Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

Indian Standard
LIQUID CRYSTAL AND SOLID-STATE DISPLAY DEVICES
PART 1  GENERIC SPECIFICATION

ICS 31.120
Electron Tubes and Display Devices Sectional Committee, LITD 04

FOREWORD

This Indian Standard (Part 1) which is identical with IEC 61747-1 : 2003 ‘Liquid crystal and solid-state display devices — Part 1: Generic specification’ issued by the International Electrotechnical Commission (IEC) after incorporating Amendment No.1 in 2003 was adopted by the Bureau of Indian Standards on the recommendation of the Electron Tubes and Display Devices Sectional Committee and approval of the Electronics and Information Technology Division Council.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

<table>
<thead>
<tr>
<th>International Standard</th>
<th>Corresponding Indian Standard</th>
<th>Degree of Equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60027 (All parts) Letter symbols to be used in electrical technology</td>
<td>IS 3722 (All parts) Letter symbols and signs used in electrical technology</td>
<td>Technically Equivalent</td>
</tr>
<tr>
<td>IEC 60050 (All parts) International Electrotechnical Vocabulary</td>
<td>IS 1885 (All parts) Electrotechnical Vocabulary</td>
<td>do</td>
</tr>
<tr>
<td>IEC 60068-2 : 1974 Environmental testing — Part 2: Tests</td>
<td>IS 9000 (Part 2/Sec 1 to 4) : 1977 Basic environmental testing procedures for electronic and electrical items: Part 2 Cold tests</td>
<td>do</td>
</tr>
<tr>
<td>IEC 60410 : 1973 Sampling plans and procedures for inspection by attributes</td>
<td>IS 10673 : 1983 Sampling plans and procedures for inspection by attributes for electronic items</td>
<td>do</td>
</tr>
</tbody>
</table>
### International Standard | Corresponding Indian Standard | Degree of Equivalence
--- | --- | ---
IEC 60617  (All parts) Graphical symbols for diagrams | IS 12032 (All parts) Graphical symbols for diagrams in the field of electrotechnology | Technically Equivalent
IEC 60748 (All parts) Semiconductor devices — Integrated circuits | IS 12970 (All parts) Semiconductor devices — Integrated circuits | Technically Equivalent
IEC 60749 : 1996\(^1\) Semiconductor devices — Mechanical and climatic test methods | IS 12641 : 2004 Semiconductor devices — Mechanical and climatic test methods (first revision) | do
IEC 61747-5 : 1998 Liquid crystal and semiconductor devices — Part 5: Environmental, endurance and mechanical test methods | IS 15934 (Part 5) : 2010 Liquid crystal and solid-state display devices: Part 5 Environmental, endurance and mechanical test methods | Identical
QC 001002 : 1986\(^2\) Rules of procedure of the IEC Quality assessment system for electronic components (IECQ) | ISQC 001002 (Parts 1 to 3) : 2000 IEC quality assessment system for electronic components (IECQ) — Rules of procedure | do
ISO 1000 : 1992 SI units and recommendations for the use of their multiples and of certain other units | IS 10005 : 1994 SI units and recommendations for the use of their multiples and of certain other units (second revision) | do
ISO 1101 : 1983 Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings | IS 8000 (Part 1) : 1985 Geometrical tolerancing on technical drawings: Part 1 Tolerances of form, orientation, location and run-out, and appropriate geometrical definitions (first revision) | do
ISO 2859 (All parts) Sampling procedures for inspection by attributes | IS 2500 (All parts) Sampling inspection procedure | do

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

<table>
<thead>
<tr>
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<th>Title</th>
</tr>
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<tbody>
<tr>
<td>IEC 60191-2 : 1966</td>
<td>Mechanical standardization of semiconductor devices — Part 2: Dimensions</td>
</tr>
</tbody>
</table>

\(^1\)Since revised in 2002.
\(^2\)Since revised in 1998 and splitted in three parts.
<table>
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<tr>
<th>International Standard</th>
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<tr>
<td>IEC 61747-3-1 : 1998</td>
<td>Liquid crystal and solid-state display devices — Part 3-1: Liquid crystal display (LCD) cells — Blank detail specification</td>
</tr>
<tr>
<td>IEC 61747-4 : 1998</td>
<td>Liquid crystal and solid-state display devices — Part 4: Liquid crystal display modules and cells — Essential ratings and characteristics</td>
</tr>
<tr>
<td>ISO 8601 : 1988</td>
<td>Data elements and interchange formats — Information interchange — Representation of dates and times</td>
</tr>
</tbody>
</table>

Only the English language text in the IEC Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
1 Scope

This part of IEC 61747 is a generic specification for liquid crystal and solid-state display
device. It defines general procedures for quality assessment to be used in the IECQ system
and gives general rules for measuring methods of electrical and optical characteristics, rules
for climatic and mechanical tests, and rules for endurance tests.

2 Normative references

The following referenced documents are indispensable for the application of this document. For
dated references, only the edition cited applies. For undated references, the latest edition of
the referenced document (including any amendments) applies.

IEC 60027 (all parts), Letter symbols to be used in electrical technology

IEC 60050 (all parts), International Electrotechnical Vocabulary

IEC 60068 (all parts), Environmental testing

IEC 60068-1:1988, Environmental testing – Part 1: General and guidance

IEC 60068-2 (all parts), Environmental testing – Part 2: Tests

IEC 60191 (all parts), Mechanical standardization of semiconductor devices

IEC 60191-1:1966, Mechanical standardization of semiconductor devices – Part 1: Preparation
of drawings of semiconductor devices

IEC 60191-2:1966, Mechanical standardization of semiconductor devices – Part 2: Dimensions

IEC 60191-3:1974, Mechanical standardization of semiconductor devices – Part 3: General
rules for the preparation of outline drawings of integrated circuits

IEC 60410:1973, Sampling plans and procedures for inspection by attributes

IEC 60617 (all parts), Graphical symbols for diagrams

IEC 60747 (all parts), Semiconductor devices – Discrete devices

IEC 60747-1:1983, Semiconductor devices – Discrete devices and integrated circuits – Part 1:
General
3 Terminology

For the purpose of standard series IEC 61747, the following terms and definitions apply.

3.1 Physical concepts

3.1.1 alignment layer
a thin layer deposited over the patterned electrodes that determines the direction of the director at the surface. This layer produces the desired ordering. Alignment such as homeotropic alignment (3.1.14) or planar alignment (3.1.15) are achieved by the co-operative ordering of the liquid crystal molecules locally affected by the surface forces. The alignment layer is generating the pretilt angle (3.1.20)

3.1.2 chiral phase
a liquid crystal phase exhibiting a spontaneous twist
3.1.3 **cholesteric phase**
a liquid crystal phase that exhibits planar nematic ordering in which the directors form a helix that has its axis perpendicular to the plane

3.1.4 **clearing point**
the phase transition temperature of a liquid crystal for transition toward the isotropic phase

3.1.5 **dichroic liquid crystal**
a liquid crystal exhibiting dichroism, i.e. the property of anisotropic absorption of light

3.1.6 **director**
the axial unit vector describing the local axis of symmetry for the orientational distribution function of any chosen molecular axis of a liquid crystal. The director co-ordinates define the local alignment of the liquid crystal.

3.1.7 **disclination**
a localized alignment defect (appearing generally under the form of closed or open lines) forming the border between areas exhibiting different alignment states

3.1.8 **discotic mesophase**
a liquid crystal phase of disc-like shaped molecules exhibiting a long range ordering with respect to the short molecular axis

3.1.9 **dynamic scattering**
an electro-optical effect showing a light scattering caused by turbulent motion in a liquid crystal layer induced by an electro-hydrodynamic effect

3.1.10 **electrically controlled birefringence**
an electro-optical effect caused by the birefringence of a liquid crystal layer which can be modulated (varied) by an electric field. It is also called "tunable birefringence"

3.1.11 **electrode layer**
an electrically conductive layer, usually transparent (e.g. made of indium tin oxide, "ITO"), covering the support plates and patterned to establish the display and electrical contact configuration

3.1.12 **ferroelectric liquid crystal**
a liquid crystal phase exhibiting a spontaneous electric polarization

NOTE This effect is commonly exhibited in chiral smectic liquid crystal.

3.1.13 **guest-host effect**
an anisotropic optical absorption effect occurring in a dichroic liquid crystal layer containing a dissolved dye
3.1.14 **homeotropic alignment**
the alignment state of a liquid crystal layer for which the director is everywhere nominally perpendicular to a support plate surface

3.1.15 **planar alignment**
the alignment state of a liquid crystal layer for which the director is everywhere nominally parallel to a support plate surface. This alignment is also referred to as homogeneous.

3.1.16 **liquid crystal**
a liquid crystal is a material that exhibits a mesophase consisting of elongated (rod-like) or disc-like (discotic) molecules and that possesses at least one long range orientational ordering with respect to one molecular axis

3.1.17 **liquid crystal cell**
a flat structure consisting of a minimum of two support plates with liquid crystal contained in the space between them. These plates are usually separated by a distance of several micrometers.

3.1.18 **mesophase (mesomorphic phase)**
an ordered state of matter between the crystalline and isotropic liquid phases, exhibiting some of the properties of the neighbouring phases, as for example fluidity and birefringence

3.1.19 **nematic phase**
molecules in this liquid-crystalline phase possess a long range orientational ordering of one molecular axis (uniaxial nematic LC) or two molecular axes (biaxial nematic LC)

3.1.20 **pretilt angle**
the angle between the plane of a support plate and the adjacent liquid crystal director

3.1.21 **sealing layer**
a layer situated between the support plates and surrounding the liquid crystal to ensure the hermeticity and integrity of the liquid crystal cell

3.1.22 **smectic phase**
a liquid crystalline phase characterized by at least a one-dimensional long range transitional ordering of the molecules and a long range orientational ordering for one molecular axis

3.1.23 **spacer**
a material incorporated into a liquid crystal cell (e.g. calibrated spheres or cylinders) to ensure a constant distance between the support plates
### 3.1.24
**support plate**
plate, generally transparent, made of e.g. glass or plastic sheet, covered with several layers (electrodes, sealing and surface alignment layers), forming the mechanical structure of a liquid crystal cell

### 3.1.25
**twist angle**
the oriented angle between the projections of the respective surface directors at the support plates on to one of the support plates of a twisted nematic cell

### 3.1.26
**twisted nematic structure**
a nematic liquid crystal state characterized by a twisted structure

### 3.1.27
**anti-ferroelectric liquid crystal**
AFLC
type of smectic liquid crystal having no macroscopic electrical polarization at zero external field

NOTE It has a paraelectric state with layers of alternating polarity of permanent dipoles without external electric field, and it transfers to a ferroelectric state of parallel alignment by applying electric field.

### 3.1.28
**cell gap**
thickness of the liquid crystal layer between the two support plates

### 3.1.29
**domain**
region having well-defined boundary in which liquid crystal molecules have the same director orientation

### 3.1.30
**helical pitch**
chiral pitch
periodic distance needed for directors to rotate by 360° in a helically structured liquid crystal

### 3.1.31
**polymer dispersed liquid crystal**
liquid crystal polymer composites within which there exists at least two different phases

### 3.1.32
**phase transition**
phenomenon in which liquid crystal changes from one phase to another, e.g. from smectic to nematic, solid to smectic, or nematic to isotropic liquid

### 3.1.33
**rubbing direction**
rubbing axis
direction/axis of rubbing the alignment layer in order to align liquid crystal molecules
3.1.34  
**super twisted nematic liquid crystal**  
**STN**  
nematic liquid crystal which possesses a twisted structure from 180° to 270° between the support plates

3.1.35  
**twisted nematic liquid crystal**  
**TN**  
nematic liquid crystal which possesses a twisted structure of around 90° between the support plates

3.1.36  
**voltage holding ratio**  
ratio of holding voltage to the initially applied signal voltage at opposite facing electrodes in a liquid crystal cell

3.2  
**General terms**

3.2.1  
**active area**  
part of a display screen area delimited by picture elements

3.2.2  
**active matrix-addressed display**  
a matrix-addressed display device in which each picture element has at least one switching element (e.g. diode or transistor)

3.2.3  
**alphanumeric display**  
a display device that is able to present a limited set of characters including at least letters and numerals

3.2.4  
**emissive display**  
a display that contains its own source(s) of light. This light can be produced by the transducer itself or provided by one or more internal light source(s) modulated by the transducer.

3.2.5  
**grey scale**  
display is said to have grey scale capability if it can display images providing more than two luminance levels

3.2.6  
**liquid crystal display cell**  
liquid crystal cell that is used to modulate light to present information

3.2.7  
**liquid crystal display module**  
a display unit combining a liquid crystal display cell with drive electronics. Additional options are possible such as backlight, mounting brackets, etc.
3.2.8  
**matrix display**  
a display device consisting of regularly distributed pixels arranged in rows and columns

3.2.9  
**monochrome display**  
a display using only one colour or black and white contrast

3.2.10  
**pixel**  
smallest element that is capable of generating full functionality of a display

3.2.11  
**reflective display**  
a display device that modulates light from an external source by reflection

3.2.12  
**segment**  
a segment is a special purpose dedicated pixel, e.g. a specific portion of an alphanumeric symbol, or a sign by itself

3.2.13  
**storage effect**  
the property of a picture element in which the visual information is retained after the activation has been removed

3.2.14  
**transflective display**  
a display device that modulates light from an external source by reflection or from another source by transmission through a semitransmissive reflector

3.2.15  
**transmissive display**  
a display device that modulates light from an external source by transmission

3.2.16  
**viewing angle range**  
the viewing angular direction range over which the visual specification is satisfied

3.2.17  
**viewing area**  
the active area (3.2.1) plus any contiguous areas that display permanent visual information or a display background

3.2.18  
**achromatic display**  
display that generates an image which is devoid of hue

3.2.19  
**backlight**  
light source system that illuminates light uniformly onto a liquid crystal display cell from behind
3.2.20  
**black matrix**
film-like structure that shades unwanted light to pass between dot electrodes in a matrix display

**NOTE**  Normally formed with a metal or organic film patterned on the substrate.

3.2.21  
**colour filter**
filter that selectively transmits light of a specific wave length range in colour liquid crystal display devices

**NOTE**  Generally, three primary colour (red, green, blue) filters are fitted onto the substrate.

3.2.22  
**common electrode**
3.2.22.1  electrode facing segment electrodes in a segment display
3.2.22.2  scanning electrode in a passive matrix display
3.2.22.3  electrode pairing with pixel electrodes fitted with transistors in an active matrix display with thin film transistors

3.2.23  
**data electrode**
signal electrode
electrode applied with the data signal voltage synchronized with the scanning signals in a multiplexed display

3.2.24  
**diffusing plate**
diffuser
optical component used to diffuse light in order to illuminate it onto the display device in a uniform manner

3.2.25  
**direct backlight**
light source system in which light tubes are placed directly underneath a display screen and illumination is made uniform using optical components such as a reflector and diffuser

3.2.26  
**edge light**
side light
light source system in which light source tubes are mounted on one or more sides of a display or a light guide plate

3.2.27  
**front projection display**
form of projection display whereby the display device and the observer are located on the same side of the screen on which the image is displayed

3.2.28  
**LCD controller**
circuit that supplies necessary control signals to driver circuits or ICs for an LCD
3.2.29  
**liquid crystal display device**  
display device using electro-optical effect of liquid crystal  

*NOTE* A general term for liquid crystal display cells and liquid crystal display modules.  

3.2.30  
**light guide plate**  
on optical component used to guide and diffuse light  

3.2.31  
**metal insulator metal**  
MIM  
thin film diode that has the non-linear conductivity of an insulation film sandwiched between metal films  

3.2.32  
**monolithic driver**  
built-in driver  
IC driver built in the same substrate as the active elements of pixels in an active matrix LCD  

3.2.33  
**multicolour display**  
chromatic display that can utilize two or more, but limited number of colours  

3.2.34  
**normally black (mode)**  
mode in which the luminance of pixels in the OFF voltage state is less than that in the ON voltage state  

3.2.35  
**normally white (mode)**  
mode in which the luminance of pixels in the OFF voltage state is greater than that in the ON voltage state  

3.2.36  
**passive matrix (addressed) display**  
matrix addressed display device in which each pixel is addressed directly by applied signals on the addressing and data lines  

3.2.37  
**polarizer**  
on optical component that intends to transmit a specific polarized light  

3.2.38  
**projection display**  
display device which projects a display image onto a screen by an optical system  

3.2.39  
**rear projection display**  
form of projection display whereby the display device and the observer are located on the opposite sides of the screen on which the image is displayed
3.2.40 reflector
3.2.40.1 optical component used in a reflective type LCD to reflect incident light
3.2.40.2 optical component in a backlight system to enhance light intensity by reflection

3.2.41 retardation film
polymer optical-anisotropic film that possesses either single or double optical axis

3.2.42 scanning electrode
electrode applied with a scanning signal voltage in a matrix display

3.2.43 segment display
display device showing only alphanumeric characters and/or fixed patterns made of segmented
electrodes which may be different in size and orientation

3.2.44 segment electrode
electrode forming a part of alphanumeric characters and/or fixed patterns in a segment display

3.2.44.2 data or signal electrode in a passive matrix display

3.2.45 storage capacitor
capacitor parallel to liquid crystal element to hold a signal voltage applied to each pixel or dot
in an active matrix display

3.2.46 substrate
plate, generally transparent, made of e.g. glass or plastic sheet, covered with several layers
(electrode, sealing and surface alignment layers), forming the mechanical structure of a liquid
crystal cell

3.2.47 tape carrier package
TCP
IC package in which chips are mounted on a flexible printed wiring board

3.2.48 thin film diode
TFD
diode formed on the surface of a substrate as a thin film

3.2.49 thin film transistor
TFT
transistor formed on the surface of a substrate as a thin film
3.2.50
transflector
optical component used in a transflective type LCD to partially reflect and partially transmit incident light

3.2.51
transparent conductive layer
transparent electrode
layer or electrode which has both electric conductivity and transmittance of visible light
NOTE A typical material is ITO (indium tin oxide).

3.3 Terms related to ratings and characteristics

3.3.1
addressing
selecting the pixels in space and/or time for activation or deactivation

3.3.2
contrast [IEV 45-25-265]
subjective assessment of the difference in appearance of two parts of a field of view seen simultaneously or successively

3.3.3
contrast ratio
the ratio between the higher, \( L_H \) and lower, \( L_L \) luminances that define the feature to be detected, measured by contrast ratio \( CR \), defined as:

\[
CR = \frac{L_H}{L_L}
\]

(see 2.22 of ISO 9241-3)

3.3.4
direct addressing
a method of addressing by applying a signal to a terminal that corresponds to one pixel only. Hence, all pixels can be addressed individually, in groups or simultaneously

3.3.5
driver
a device that transforms the address information into driving signals suitable for selecting a pixel. The same signals may also activate the pixel

3.3.6
duty ratio
the reciprocal value of the number of pixel groups which are addressed in a multiplex addressing scheme (e.g. the reciprocal of the number of rows for a row-at-a-time matrix addressing scheme)

3.3.7
electro-optic characteristic
the variation of a photometric property (e.g. luminance or contrast) as a function of electrical drive quantities (voltage or current)

3.3.8
image polarity
the relationship between background brightness and image brightness

The presentation of brighter images on a darker background is designated by negative polarity, and darker images on a brighter background is designated by positive polarity
3.3.9 **matrix addressing**

A method of addressing in which a pixel is selected by applying signals to the terminals that correspond to its row and column. Hence, an individual pixel is addressed by selecting groups in space and time.

**NOTE** A typical example is a panel with row and intersecting column electrodes.

3.3.10 **multiplex driving**

A method of temporal driving in which a first set of pixel groups is selected in a sequence once in a time frame and a second set of intersecting pixel groups is selected according to the pattern to be displayed.

**NOTE** A typical example is a cell with row and intersecting column electrodes in which one row is selected at a time.

3.3.11 **static driving**

A method of driving in which all pixels are addressed simultaneously and constantly.

3.3.12 **after image**

Short time remnant of an image on the screen after the actual image is removed.

3.3.13 **aperture ratio**

Fill factor

Ratio of the pixel area available for light modulation to the total geometrical pixel area.

3.3.14 **bubble**

Visual defect caused by a cavity in the liquid crystal material or paste of a polarizer or reflector.

3.3.15 **cross-talk**

Shadowing

Undesirable luminance variation on a part of a display area produced by an image displayed on another part of the display.

3.3.16 **delay time**

Time interval from switching the display from OFF state to ON state or from ON state to OFF state till the instant at which the luminance of the liquid crystal display changes by 10% of the total possible luminance variation range (see Figure 2).

3.3.17 **designed viewing direction**

Viewing direction obtained by designing the visual characteristics of an LCD device to enable the easiest viewing according to the purpose of device use.
3.3.18  
**diffused light method**  
Method for illuminating the device under test during electro-optical measurements using diffused light.  

NOTE  The measuring spot on the display is uniformly illuminated from all directions. Such an illumination can be realized by integrating spheres, diffusing hemispheres, etc.

3.3.19  
**direct beam method**  
Method for illuminating the device under test during electro-optical measurements using a direct beam.  

NOTE  The measuring spot on the display is illuminated by a directional light-beam.

3.3.20  
**fall time**  
Time interval at which luminance changes from 10 % to 90 % of the total possible luminance variation range for normally white mode or from 90 % to 10 % for normally black mode after switching LCD driving voltage from ON state to OFF state (see Figure 2).

3.3.21  
**frame frequency**  
Number of image frames addressed per second.

3.3.22  
**frame rate control**  
Method for realizing grey-levels that makes use of the temporal integration of the human visual system.  

NOTE  Different optical levels in different frames will be averaged over time to provide the sensation of a certain grey-level.

3.3.23  
**image sticking**  
Long time remnant of an image on the screen after the actual static image is removed.

3.3.24  
**LCD driving voltage**  
LCD drive voltage  
Voltage that drives a liquid crystal display cell (see Figure 1).

3.3.25  
**line defect**  
Vertical / horizontal line defect  
Visual defect located along the same line.

3.3.26  
**logic (drive) voltage**  
Voltage applied to operate the logic circuitry in an LCD module (see Figure 1).

3.3.27  
**mura**  
Non-uniformity  
Visual imperfection in luminance or chromaticity.
3.3.28 optical threshold voltage
specific voltage necessary to vary the luminance from the initial luminance at 0 V to 10 % of
the maximum possible variation range

3.3.29 optical saturation voltage
specific voltage necessary to vary the luminance from the initial luminance at 0 V to 90 %
of the maximum possible variation range

3.3.30 pinhole
visible missing part of a pixel electrode, black matrix, etc.

3.3.31 point defect
general term for image defects, such as luminous dots, half luminous dots, dark dots, linked
dots, pinholes, bubbles and foreign material inclusions

3.3.32 preferred viewing direction
specific viewing direction of LCD device in which the displayed image can be best perceived

3.3.33 response time
generic term for “turn-on time” and “turn-off time” (see Figure 2)

3.3.34 rise time
time interval at which luminance changes from 90 % to 10 % of the total possible luminance
variation range for normally white mode or from 10 % to 90 % for normally black mode after
switching LCD driving voltage from OFF state to ON state (see Figure 2)

3.3.35 scratch defect
defect by scratching glass or polarizer surface

3.3.36 stain
stain shaped defect larger than a pixel and with unclear boundary

3.3.37 subpixel
dot
separately addressed internal structure in a pixel that extends the pixel function

NOTE Display engineers often use the term “dot”.

3.3.38 transmittance
luminous flux ratio of outgoing light to incident light in a transmissive LCD
3.3.39
**turn-off time**
time interval from switching the display from ON state to OFF state till the instant at which the luminance of a liquid crystal display reaches 90 % in the normally white mode or 10 % in the normally black mode

NOTE 0 % is the minimum possible luminance and 100 % is the maximum. The turn-off time is the sum of delay and fall times (see Figure 2).

3.3.40
**turn-on time**
time interval from switching the display from OFF state to ON state till the instant at which the luminance of a liquid crystal display reaches 10 % in the normally white mode or 90 % in the normally black mode

NOTE 0 % is the minimum possible luminance and 100 % is the maximum. The turn-on time is the sum of delay and rise times (see Figure 2).

3.3.41
**viewing direction**
direction or angle for viewing an LCD device

NOTE It is defined by the inclination angle $\theta$ and the azimuth $\varphi$.

4 Technological aspects

4.1 Order of precedence

Where there are conflicting requirements, documents shall rank in the following order of authority:

a) the detail specification;
b) the blank detail specification;
c) the family specification, if any;
d) the sectional specification;
e) the generic specification;
f) the basic specification;
g) the IECQ rules of procedure;
h) any other international (e.g. IEC) documents to which reference is made;
i) a national document.

The same order of precedence shall apply to equivalent national documents.

4.2 Terminology, units and symbols

Terminology shall, wherever possible, be either taken from article 3 or from IEC 60050\(^1\).

Units, graphical and letter symbols shall, wherever possible, be taken from the following standards:

- IEC 60027;
- IEC 60617;
- ISO 1000.

Any other units, symbols or terminology peculiar to one of the devices covered by this generic specification shall be taken from the relevant IEC or ISO standards (see 2) or derived in accordance with the principles of the standards listed above.

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\(^1\) (International Electrotechnical Vocabulary)
It is recommended to use letter symbols as listed in Table 1 below.

### Table 1 – Letter symbols

<table>
<thead>
<tr>
<th>No</th>
<th>Name of quantity</th>
<th>Symbol</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Horizontal pixel pitch</td>
<td>$H_{\text{pitch}}$</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>002</td>
<td>Vertical pixel pitch</td>
<td>$V_{\text{pitch}}$</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>003</td>
<td>Operating display luminance</td>
<td>$L$</td>
<td>cd/m²</td>
<td></td>
</tr>
<tr>
<td>004</td>
<td>Contrast ratio (diffused light)</td>
<td>$CR_{\text{diff}}$</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>005</td>
<td>Contrast ratio (direct beam)</td>
<td>$CR_{\text{dir}}$</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>006</td>
<td>Viewing angle range (horizontal)</td>
<td>$\theta_H$</td>
<td>° (degree)</td>
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<tr>
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<td>Viewing angle range (vertical)</td>
<td>$\theta_V$</td>
<td>° (degree)</td>
<td></td>
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<tr>
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<td>Reflectance (regular)</td>
<td>$\rho_r$</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>009</td>
<td>Reflectance (diffuse)</td>
<td>$\rho_d$</td>
<td>%</td>
<td></td>
</tr>
<tr>
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<td>Transmittance (regular)</td>
<td>$\tau_r$</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>011</td>
<td>Transmittance (diffuse)</td>
<td>$\tau_d$</td>
<td>%</td>
<td></td>
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<tr>
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<td>Turn-on time</td>
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<td>ms</td>
<td>Refer to Figure 2</td>
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<tr>
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<td>Rise time</td>
<td>$t_r$</td>
<td>ms</td>
<td>Refer to Figure 2</td>
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<tr>
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<td>ms</td>
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<tr>
<td>015</td>
<td>Fall time</td>
<td>$t_f$</td>
<td>ms</td>
<td>Refer to Figure 2</td>
</tr>
<tr>
<td>016</td>
<td>Threshold voltage</td>
<td>$V_{\text{in}}$</td>
<td>V</td>
<td></td>
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<td>017</td>
<td>Saturation voltage</td>
<td>$V_{\text{sat}}$</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>018</td>
<td>Oscillator frequency</td>
<td>$f_{\text{OSC}}$</td>
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<tr>
<td>019</td>
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<td>$f_{\text{FRM}}$</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>020</td>
<td>Operating frequency</td>
<td>$f_{\text{op}}$</td>
<td>Hz</td>
<td></td>
</tr>
<tr>
<td>021</td>
<td>Supply voltage for logic drive</td>
<td>$V_{\text{DD}} - V_{\text{SS}}$</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>022</td>
<td>Voltage for LCD drive</td>
<td>$V_{\text{DD}} - V_{\text{EE}}$</td>
<td>V</td>
<td>Refer to Figure 1</td>
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<td>$V_{\text{EE}} - V_{\text{SS}}$</td>
<td>V</td>
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<td>$V_{\text{OP}} - V_{\text{SS}}$</td>
<td>V</td>
<td></td>
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<td>Supply current</td>
<td>$I_{\text{DD}}$</td>
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<td>027</td>
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<td>$I_{\text{EE}}$</td>
<td>mA</td>
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</tr>
<tr>
<td>028</td>
<td>Operating LCD voltage</td>
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<td>V</td>
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<td>029</td>
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<td>$V_{\text{BL}}$</td>
<td>V</td>
<td></td>
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<td>030</td>
<td>Backlight supply current</td>
<td>$I_{\text{BL}}$</td>
<td>mA</td>
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<td>031</td>
<td>Input signal voltage</td>
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<td>032</td>
<td>High level input signal voltage</td>
<td>$V_{\text{INH}}$</td>
<td>V</td>
<td></td>
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<td>033</td>
<td>Low level input signal voltage</td>
<td>$V_{\text{INL}}$</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>034</td>
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<td>035</td>
<td>Total current consumption</td>
<td>$I_{\text{tot}}$</td>
<td>mA</td>
<td></td>
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<td>036</td>
<td>Total parallel segment resistance</td>
<td>$R_{\text{tot}}$</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>037</td>
<td>Total parallel segment capacitance</td>
<td>$C_{\text{tot}}$</td>
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<td>038</td>
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<td>039</td>
<td>Low level input signal current</td>
<td>$I_{\text{INL}}$</td>
<td>mA</td>
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<td>°C</td>
<td></td>
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<td>042</td>
<td>Soldering temperature</td>
<td>$T_{\text{sld}}$</td>
<td>°C</td>
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</tbody>
</table>
Figure 1 – Block diagram for explanation of supply voltages
4.3 Preferred values of temperature, humidity and pressure

Preferred values of temperature, humidity and pressure for the measurement of characteristics, for tests and for operating conditions, are given in IEC 61747-5.

4.4 Marking

4.4.1 Device identification

The marking on the device shall enable clear identification of the device.

4.4.2 Device traceability

The device shall be provided with a traceability code which enables back-tracing of the device to a certain production or inspection lot.
4.4.3 Packing

Marking on the packing shall state:

a) the device identification code;
b) the traceability code(s) of the enclosed devices;
c) the number of enclosed devices;
d) the required precautions, if any.

This marking shall be in accordance with custom regulations.

NOTE Additional requirements can be specified in the relevant detail specification.

4.5 Categories of assessed quality

This generic specification provides three categories of assessed quality. The devices are grouped in an identified and date-coded inspection lot, which is tested to the specified quality categories. The AQLs or LTPDs associated with the same inspection group may vary for each category and shall be as specified in the detail specification.

The minimum requirements of the categories are as follows:

Category I The type meets the requirements of qualification approval of categories II or III. Each lot meets the inspection requirements of group A which includes functional tests. Every three months, one lot meets the inspection requirements for interconnection ability. Annually, one lot meets the group B and group C inspection requirements (see 5.6.1).

Category II The lot meets the inspection requirements of group A and group B on a lot-by-lot basis, and of group C on a periodic basis.

Category III The lot is 100% screened and meets the inspection requirements of group A and group B on a lot-by-lot basis, and of group C on a periodic basis.

The sectional or blank detail specifications shall define the minimum requirements for each category. A detail specification may contain requirements, including screening requirements, additional to those given in the generic, sectional or blank detail specification.

4.6 Screening

A screening is an examination or test applied to all devices in a lot.

When required by the detail specification, all devices in the lot shall be screened by submitting them to one of the sequences given in the relevant table of the sectional or blank detail specification, and all defectives removed. Other sequences not specified in this standard are applicable only where the above sequences are not correlated or are in contradiction with recognized failure mechanisms. When a part of the screening process as given in the relevant table of the sectional or blank detail specification forms part of the manufacturing process in the prescribed sequence, these procedures need not be repeated. For the purpose of this specification, burn-in is defined as thermal and electrical stress applied to all devices in a lot for a specified period of time for the purpose of detecting and removing potential early failures.

4.7 Handling

See IEC 60747-1, chapter IX.

Adequate warning shall be displayed in the case of harmful products (e.g. Be0).
5 Quality assessment procedures

Quality assessment comprises the procedure for obtaining qualification approval as defined in 5.5, followed by quality conformance inspection on a lot-by-lot basis (including screening if required) and on a periodic basis as qualified in the detail specification.

The quality assessment tests are subdivided into group A, B and C tests; these are performed lot by lot or periodically, as defined in 4.5. In some cases, group D tests may also be specified, for example, for qualification approval.

5.1 Eligibility for qualification approval

A type of device becomes eligible for qualification approval when the rules of procedure of IEC QC 001002, clause 11, are satisfied.

5.1.1 Primary stage of manufacture

The primary stage of manufacture is defined in the sectional or blank detail specification.

5.2 Commercially confidential information

If any part of the manufacturing process is commercially confidential, this shall be suitably identified, and the chief inspector shall demonstrate to the satisfaction of the National Supervising Inspectorate (NSI) that the requirements of the rules of procedure given in 10.2.2 of IEC QC 001002, have been complied with.

5.3 Formation of inspection lots

See the rules of procedure given in 12.2 of IEC QC 001002.

5.4 Structurally similar devices

See the rules of procedure given in 8.5.3 of IEC QC 001002.

Details concerning grouping are given in the relevant sectional or blank detail specifications.

5.5 Granting of qualification approval

See the rules of procedure given in 11.3.1 of IEC QC 001002.

Method a) or b) of the rules of procedure may be used at the manufacturer's discretion in accordance with the inspection requirements given in the sectional or blank detail specifications. Samples may be composed of appropriate structurally similar devices. In some cases, group D tests are required for qualification approval. All variables measurements called for as post-test end-points in the detail specification shall be recorded as variables data.

The qualification report shall include a summary of all the test results for each group and subgroup, including number of devices tested and number of devices failed. This summary shall be derived from variables and/or attributes data.

The manufacturer shall retain all data for submission to the NSI on demand.
5.6 Quality conformance inspection

Quality conformance inspection shall consist of the examinations and tests of groups A, B, C and D, as specified.

For group B and C inspection, samples may be composed of structurally similar devices.

Samples for periodic tests shall be drawn from one or more lots which have passed groups A and B inspection. Individual devices shall have passed the group A measurements called for in the detail specification.

5.6.1 Division into groups and subgroups

The following guidelines shall be used in the preparation of detail specifications.

5.6.1.1 Group A inspection (lot-by-lot)

This group prescribes the visual inspection and the electrical measurements to be made on a lot-by-lot basis to assess the principal properties of a device. Unless otherwise specified, structural similarity groupings are not permitted.

Group A inspection is divided into appropriate subgroups as follows:

Subgroup A1 This subgroup comprises a visual examination as specified in 6.2.1.
Subgroup A2 This subgroup comprises measurements of primary characteristics of the device.
Subgroups A3 and A4 These subgroups may not be required. They comprise measurements of secondary characteristics of the device. The correct requirements for each device category are given in the relevant sectional or blank detail specification. The choice between subgroups A3 or A4 for given measurements is essentially governed by the desirability of performing them at a given quality level.

5.6.1.2 Group B inspection (lot-by-lot, except for category I, see 4.5)

This group prescribes the procedures to be used to assess certain additional properties of the device, and includes mechanical, climatic, electrical and optical endurance tests that can normally be performed in one week or as specified in the relevant sectional or blank detail specification.

5.6.1.3 Group C inspection (periodic)

This group prescribes the procedures to be used on a periodic basis to assess certain additional properties of the devices, and includes electrical and optical measurements, mechanical, climatic and endurance tests appropriate for checking at intervals of either three months (categories II and III) or one year (category I), or as specified in the relevant sectional or blank detail specification.

5.6.1.4 Division of group B and group C into subgroups

To enable comparison and to facilitate change from group B to group C and vice versa when necessary (see 5.6.3), tests in these groups have been divided among subgroups bearing the same number for corresponding tests.
The division is as given below.

Subgroups B1/C1 Comprise measurements that control dimensional interchangeability of the devices.

Subgroups B2a/C2a Comprise measurements that assess electrical and optical properties of the devices of a design nature.

Subgroups B2b/C2b Comprise measurements that further assess some of the electrical and optical characteristics of the device already measured in group A by measurement under different voltage, current, temperature or optical conditions.

Subgroups B2c/C2c Comprise verification of ratings of the device, where appropriate.

Subgroups B3/C3 Comprise tests intended to assess mechanical robustness of the device.

Subgroups B4/C4 Comprise tests intended to assess interconnection ability of the device.

Subgroups B5/C5 Comprise tests intended to assess the ability of the device to withstand climatic stresses, for example change of temperature, sealing.

Subgroups B6/C6 Comprise tests intended to assess the ability of the device to withstand mechanical stresses, for example vibration, shock.

Subgroups B7/C7 Comprise tests intended to assess the ability of the device to withstand long-term humidity.

Subgroups B8/C8 Comprise tests intended to assess failure characteristics of the device under endurance testing.

Subgroups B9/C9 Comprise tests intended to assess electrical and optical properties of the device under storage conditions at extremes of temperature.

Subgroups B10/C10 Comprise tests intended to assess performance of the device during variations of air pressure.

Subgroups B11/C11 Comprise tests on the permanence of marking.

Subgroup CRRL Lists a selection of tests and/or measurements made in the preceding subgroups, the results of which shall be presented in the Certified Record of Released Lots (CRRL).

These subgroups may not all be required.

5.6.1.5 Group D inspection

This group prescribes the procedures to be carried out at intervals of 12 months or for qualification approval only.

5.6.2 Inspection requirements

The statistical sampling procedures described in 5.7 shall be used.

5.6.2.1 Criteria for lot rejection

Lots failing to meet the quality conformance inspection of either group A or group B inspection shall not be accepted. If, during quality conformance inspection, devices fail a test in a subgroup which would result in the lot being rejected, the quality conformance inspection can be terminated, and the lot shall be considered a rejected lot in group A and B. If a lot is withdrawn in a state of failing to meet quality conformance requirements and is not re-submitted, it shall be considered a rejected lot.
5.6.2.2 Re-submitted lots

Failing lots, that have been reworked when technically possible and are resubmitted for quality conformance inspection, shall contain only devices that were included in the original lot and shall be re-submitted only once for each inspection group (group A and B). Re-submitted lots shall be kept separate from new lots and shall be clearly identified as re-submitted lots. Re-submitted lots shall be randomly re-sampled and inspected for all the inspection criteria of group A.

5.6.2.3 Procedure in case of test equipment failure or operator error

If any devices are believed to have failed as a result of faulty test equipment or operator error, the failures shall be entered in the test record (but may be excluded from the CRRL by agreement with the NSI) and shall be submitted along with a complete explanation of why the failures are believed to be invalid to the NSI.

The chief inspector shall decide whether replacement devices from the same inspection lot may be added to the sample. Replacement devices shall be subjected to the same tests to which the discarded devices were subjected prior to failure and to any remaining specified tests to which the discarded devices were not subjected prior to failure.

5.6.2.4 Procedure in case of failure in periodic tests

When a group B failure occurs, the corresponding group C tests (see 5.6.1.4) are invalid. In the event of failing periodic inspection tests for causes other than faults or an operator error, see the rules of procedure given in 12.6 of IEC QC 001002 with the following amendments:

- 12.6.1 a): “suspend further releases under the system of all components within the structurally similar set.”
- 12.6.4 a): “the procedure for release under the system of corrected lots shall be returned immediately after correcting the manufacturing fault”.
- 12.6.8: “If qualification approval has been withdrawn in accordance with 12.6.7 of the rules of procedure, it may be re-instated by a simplified procedure (which focuses on the tests of those features which caused the failure) at the discretion of the NSI.”

5.6.3 Supplementary procedure for reduced inspection

5.6.3.1 Group B

A special reduced inspection procedure may be used which allows the manufacturer to carry out the appropriate group B tests at normal inspection on every fourth lot with a maximum interval of three months instead of on a lot-by-lot basis for the tests in all subgroups of group B. This special procedure applies to each subgroup which has fulfilled the required conditions.

The condition for this change shall be that 10 successive lots have passed group B inspection. Reversion to normal inspection in group B shall be made when a sample has failed to meet a subgroup inspection under the reduced inspection procedure.
5.6.3.2 Group C

When a three-month interval is specified for periodic tests, the test period may be extended to six months provided that three successive periodic tests have been passed at three-month intervals. Reversion to the normal three-month interval shall be made when a sample has failed to meet a subgroup inspection under the extended interval procedure (see also 5.6.2.4).

5.6.4 Sampling requirements for small lots

Where a lot size is small, the procedures shall refer to 3.6.4 of IEC 60747-10 or 3.5 of IEC 60410.

5.6.5 Certified records of released lots (CRRL)

See the rules of procedure given in clause 14 of IEC QC 001002.

5.6.6 Delivery of devices subjected to destructive or non-destructive tests

Tests considered as destructive are marked (D) in the sectional or blank detail specifications. Devices subjected to destructive tests shall not be included in the lot for delivery. Devices subjected to non-destructive environmental tests may be delivered provided they are re-tested according to group A requirements and satisfy them.

5.6.7 Delayed deliveries

Before delivery of lots in store for a period and in conditions specified in the relevant sectional or blank detail specification, the lots or the quantities to be delivered shall undergo the specified group A inspection and the group B interconnection ability tests. Once this has been done for the complete lot, no further re-testing is required for another period.

5.6.8 Supplementary procedure for deliveries

The manufacturer may, at his discretion, supply devices that have met a more severe assessment level than that required.

5.7 Statistical sampling procedures

For group A, B and C inspections, either the AQL sampling procedure or the LTPD sampling procedure shall be used. The detail specification shall specify which of the procedures is to be used.

5.7.1 AQL sampling plans

See 4.5 of IEC 60410.

There are three types of sampling plans: single, double and multiple. When several types of plans are available for a given AQL and code letter, any one may be used.

5.7.2 LTPD sampling plans

See annex D.

5.8 Endurance tests

Endurance tests shall be specified in the detail specification.
5.9 **Endurance tests where the failure rate is specified**

Failure rate as used in this standard is defined as LTPD expressed as a percentage per thousand hours.

5.9.1 **General**

Endurance tests shall be conducted in accordance with the procedures mentioned.

Endurance tests performed on devices at, or within, their maximum ratings shall be considered non-destructive.

5.9.2 **Selection of samples**

Samples for endurance tests shall be selected at random from the inspection lot (see annex D). The sample size for a 1 000 h test shall be chosen by the manufacturer from the column under the specified failure rate (see table D.1) or the actual lot size (see table D.2).

The acceptance number shall be the one associated with the particular sample size chosen.

5.9.3 **Failure**

A device which fails at one or more of the end-point limits specified for endurance tests at any specified reading interval shall be considered a failure and be considered as such at any subsequent reading interval. If the sample fails, the test may be terminated at the discretion of the manufacturer.

5.9.4 **Endurance test time and sample size**

Whenever the failure rate is specified, the endurance test time shall be 1 000 h initially. Once a lot has passed the 1 000 h test, endurance tests can be reduced to a certain period, as specified in the detail specification.

5.9.5 **Procedure to be used if the number of observed failures exceeds the acceptance number**

In the event that the number of failures observed on endurance tests exceeds the acceptance number, the manufacturer shall choose one of the following options:

a) withdraw the entire lot;

b) add additional samples in accordance with 5.9.5.1;

c) extend the test time to 1 000 h in accordance with 5.9.5.2, if a time less than 1 000 h was originally chosen;

d) screen the lot and re-submit in accordance with 5.6.2.2.

After applying one of the preceding options, the procedure of 5.6.2.4 shall apply.

5.9.5.1 **Additional samples**

This option shall be used only once for each submission. When this option is chosen, a new total sample size (initial plus added) shall be chosen by the manufacturer from tables D.1 or D.2 from the column specifying the failure rate (table D.1) or the actual lot size (table D.2).
A quantity of additional units sufficient to increase the sample to the newly chosen total sample size shall be selected from the lot. The new acceptance number shall be the one associated with the new total sample size chosen. The added sample shall be subjected to the same endurance test conditions and time period as the initial sample. If the total observed number of defectives (initial plus added) does not exceed the acceptance number for the total sample, the lot shall be accepted; if the observed number of defectives exceeds the new acceptance number, the lot shall be rejected.

5.9.5.2 Extension of endurance test period

If an endurance test time periods less than 1 000 h is used and the number of failures observed in the initial sample exceeds the acceptance number, the manufacturer may, instead of adding additional samples, choose to extend the test time of the entire initial sample to 1 000 h and determine a new acceptance number from tables D.1 or D.2. The new acceptance number shall be one associated with the largest sampling size in the specified column which is less than, or equal to, the sample size being tested. A device which is a failure at the initial reading interval shall be considered as such at the 1 000 h reading interval. If the observed number of defectives exceeds this acceptance number, the lot shall not be accepted.

5.10 Accelerated test procedures

Under consideration.

5.11 Capability approval

Under consideration.

6 Test and measurement procedures

6.1 Standard atmospheric conditions for electrical and optical measurements

Unless otherwise specified, all electrical and optical measurements are carried out under the atmospheric conditions given in IEC 60749 and IEC 61747-6.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>25 °C ± 5 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>Between 45 % and 75 %</td>
</tr>
<tr>
<td>Atmospheric pressure</td>
<td>Between 86 kPa and 106 kPa (860 mbar and 1 060 mbar)</td>
</tr>
</tbody>
</table>

Measurements may be carried out at other temperatures provided the National Supervising Inspectorate is satisfied that the device will conform to the detail specification when tested at an ambient temperature of 25 °C ± 1 °C and relative humidity between 48 % and 52 % when this is important.

6.2 Physical examination

6.2.1 Visual examination

Unless otherwise specified, visual examination shall be performed under normal factory lighting and under normal visual conditions. Examination shall be made for correctness of the following elements:

a) marking and legibility*;

b) terminal identification;

c) appearance of the device, which shall be checked in accordance with IEC 61747-5.

* Being revised.
6.2.2 Dimensions

Dimensions shall be checked in accordance with the specified drawing. Examples of typical drawings for LCD modules are shown in annex B.

6.2.3 Permanence of marking

The purpose of this test is to determine the permanence of marking following handling and use of typical cleaning on the device.

6.2.3.1 Conditions

Solvents, rubbing conditions and materials shall be specified in the relevant sectional or blank detail specification.

6.2.3.2 Initial and final measurement

The specimen shall be visually inspected.

6.3 Electrical and optical measurements

6.3.1 General conditions and precautions

6.3.1.1 Alternative methods

Measurements may be carried out by using the methods specified or any other method giving equivalent results but, in case of dispute, only the specified method shall be used.

NOTE By “equivalent” is meant the value of the characteristic established by such other methods is within the specified limits when measured using the specified method.

a) Method for electrical and optical measurements shall be in accordance with IEC 60747 and IEC 60748. They shall be used when required and as prescribed by the detail specification.

b) Methods for electrical and optical measurements not included in IEC 60747 and IEC 60748 shall be described in the relevant or detail specification.

6.3.1.2 Precision of measurements

The limits quoted in detail specifications are absolute. Measurement inaccuracies shall be taken into account when determining the actual measurement limits.

6.3.1.3 General precautions

Usual precautions should be taken to reduce measurement errors to a minimum and to avoid damage to the device. The most important of these are given in IEC 60747-1.

6.4 Environmental tests

Methods for environmental tests shall be in accordance with IEC 60068. They shall be used when required and as prescribed by the detail specification. They are indicated as “destructive” or “non-destructive” according to IEC 61747-5. When a mandatory sequence of testing is required, it shall be specified in the sectional specification or in the blank detail specification.

Methods for environmental tests not included in IEC 61747-5 shall be described in the detail specification.

For those test methods which involve the observation or the application of external forces which are related to the orientation of the device, such orientations and the direction of the force applied shall be in accordance with annex C.
## Cross references index

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<th>IEC 61747-1 Clause</th>
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<th>Old clause number</th>
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<td>6</td>
<td>Test and measurement procedures</td>
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Example of outline drawings of liquid crystal display cells
### Original dimensions are in millimetres and inches:

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<th>Ref.</th>
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<th>Notes</th>
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<td>A</td>
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<td>x</td>
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</tbody>
</table>

**NOTE 1** Overall dimensions, including polarizers and diffusers, if any.

**NOTE 2** Nominal dimensions of observation area.

**NOTE 3** Total number of terminals, including lacking or non-connected positions.

**NOTE 4** True geometrical dimension.

**NOTE 5** Y.X. reference planes (in accordance with ISO 1101) marked out in reference to a normal reading of the display.

**NOTE 6** Positional tolerance (in accordance with ISO 1101).

**NOTE 7** The display pattern and the assignment of terminals shall be represented on the data sheet.

**NOTE 8** e: standard pitch.
Annex C
(normative)

Orientation of LCD modules
D.1 General

The following specified procedures are suitable for all quality conformance requirements.

D.1.1 Selection of samples

Samples shall be randomly selected from the inspection lot. For continuous production, the manufacturer, at his option, may select samples in a regular periodic manner during manufacture, provided that the lot meets the requirements for the formation of lots.

D.1.2 Failures

Failure of a unit for one or more tests of a subgroup shall be charged as a single failure.

D.2 Single-lot sampling method

Quality conformance inspection information (sample sizes and number of observed defectives) shall be accumulated from a single inspection lot to demonstrate conformance to the individual subgroup criteria.

D.2.1 Sample size

The sample size for each subgroup shall be determined from tables D.1 or D.2 and shall meet the specified LTPD. The manufacturer may, at his option, select a sample size greater than that required; however, the number of failures permitted shall not exceed the acceptance number associated with the chosen sample size in tables D.1 or D.2.

In table D.2, the LTPD column to be used for sample size determination shall be that given in the lot size column which is nearest in value to the actual size of the submitted lot except that, if the actual lot size is halfway between two of the lot sizes given in the table, either of the lot size columns may be used at the manufacturer’s discretion. If, in table D.2, the appropriate lot size column does not contain an LTPD value equal to or less than the specified LTPD value, a 100 % inspection shall be used. In table D.2, the LTPD value in the appropriate lot size column which is numerically closest to the specified LTPD value shall be used to determine the sample size.

D.2.2 Acceptance procedure

For the first sampling, an acceptance number shall be chosen and the associated number of sample devices for the specified LTPD selected and tested (see 5.9.2). If the observed number of defectives from the first sample is less than or equal to the pre-selected acceptance number, the lot shall be accepted. If the observed number of defectives exceeds the pre-selected acceptance number, an additional sample may be chosen such that the total sample complies with 5.9.2. Tables D.1 or D.2, which are used for the first sampling of a given inspection lot for a given subgroup, shall be used for any and all subsequent samplings for the same lot and subgroup for each lot submission.
D.3 Additional sample

The manufacturer may add an additional quantity to the initial sample, but this may be done only once for any subgroup; the added samples shall be subjected to all the tests within the subgroup. The total sample size (initial and added samples) shall be determined by the new acceptance number selected from tables D.1 or D.2.

D.4 Multiple criteria

When one sample is used for more than one acceptance criterion, the entire sample for a subgroup shall be used for all criteria within the subgroup. In table D.1, the acceptance number shall be that associated with the largest sample size in the appropriate LTPD column which is less than or equal to the sample size used. In table D.2, the acceptance number shall be that associated with the specified LTPD in the appropriate lot size column for the sample size used.

D.5 100 % inspection

Inspection of 100 % of the lot shall be allowed, at the option of the manufacturer, for subgroups other than those which are called destructive. If the observed percentage of defective devices for the inspection lot exceeds the specified LTPD value, the lot shall be considered to have failed the appropriate subgroup(s). Re-submission of lots tested on a 100 % inspection basis shall also be on a 100 % inspection basis only and in accordance with the tightened inspection LTPD.

D.6 Tightened inspection

Tightened inspection shall be performed by testing to the criteria of the next lowest LTPD in tables D.1 or D.2 to those specified.
Table D.1 – LTPD sampling plans –

Minimum size of samples to be tested to ensure, with a 90 % confidence, that a lot having a percentage of defective devices equal to the specified LTPD will not be accepted (single sample)

| Acceptance number (c) | 50 | 30 | 20 | 15 | 10 | 7 | 5 | 3 | 2 | 1.5 | 1 | 0.7 | 0.5 | 0.3 | 0.2 | 0.15 | 0.1 |
|-----------------------|----|----|----|----|----|---|---|---|---|----|----|----|----|----|----|----|----|----|
| (for device/hours required for life test, multiply by 1 000) |
| 0  | 5  | 8  | 11 | 15 | 22 | 32 | 45 | 76 | 116 | 153 | 231 | 332 | 461 | 677 | 1 152 | 1 534 | 2 303 |
| 1  | 8  | 13 | 18 | 25 | 38 | 56 | 77 | 129 | 195 | 258 | 390 | 555 | 778 | 1 296 | 1 946 | 2 992 | 3 891 |
| 2  | 11 | 18 | 25 | 34 | 52 | 76 | 105 | 170 | 259 | 361 | 559 | 865 | 1 173 | 2 662 | 3 547 | 5 323 |
| 3  | 13 | 22 | 32 | 43 | 65 | 94 | 132 | 221 | 333 | 444 | 666 | 953 | 1 377 | 2 226 | 3 341 | 4 542 | 6 681 |
| 4  | 16 | 27 | 38 | 52 | 78 | 113 | 158 | 265 | 396 | 531 | 768 | 1 140 | 1 569 | 2 663 | 3 997 | 5 327 | 7 994 |

* r is the failure criterion.

NOTE 1 Sample sizes are based upon the Poisson exponential binomial limit.

NOTE 2 The minimum quality (approximate AQL) required to accept (on average) 19 out of 20 lots is shown in parentheses for information only.
Table D.2 – Hypergeometric sampling plans for small lot sizes of 200 or less

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NOTE Table D.2 gives the LTPD values associated with certain single sampling plans (acceptance number, sample size and lot size). The table has the following features:

a) calculations are based upon the hypergeometric distribution (exact theory) for lots of 200 devices or less;
b) the LTPD of a sampling plan is defined as the interpolated percentage of defectives for which there is a 0.10 probability of lot acceptance under the plan. The LTPD so defined need not be a realizable lot percentage of defectives for the lot size involved;
c) the sequence of sample sizes and lot sizes are generated by taking products of preceding numbers in the respective sequences and the numbers 2 and 5.
Table D.3 – AQL and LTPD sampling plans

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<th>AQL</th>
<th>0.10</th>
<th>0.15</th>
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<th>0.40</th>
<th>0.65</th>
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This table gives AQL and LTPD values which are considered to be sufficient to ensure that a satisfactory average outgoing quality limit will be maintained under both plans for lot sizes up to 150,000. It should be noted that the limiting quality protection varies relatively widely with lot size under the AQL plan, in comparison with the LTPD plan.

The table has been formulated by selecting, at an acceptance number $c = 2$, the LTPD value in table D.1 at which the sample size is most nearly equal to the sample size given for inspection level II, sample size code letters C through N in IEC 60410 and/or ISO 2859.

Table D.3 may be used provided that the maximum value of the acceptance number of the LTPD sampling plan is not greater than 4.
Bibliography

ISO 9241-3:1992, Ergonomic requirements for office work with visual display terminals (VDTs) – Part 3: Visual display requirements
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