB5P0050M			○	○	–			○		○	3/5/13	95/80*2	
RB5P0060M		○		○	NTSC/PAL			○		○		120	P-QFP048-1010
RB5P006AM	○	○		○	NTSC/PAL			○		○			
★RB5P0070M*1	○	○		○	NTSC/PAL				○	○	3/7	330	P-QFP072-1010

○ : Available
*1 For digital signal input panels
*2 At analog RGB input

Features

- Suitable for battery driven products thanks to low power consumption.
- Wide lineup variety, from amorphous silicon TFT-LCDs to poly-silicon TFT-LCDs.
- Natural gray-scale display and wide range of brightness adjustment are realized by adopting original SHARP brightness adjustment circuit where common amplitude and gamma correction point react to each other.
- Can be unified with a timing controller IC by adopting a stacked package and can adopt QFN packages to contribute to making smaller products.

System Configuration Example : Analog Signal Input TFT-LCDs



★Under development

Classification of Video Interface ICs for TFT-LCDs

		Compact LCD TVs/ Automobile navigation systems	Digital still cameras/Camcorders/ Automobile navigation systems	Digital still cameras/Camcorders
Applications				
Input Signal		Composite Video & Y/C	Analog RGB	Y/Color Difference
Source supply voltage	For 12 V (or +5 V/−8 V) LCD panels*1	IR3Y18A IR3Y31M	IR3Y34M IR3Y35M RB5P0010M	
	For 5V LCD panels		IR3Y26A/A1	
		IR3Y29AM/BM RB5P0060M RB5P006AM ★RB5P0070M*1		IR3Y37M IR3Y37AM RB5P0020M RB5P0050M

*1 IR3Y34M and IR3Y35M are applied to only LCD panels of 12 V source supply voltage.
*2 For digital signal input panels

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- Audio visual equipment
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