REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

1. **Specification subject to change without notice.**
2. **All dimensions and specifications apply to standard modules. This information may vary for modules with optional features.**
3. **All dimensions are in millimetres.**
4. **Precautions: These precautions apply equally to modules from all makers, not just Densitron. Violation of these guidelines may void the warranty and can cause problems ranging from erratic operation to catastrophic display failure.**

Handling precautions:
♦ This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

Power supply precautions:
♦ Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
♦ Prevent the application of reverse polarity to VDD and VSS, however briefly.
♦ Use a clean power source free from transients. Power up conditions are occasionally "jolting" and may exceed the maximum ratings of the module.
♦ The +5V power of the module should also supply the power to all devices that may access the display. Don't allow the data bus to be driven when the logic supply to the module is turned off.
♦ DO NOT install a capacitor between the VO (contrast) pin and ground. VDD must, at all times, exceed the VO voltage level. The capacitor combines with the contrast potentiometer to form an R-C network which "holds-up" VO, at power-down, possibly damaging the module.

Operating precautions:
♦ DO NOT plug or unplug the module when the system is powered up.
♦ Minimise the cable length between the module and host MPU. (Recommended max. length 30 cm).
♦ For models with EL backlights, do not disable the backlight by interrupting the HV line. Unloaded inverters produce voltage extremes that may arc within a cable or at the display.
♦ Operate the module within the limits of the modules temperature specifications.

Mechanical / Environmental precautions:
♦ Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure. Densitron recommends the use of Kester "245" no-clean solder.
♦ Mount the module so that it is free from torque and mechanical stress.
♦ Surface of LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polariser. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
♦ ALWAYS employ anti-static procedure while handling the module.
♦ Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
♦ DO NOT store in direct sunlight.
♦ If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap.

Notes: (unless otherwise specified)

Unless otherwise specified: Dimensions are mm Tolerances are: X = ± 3 0.X = ± 0.5 0.XX = ± 0.05	APPROVALS	DATE	DENSITRON EUROPE LTD BIGGIN HILL, ENGLAND	
	DRAWN			
	CHECKED		TITLE PROVISIONAL SPECIFICATION	
	ISSUED		DWG.NO. **OM160320-(Chameleon)**	SHEET 1 of 6

1.0 DESCRIPTION

The OM160320 is a high speed very low power LCD terminal with the following features

- 160x320 pixels
- 1/200 duty cycle
- Built-in touch panel
- Built-in EL backlight and drivers
- 3 wire serial interface
- Low RFI emmision design
- 3 sleep modes
- Standby current <20µA
- Active current as low as 5mW

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	See Drawing	mm
Display format	160x320	dots
Driving method	1/200 duty	duty
Colour/type	Chameleon High Reflection Positive/Negative Lit Image	-
Viewing direction	6 o'clock	-
Front polariser	Transmissive	-
Rear polariser	Transflective / Chameleon	-
Backlight colour/type	White EL	-
Dot size	0.2(W) x 0.2(H)	mm
Dot pitch	0.22(W) x 0.22 (H)	mm
Character Size	N/A	mm
Active display area	35.18(W) x 70.38(H)	mm
Viewing area	39.0(W) x 78.0(H)	mm
Weight	N/A	g

Notes: W-Width; H-Height; D-Depth.

3.0 ELECTRICAL CHARACTERISTICS

Item		Symbol	Condition	Specification value			Unit
				Min	Typ	Max	
Operating voltage	Recommended	V_{DD}		2.4	—	3.6	V
	Operable	V_{DD}		3.6	—	5.5	
High level input voltage		V_{IHC}		$0.8 \times V_{DD}$	—	V_{DD}	
Low level input voltage		V_{ILC}		V_{SS}	—	$0.2 \times V_{DD}$	
High level output voltage		V_{OHC}	$I_{OH} = -0.5mA$	$0.8 \times V_{DD}$	—	V_{DD}	
Low level output voltage		V_{OLC}	$I_{OL} = 0.5mA$	V_{SS}	—	$0.2 \times V_{DD}$	
Input leakage current		I_{LI}	$V_{IN} = V_{DD}$ or V_{SS}	−1.0	—	1.0	µA
Output leakage current		I_{LO}		−3.0	—	3.0	
Static current consumption		Standby 1	LCD off, EL off, touch OFF, LED's off	—	20	-	µA
		Standby 2	LCD on, EL off, touch READY, LED's off	200	-	400	µA
		Active Mode	LCD on, EL off, touch on, LED's on, data transfer	-	-	600	µA

4.0 INTERFACE PIN ASSIGNMENT (Provisional)

5.0 ELECTRO-OPTICAL CHARACTERISTICS

1	Display colour	Background:	Grey-White		Dot colour:	Black		
2	Absolute	Operating temperature:		-20 to 70 °C	Storage temperature:		-20 to 80 °C	
	MAX ratings	LC operating voltage: 18V						
6	Contrast	Cr	25	$\theta=0$, Vop=7.5V	-	10	-	-

DEFINITION OF CONTRAST RATIO (K)

$$K = \frac{\text{Brightness of non-selected dots}}{\text{Brightness of selected dots}}$$
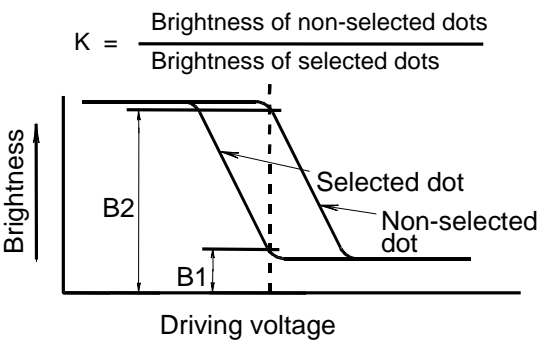
CONTRAST VERSUS VIEWING ANGLE

NTN, NTN-H: Ø1 < 0° < Ø2
TN, TN-H: Ø1 < 20° < Ø2
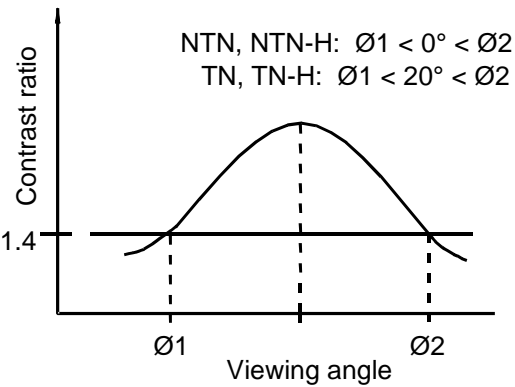
DEFINITION OF ANGLES Ø AND θ
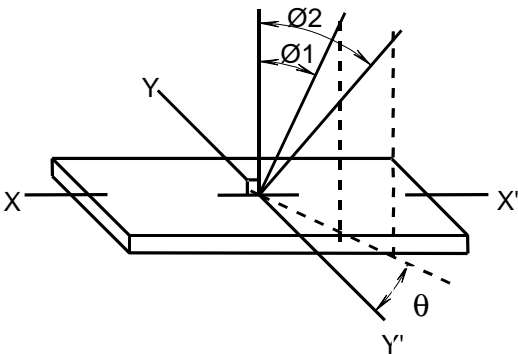
DEFINITION OF OPTICAL RESPONSE

Non-selected   Selected   Non-selected

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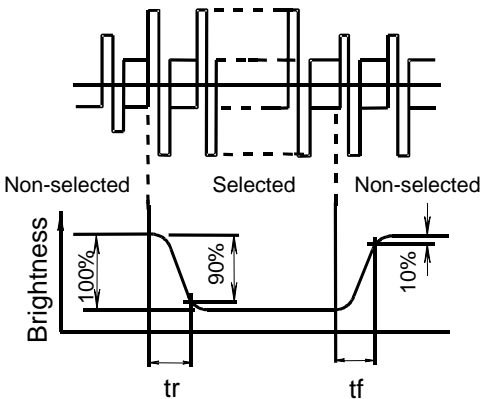
6.0 COMMUNICATION PROTOCOL

Bit level communication and handshake

ILC02 uses a 1MHz SPI interface with hardware handshaking, and the ILC02 is the master. When ILC02 wants to send data it checks the state of the SEN input pin. If SEN is high then it starts sending 8 clock pulses (SCK). The clock period is 1000 ns, symmetrical, rise and fall times are less than 50 ns. SEN is not checked between bits. Output data (SDO) is valid from after 100 ns of the falling edge of the clock till the next falling edge of the clock. Input data (SDI) is sampled at the rising edge of the clock. Setup and hold times are 100 ns.

Operating modes

There are three states of the ILC02: active, idle and sleep.

· In sleep mode the LCD, the backlight, the LEDs, the light sensor are switched off, the clock of the uP is stopped, and the SPI interface is off. This is the lowest power mode of the ILC02.

· In idle mode the LCD is active, but the backlight, the LEDs, the light sensor are switched off, the clock of the uP is stopped, and the SPI interface is off.

· In active mode the LCD is active, the backlight, the LEDs, the light sensor are controlled and can be switched on, the clock of the uP is running. The SPI interface is running, the PIC send its status byte, and checks for available command in no less than 20 ms intervals.

The uP wakes up from idle mode or sleep mode if either of the following wake-up events happens:

· A key is pressed
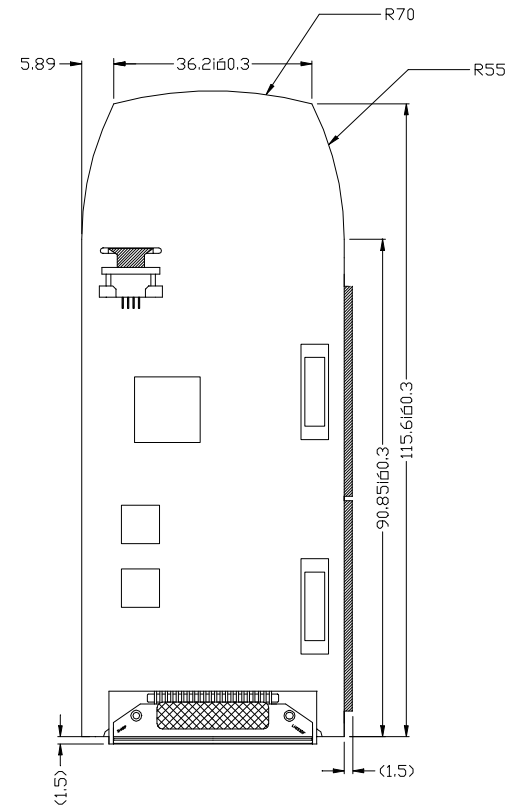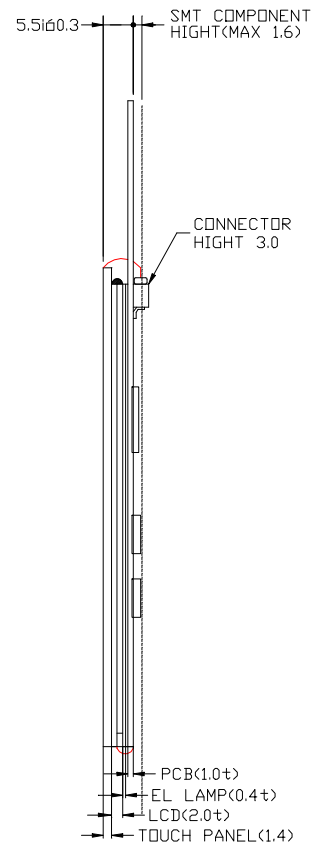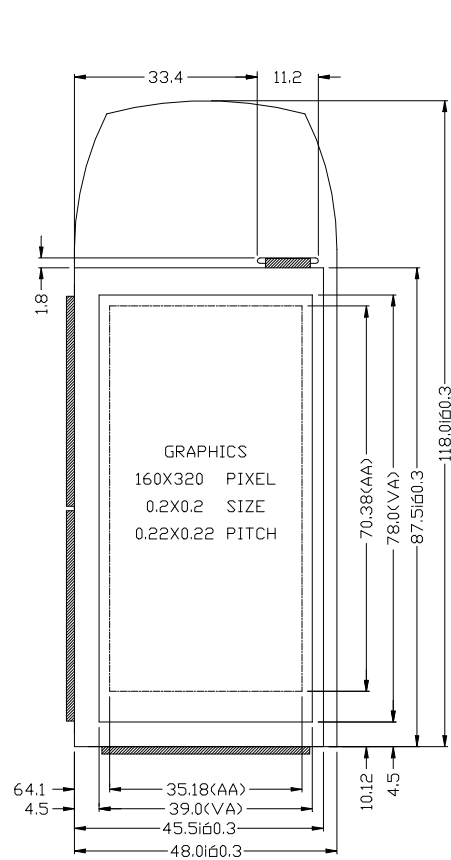· The touch screen is touched
· LID state changed
· IRQ goes low

The uP enters idle or sleep mode only if it receives a command. After -RESET goes low for 20ms the ILC02 is in active state, the LCD, the backlight, the LEDs, the light sensor are switched off, but can be switched on with sending the appropriate commands.
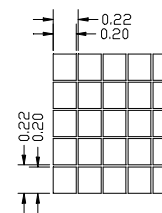
Byte level communication

In active mode the ILC02 sends its status byte, and checks for new commands. The status byte is as follows:

Bit	Name	Description
D7	-	=1 reserved for future use
D6	-	=1 reserved for future use
D5	-	=1 reserved for future use
D4	TOUCH	=0 if the touch is pressed
D3	LID	=0 if the LID is closed (hall sensor returns 0)
D2	SW3	=0 if SW3 is pressed
D1	SW2	=0 if SW2 is pressed
D0	SW1	=0 if SW1 is pressed

Bits in the status byte are for information only. The host should validate these with sending the appropriate read command. Only then will the keys and the touch debounced and their state reported properly. ILC02 checks if the byte received while sending the status byte is a valid command. If the received byte is 0FFH (NOP command) then it waits 20ms, or less if there is any change in keypress, touch or IRQ, and sends its status byte again. If the received byte is not 0FFH, then ILC02 sends the status byte repeatedly and receives all the command parameters. After (and sometimes during) receiving all the parameters ILC02 executes the command. If the command is a read command ILC02 sends the response bytes. Data received while sending the response bytes are ignored. Then ILC02 sends its status byte again to see if there is any other commands waiting.

33.4
11.2

5.5í±0.3

SMT COMPONENT
HIGHT(MAX 1.6)

5.89
36.2í±0.3

R70
R55

DOT DETAILED

0.22
0.20

0.22
0.20

1.8

CONNECTOR
HIGHT 3.0

GRAPHICS
160X320 PIXEL
0.2X0.2 SIZE
0.22X0.22 PITCH

118.0í±0.3
87.5í±0.3
78.0(VA)
70.38(AA)

115.6í±0.3
90.85í±0.3

64.1
4.5
10.12
4.5
35.18(AA)
39.0(VA)
45.5í±0.3
48.0í±0.3

(1.5)
(1.5)

PCB(1.0t)
EL LAMP(0.4t)
LCD(2.0t)
TOUCH PANEL(1.4)

NOTE:
1.LCD DISPLAY MODE:FSTN/POSITIVE/TRANSFLECTIVE TYPE.
2.VIEWING ANGLE: 6 O'CLOCK.
3.OPERATING TEMP:-20 TO 70 DEGREE.
4.STORAGE TEMP:-30 TO 80 DEGREE.
5.THE LCD DRIVING CODITION IS:1/160D,1/13.6B