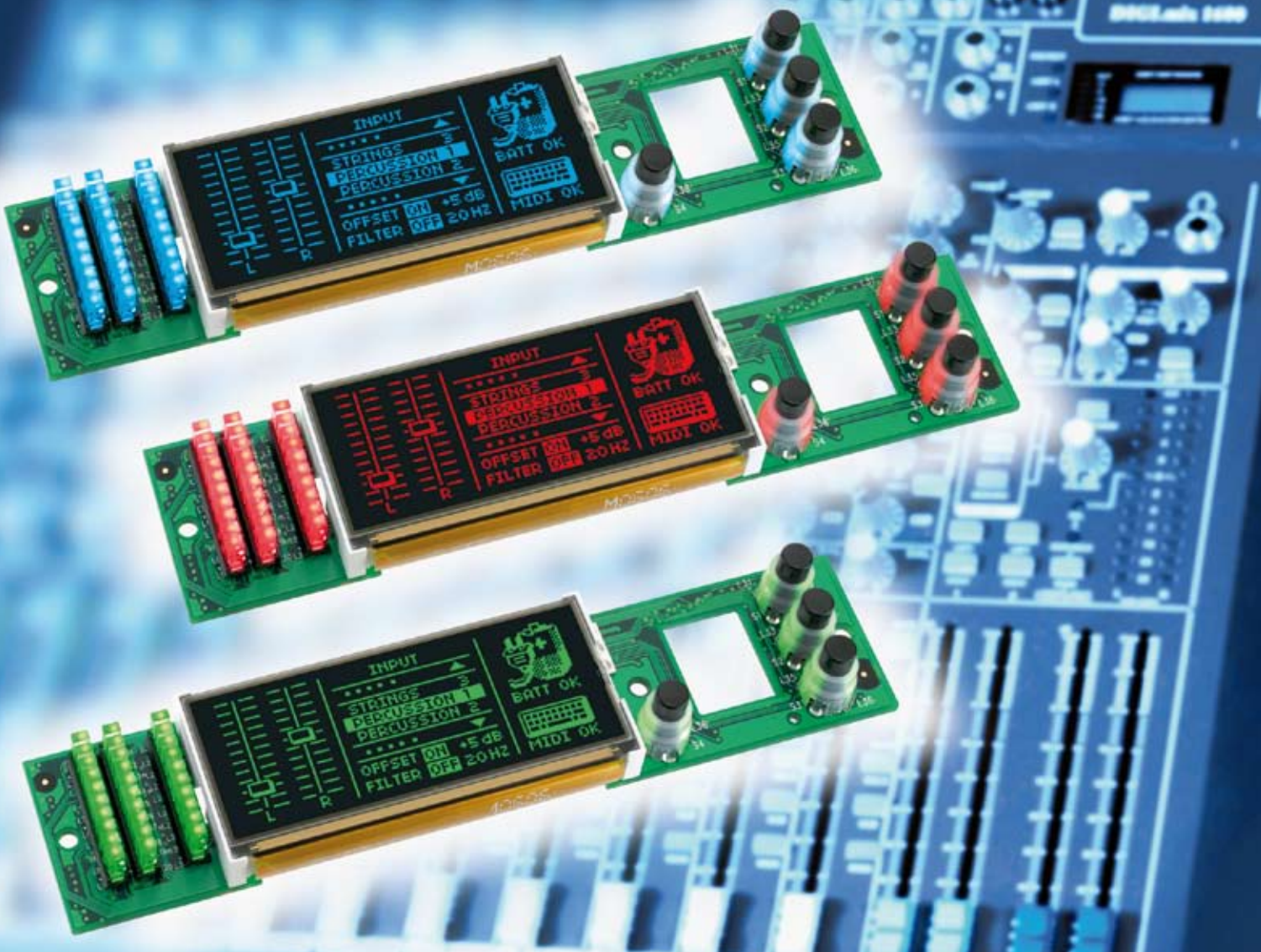


## Customized Glasses and Modules

*A guide to implement individual LCD solutions*



## Application examples

### Coffee Machine



Free shape LCD for special designs

### Industrial measurement



Segment module TN

### Industrial controller



Mixed alphanumeric / segment module with bicolor LED backlight red / green

### For universal use




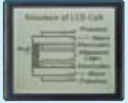






132 x 65 dots full graphic module with flex cable, specially shaped glass and snap-in backlight

## Technical solutions of the highest level

Data Modul offers customized solutions for LC glasses and LC modules. We combine more than 30 years of experience as well as technical know how and competence with the experience of leading manufacturers. The results are technical solutions of the highest level. All basic data can be specified according to customer requests which guarantees the ideal integration of the LC module into a company's application. Data Modul guides the customer through all necessary steps beginning at the design over development and production of a display.

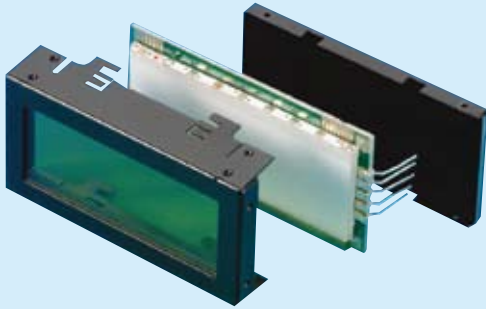
## LCD technologies

	Technology	Dot color / Background	Features
	TN, HTN, IBN	black / gray optional other	<ul style="list-style-type: none"> <li>• TN (Twisted Nematic) / HTN (Higher Twisted Nematic) is the most cost-effective technology</li> <li>• IBN Improved Black Nematic (ultra high contrast)</li> <li>• suitable for static and low multiplex driving</li> <li>• twisting of molecules is 90° / 110°</li> </ul>
	STN / grey silver blue	dark blue / yellow green	<ul style="list-style-type: none"> <li>• STN (Super Twisted Nematic) twisting angle up to 270° which gives almost ideal steepness of the characteristic optoelectronic curves</li> <li>• improvement of the viewing angle</li> <li>• refer to page 13 for detailed information</li> </ul>
	FSTN	black / white	<ul style="list-style-type: none"> <li>• FSTN (Film Super Twisted Nematic)</li> <li>• high-contrast black and white representation by utilization of a decelerating film</li> <li>• more cost-effective, lighter and flatter than DSTN</li> </ul>
	DSTN	black / white	<ul style="list-style-type: none"> <li>• DSTN (Double Super Twisted Nematic)</li> <li>• high-contrast black and white representation by utilization of an additional compensation cell</li> </ul>
	FFSTN / ISTN	black / white negative	<ul style="list-style-type: none"> <li>• FFSTN (Double Film Super Twisted Nematic/Intelligent STN)</li> <li>• high-contrast black and white negative mode display</li> <li>• optimal performance with white or multi color backlights</li> <li>• more cost-effective, lighter and flatter than DSTN</li> <li>• ISTN for best contrast through the whole temp. range</li> </ul>
	CSTN	color	<ul style="list-style-type: none"> <li>• FSTN with color filter mask (passive matrix)</li> <li>• passive driven dot matrix</li> <li>• white LED or CCFL illumination</li> </ul>
	TFT	black / white colored	<ul style="list-style-type: none"> <li>• TFT (Thin Film Transistor)</li> <li>• active driven dot matrix</li> <li>• very wide viewing angle</li> <li>• color or monochrome display</li> <li>• white LED or CCFL illumination</li> </ul>
	ZBD / BCD	black / white colored	<ul style="list-style-type: none"> <li>• enormous power saving bistable technology</li> <li>• power only required for image updates</li> <li>• images do not degrade</li> <li>• high contrast, wide viewing angle</li> </ul>



## Module technologies

### Bezel with Zebra and PCB

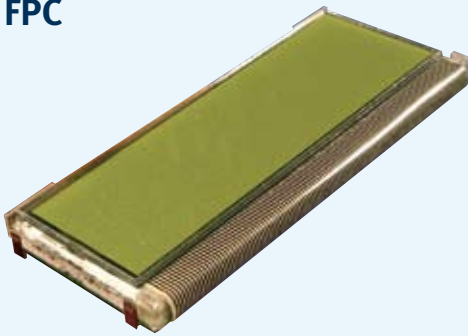


#### Advantages

- large viewing areas realizable
- easy assembly by holes in PCB
- integration of additional circuitry such as switches, LEDs and MCUs on PCB feasible

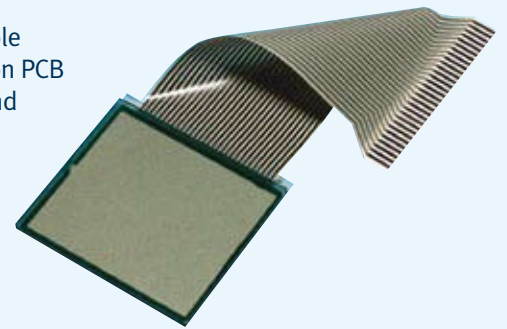


### FPC

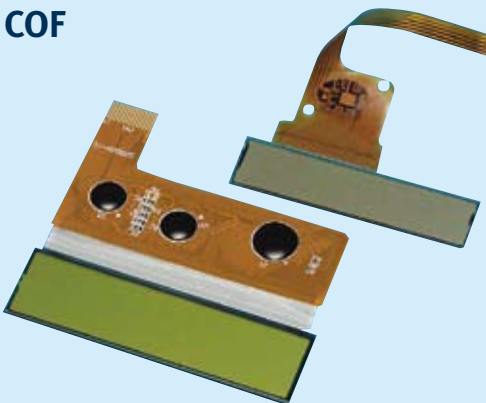


#### Advantages

- very compact construction possible
- integration of additional circuitry on PCB
- variable distance between LCD and host system



### COF

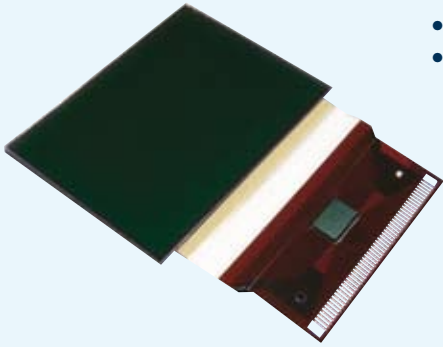


#### Advantages

- very flat
- integration of additional components such as resistors and capacitors
- variable distance between LCD and host system
- any shape of flex feasible

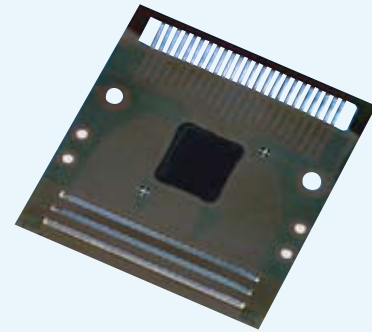


## TAB / TCP



### Advantages

- very flat
- very compact construction possible
- low tooling costs
- high resolution available

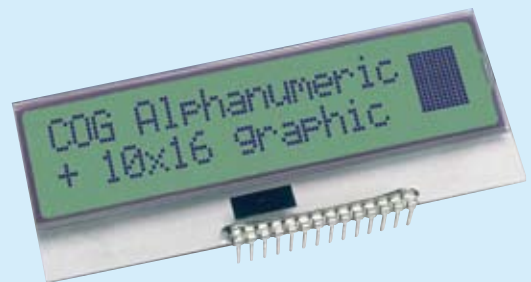


## COG



### Advantages

- very flat
- light weight
- compact design
- vibration resistant
- very cost-efficient
- high reliability
- suitable for explosion proof applications
- ease of mounting in conjunction with snap-in backlight units or plastic frames

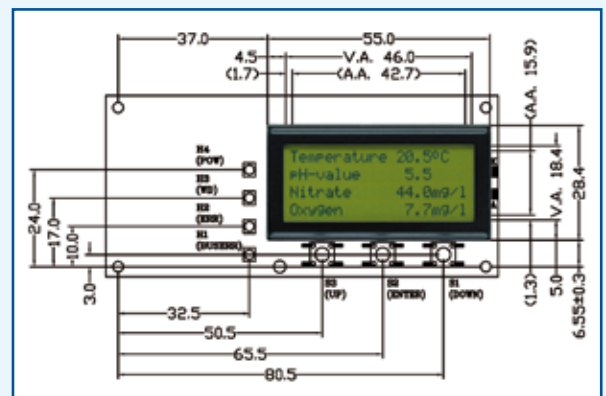


## Semi custom



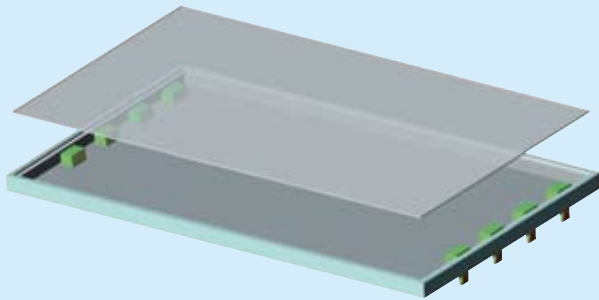
### Advantages

- reduction of tooling and engineering costs by use of existing LCM-components
- integration of additional circuitry such as switches, LEDs and MCUs on PCB feasible
- reduction of processing time



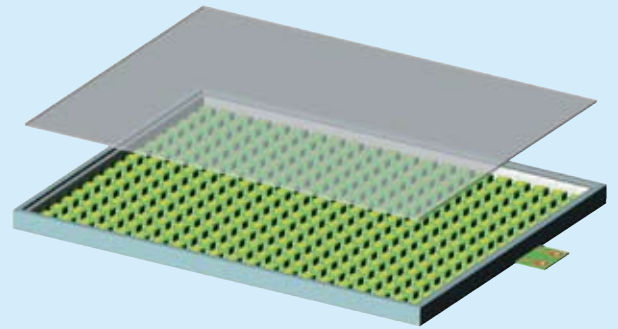


## Backlight design



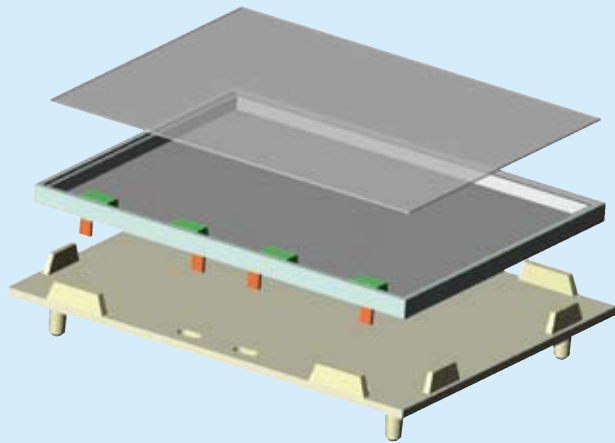
### LED 01

- low power
- thin construction



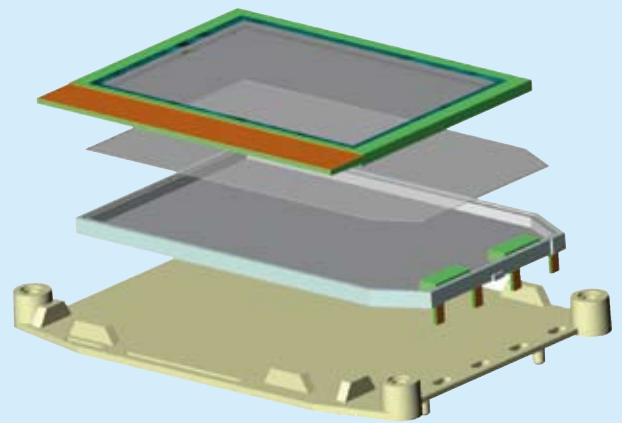
### LED 04

- high brightness



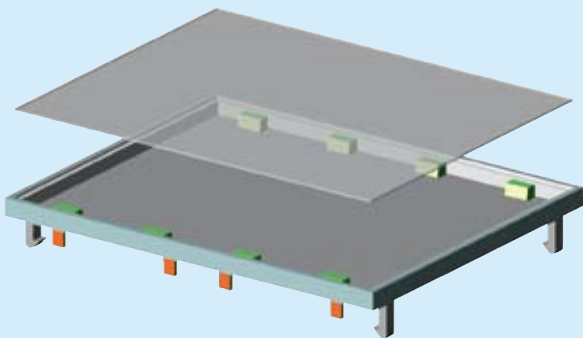
### LED 02

- low power
- thin construction
- example with mounting frame



### LED 05

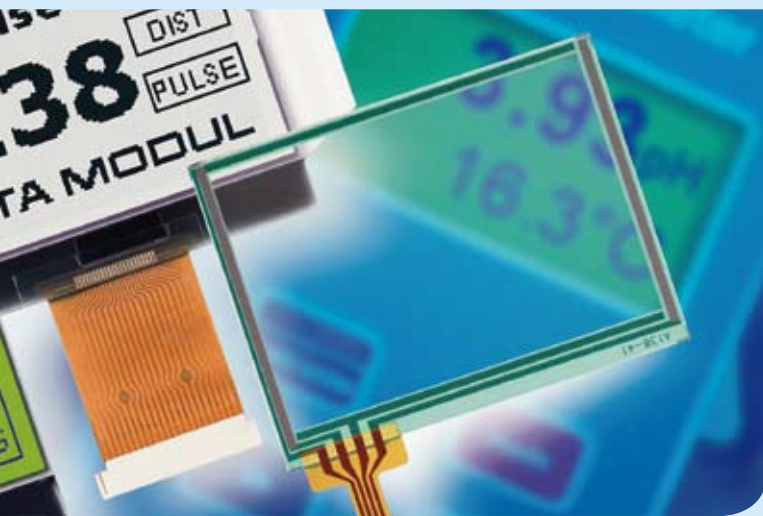
- low power
- thin construction
- special design for high brightness LEDs
- example with mounting frame and display



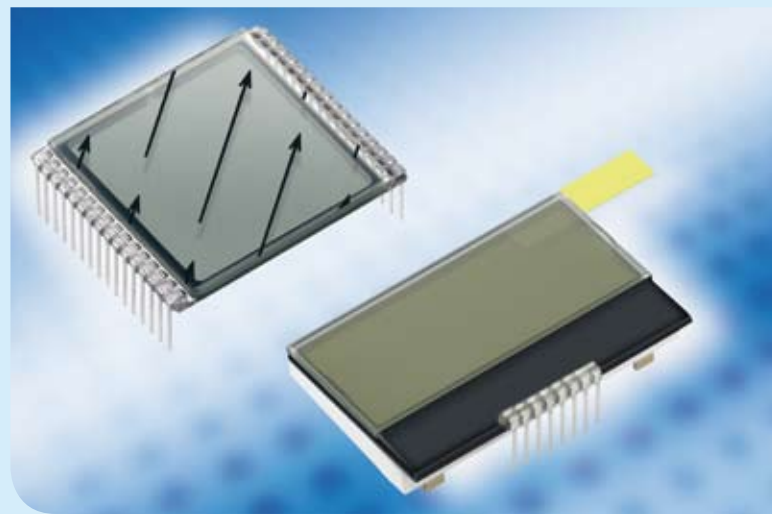
### LED 03

- low power
- thin construction
- example with mounting hooks

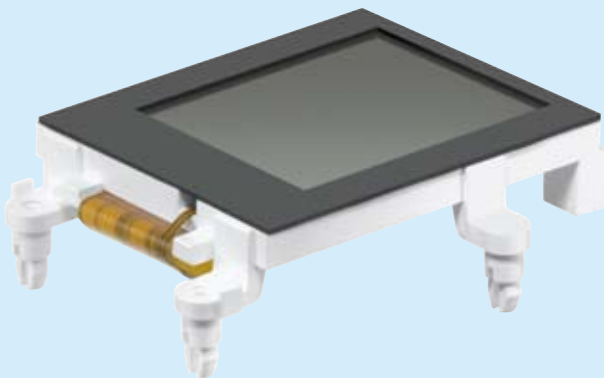
## Special features and finishing



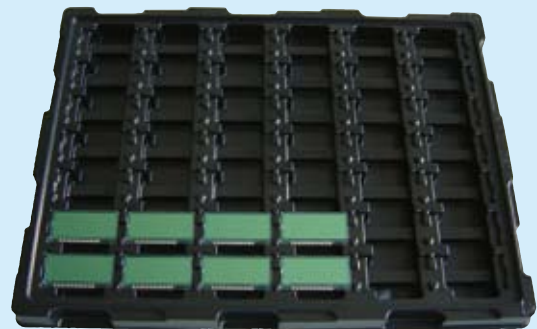
- 4 wire analog resistive touchpanel
- matrix touch panel
- glass / foil technology



- hatched foils
- pull off tapes



- plastic housings
- snap-fits, hooks



- plastic tray for automatic placement equipment



- multicolor backlight

### Further Options:

- brightness- and contrast- enhancement filter
- color and retardation filter
- color screen printing
- conformal coating
- anti-glare face plates
- ITO heater for low temperature applications
- non - magnetic components
- MLS (multi line selection)
- grey scale imaging

## Types of bonding

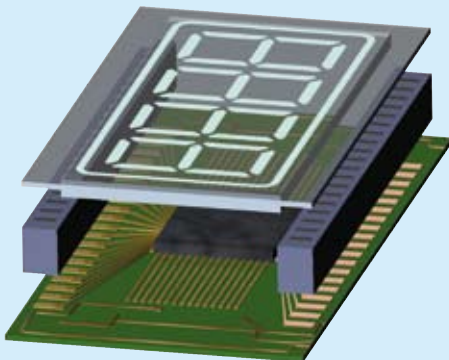
### FPC/FFC



- variable distance between LCD and host system
- FPC in any shape and pitch available
- FFC as a standard available (pitch 0.5/0.8/1.0mm)
- backlight contacts integrable
- solderable or pluggable into ZIF-connector



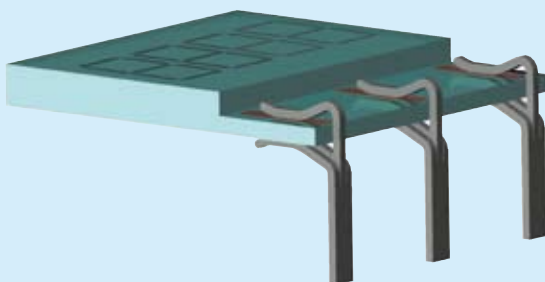
### Bonding with elastomer (zebra) connector



- high contact density
- solderless connection
- housing of appliance can act as mounting frame (bezel)



### Bonding with metal pins



- treatment in wave soldering
- suitable for small series
- cost effective
- no additional fixture necessary
- pitch 1.8 / 2.0 / 2.54 mm



## LCD controller reference table

### Graphic

Controller	SEG	COM	Supply Voltage	Interface			Package				Special features
SBN1661	80	32	5V	parallel					SMD	DIE	
ST754x	102	68	1.7 to 3.3V	parallel	SPI	I <sup>2</sup> C		COG			
ST757x	102	68	1.7 to 3.3V	parallel	SPI			COG			
SSD181x	132	64	2.7 to 3.3V	parallel	SPI		TAB	COG			
S1D1x60x	132	65	2.7 to 5.5V	parallel	SPI		TAB	COG			
ST756x	132	65	2.7 to 3.3V	parallel	SPI		TAB	COG			
NT753x	132	65	1.8 to 3.6V	parallel	SPI		TAB	COG			
PCF8535	133	65	5V			I <sup>2</sup> C		COG			
NT7506	128	129	1.8 to 3.5V	parallel	SPI		TAB	COG			grey scale
SSD1854	128	160	1.8 to 3.3V	parallel	SPI	I <sup>2</sup> C	TAB	COG			grey scale
S1D15E0x	160	132	1.7 to 3.6V	parallel	SPI		TAB	COG			MLS / grey
S1D1570x	200	65	2.4 to 5.5V	parallel	SPI		TAB	COG			
S1D153x	200	65	5V	parallel	SPI		TAB			DIE	
IST3x	240	128	2.4 to 3.6V	parallel	SPI		TAB	COG			
S1D1571x	256	81	2.7 to 5.5V	parallel	SPI		TAB	COG			MLS
UC160x	240	128	1.8 to 3.3V	parallel	SPI	I <sup>2</sup> C	TAB	COG			
UC161x	256	160	1.8 to 3.3V	parallel	SPI	I <sup>2</sup> C	TAB	COG			grey scale
ST752x	255	160	2.4 to 3.3V	parallel	SPI	I <sup>2</sup> C	TAB	COG			grey scale
RA88xx	320	240	3.0 to 5.0V	parallel					SMD	DIE	char set
T6963	640	256	5V	parallel					SMD		char set
S1D13700	640	240	3.0 to 5.5V	parallel					SMD		char set/grey scale

### Alphanumeric

Controller	SEG	COM	Supply Voltage	Interface			Package				Special features
ST706x	40	16	2.7 to 5.5V	parallel					SMD	DIE	
NT3881	40	16	4.5 to 5.5V	parallel					SMD	DIE	
PCF2119	80	18	1.5 to 5.5V	parallel		I <sup>2</sup> C		COG			
NT760x	100	16	2.8 to 5.5V	parallel				COG			
SPLC093	80	26	2.4 to 5.5V	parallel	SPI			COG			
RW1067	80	34	2.7 to 5.5V	parallel	SPI					DIE	1000 chrs internal
ST703x	100	18	2.7 to 5.5V	parallel	SPI	I <sup>2</sup> C		COG			

### Segment

Controller	SEG	COM	Supply Voltage	Interface			Package				Special features
PCF857x	40	4	2.0 to 6.0V			I <sup>2</sup> C		COG	SMD	DIE	
IST3040	40	4	2.4 to 3.6V		serial			COG			
RW1026	48	4	2.4 to 5.2V		serial					DIE	
HT162x	64	16	2.4 to 5.2V		serial			COG	SMD		

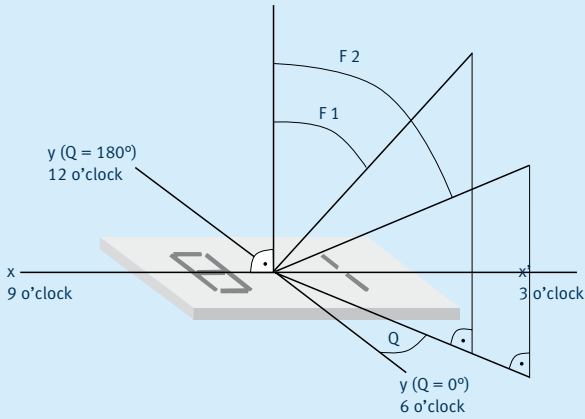
### µC incl. LCD driver

Controller	SEG	COM
ATMEGA169	25	4
MSP430	40	4
PIC18C9	48	4

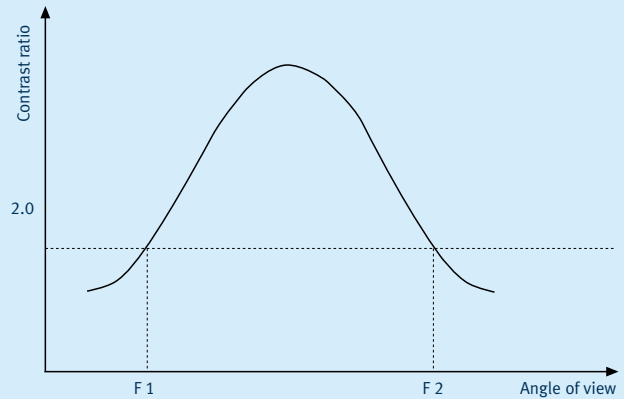


## Optoelectronic features

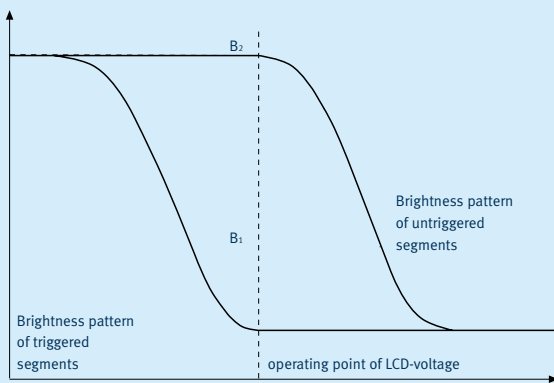
### Definition of Q and F



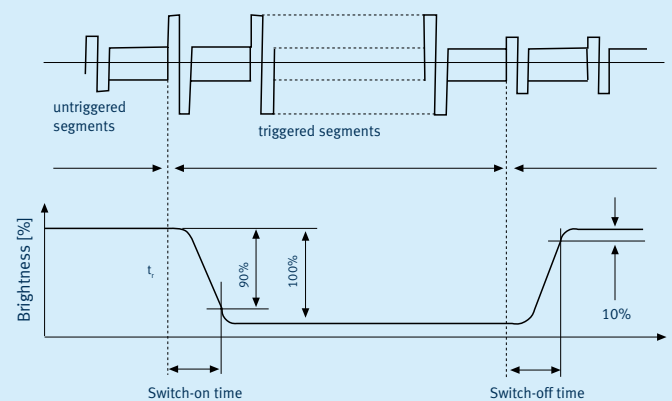
### Definition of viewing angle F 1 and F 2



### Definition of contrast ratio CR



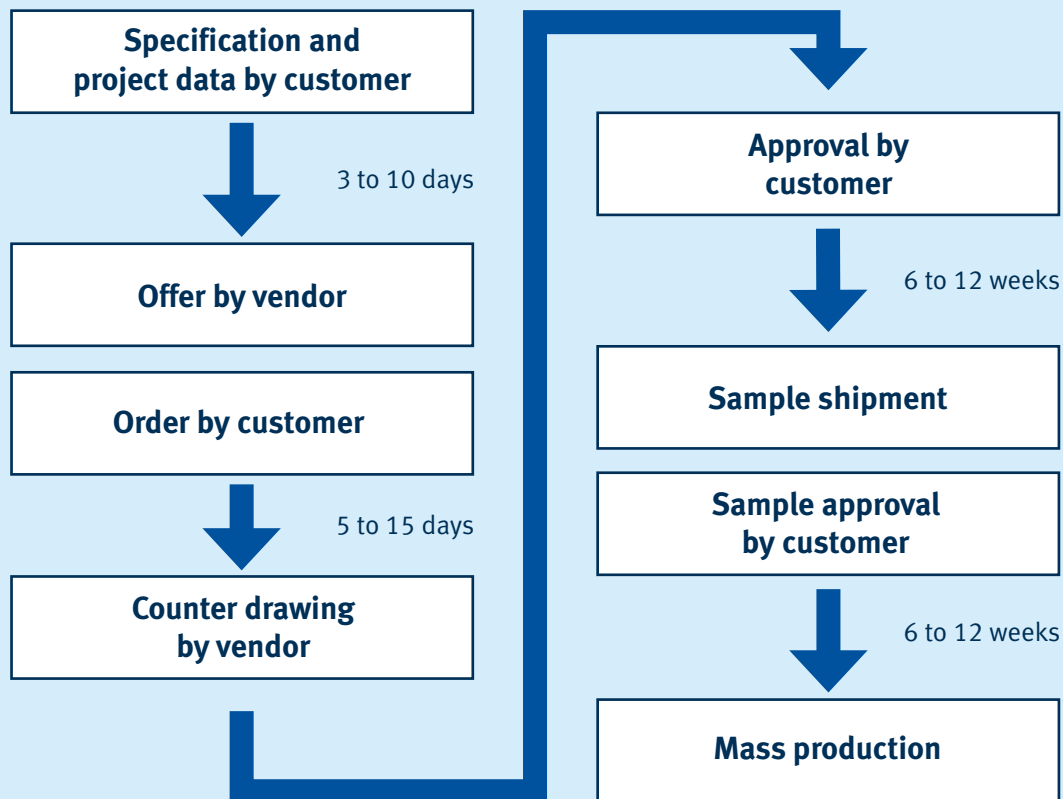
### Definition of switching times



Technology/Duty ratio	Duty 1/1	Duty 1/4	Duty 1/8	Duty 1/16	Duty 1/32	Duty 1/64	Duty 1/128
<b>TN</b>	Viewing cone X	70...-70		-	-	-	-
	Viewing cone Y	30...-60	30...-50	20...-40	-	-	-
	Operation temp	-40°C...+85°C		-30°C...+85°C	-	-	-
	Storage temp	-40°C...+90°C		-40°C...+90°C	-	-	-
<b>STN</b>	Viewing cone X	-	-	50...-50	45...-45	40...-40	35...-35
	Viewing cone Y	-	-	70...-60	70...-50	30...-45	25...-30
	Operation temp	-	-	-30°C...+85°C			-20°C...+80°C
	Storage temp	-	-	-40°C...+85°C			-
<b>FSTN</b>	Viewing cone X	-	-	45...-45	40...-40	35...-35	30...-30
	Viewing cone Y	-	-	70...-60		70...-50	35...-40
	Operation temp	-	-	-30°C...+80°C			-20°C...+80°C
	Storage temp	-	-	-40°C...+85°C			-

Remarks: The above data is for general reference only and may vary due to different display modes or illumination.

## Project flowchart

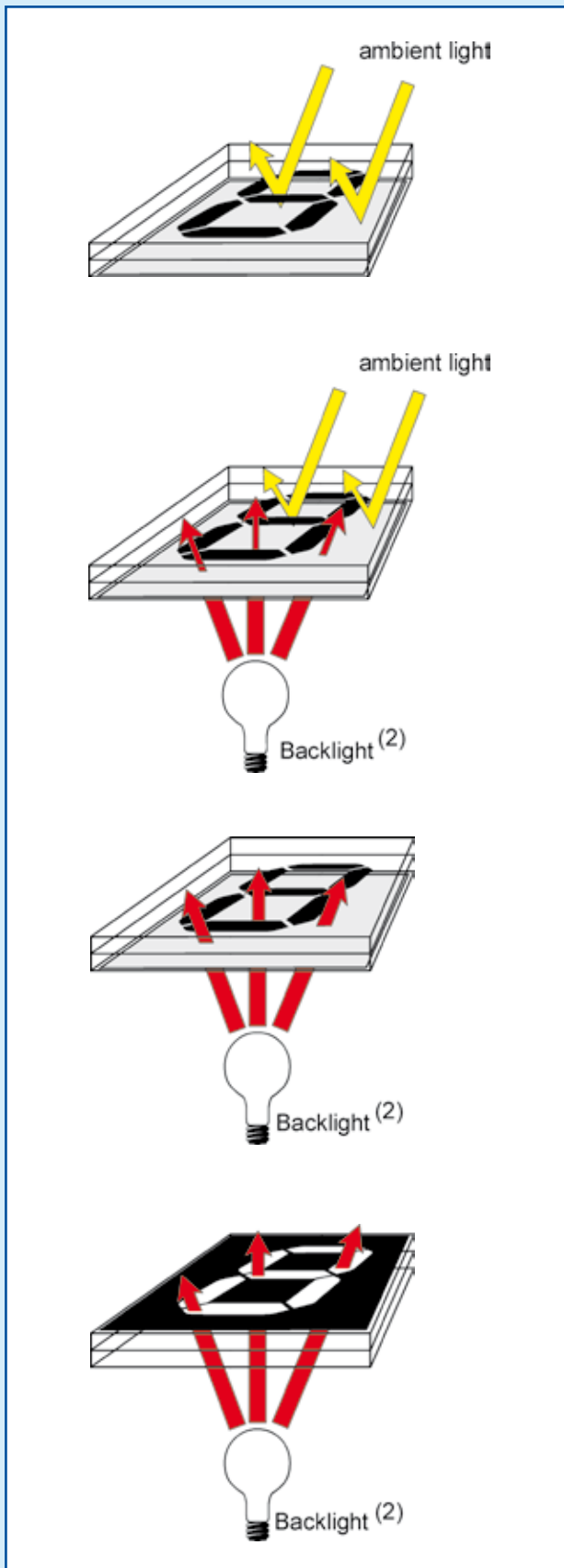


## Glossary

A.A.	active area	PCB	printed circuit board
BEF	brightness enhancement filter	RF	reflective mode
Bezel	mounting frame	RTV	room temperature vulcanisation
CCFL	cold cathode fluorescent lamp	SMT	surface mounted technology
COB	chip on board	SPI	serial peripheral interface
COG	chip on glass	TAB	tape automated bonding
DUTY	multiplex	TC	temperature compensation
EL	electro luminescent	TCP	tape carrier package
FFC	flexible film cable	TF	transflective mode
FPC	flexible printed circuit	TM	transmissive mode
HS	heat seal	Topr	operating temperature
HT	high temperature	Tstrg	storage temperature
ITO	indium tin oxide	V.A.	viewing area
LED	light emitting diode	VLCD	contrast voltage
Ledge	contact area on the glass	Zebra	elastomer (rubber) connector
MUX	multiplex	ZIF	zero insertion force



## Display modes by the use of different polarizers



- **reflective positive<sup>(1)</sup>**
- Function: the reflector on the rear side of the LCD uses the ambient light at maximum
- Applications: ultra low power without the need or feasibility of a backlight
  
- **transflective positive<sup>(1)</sup>**
- Function: the transflector on the rear side of the LCD uses partially the ambient light and partially the backlight
- Applications: low power with the feasibility of a temporary activated backlight
  
- **transmissive positive<sup>(1)</sup>**
- Function: the LCD uses the backlight at maximum
- Applications: mid power with the feasibility of a permanently activated backlight
  
- **transmissive negative<sup>(1)</sup>**
- Function: the LCD uses the backlight at maximum
- Applications: mid-high power with the feasibility of a permanently activated backlight

<sup>(1)</sup> compare page 13 for further color and filter options

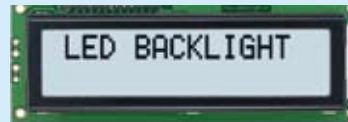
<sup>(2)</sup> compare page 6 for backlight types

## Overview of different LCD styles

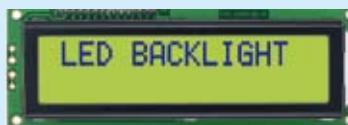
Different STN modules in combination with polarizers, optical films and suitable backlights create a variety of completely unique looking modules. This allows our customers to match their design requirements with their applications. On this page, DATA MODUL provides an overview of the most common modules and backlight variations.



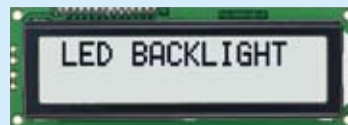
Yellow green mode reflective



FSTN positive mode with blue backlight



Yellow green mode with yellow green backlight



FSTN positive mode with white backlight



Silver mode reflective



FFSTN mode with blue backlight



Silver mode with yellow green backlight



FFSTN negative mode with amber backlight



Silver mode with white backlight



FFSTN mode with white backlight



FSTN positive mode reflective



FFSTN mode with yellow green backlight



FSTN positive mode with yellow green backlight



FFSTN mode with red backlight



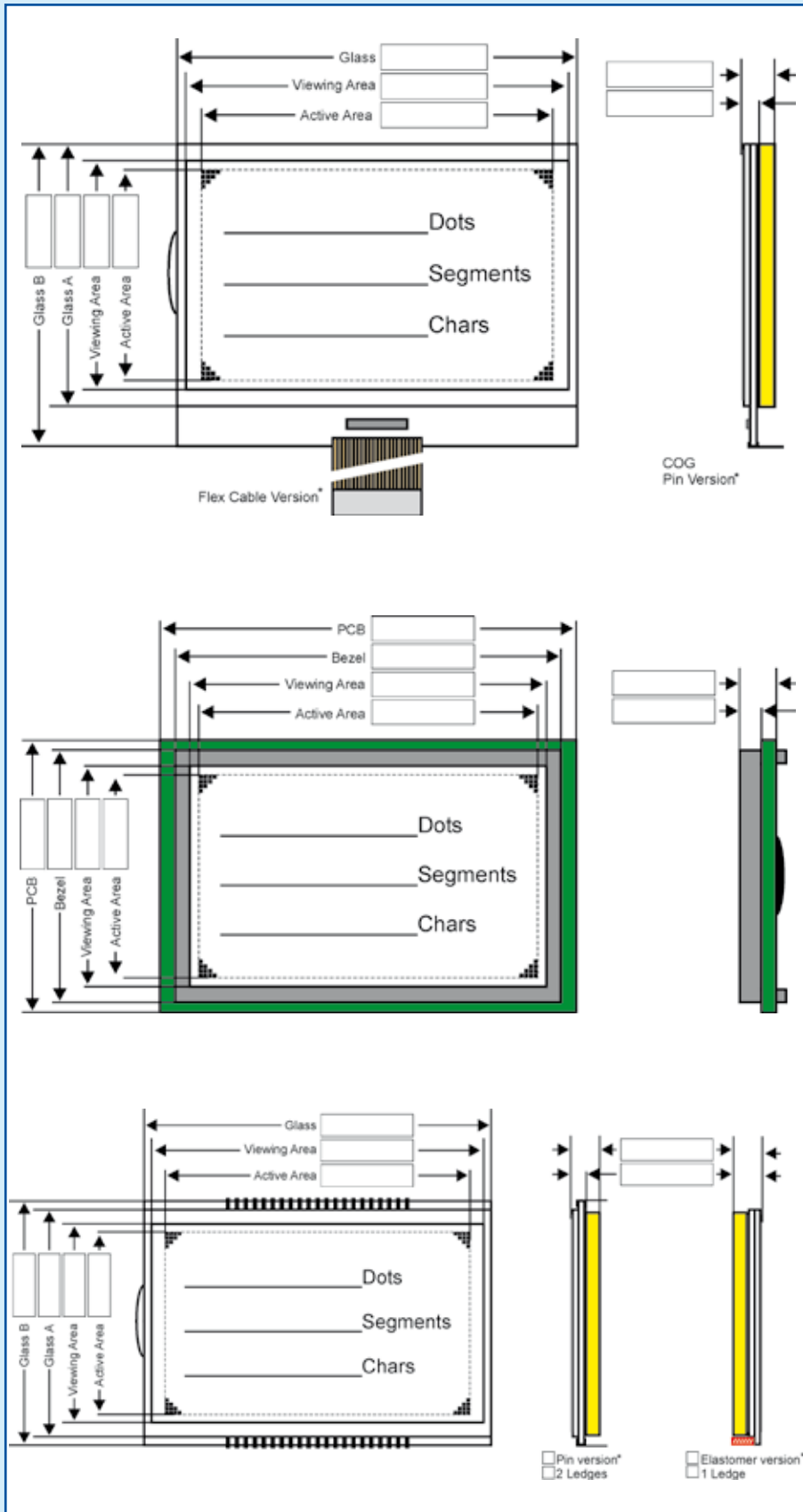
FSTN positive mode with amber backlight



Transm. negative with white backlight



## Product specification sheet



### LCD Technology/Duty ratio (compare p.13)

- TN    HTN    STN    STN-grey  
FSTN    ISTN    DSTN    CSTN  
 Duty 1/\_\_\_\_

### Polarizers/Presentation (compare p. 12)

- reflective    transfl.    transmissive  
positive    negative

### Backlight (compare p.6)

- LED-style\_\_\_\_    CFL    EL-foil  
 Color\_\_\_\_

### \*Connector Flex cable    Pins

- Elastomer    ZIF  
 \_\_\_\_length

### Supply voltage (controller/LCD)\_\_\_\_V

Operating Temp\_\_\_\_ °C to\_\_\_\_ °C

Storage Temp\_\_\_\_ °C to\_\_\_\_ °C

Interface serial    parallel

Company \_\_\_\_\_

Name \_\_\_\_\_

Place \_\_\_\_\_

Phone \_\_\_\_\_

Email \_\_\_\_\_

Project Data \_\_\_\_\_

Application \_\_\_\_\_

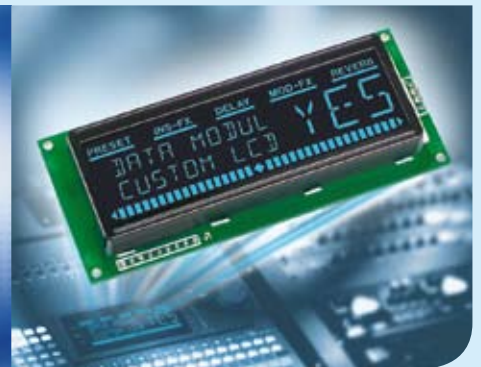
Samples \_\_\_\_\_

Quantity/year \_\_\_\_\_

Lot size \_\_\_\_\_

further information

## Application examples





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