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# GRAPHICAL SYMBOLS USED IN ELECTROTECHNOLOGY

## PART 3 – ANALOGUE ELEMENTS

SRI LANKA STANDARDS INSTITUTION

Gr. 7

SRI LANKA STANDARD

# GRAPHICAL SYMBOLS USED IN ELECTROTECHNOLOGY

## PART 3 : ANALOGUE ELEMENTS

**FOREWORD**

This Sri Lanka Standard was authorised for adoption and publication by the Council of the Sri Lanka Standards Institution on 1985-04-24, after the draft, finalised by the Drafting Committee on Graphical Symbols, had been approved by the Electrical Engineering Divisional Committee.

This standard is one of the series of Sri Lanka Standards for Graphical Symbols used in electrotechnology.

In view of detailed text associated with many of the symbols, this section has not been presented in the exact format used in other sections. Many of the examples in this standard have been included to illustrate principles. They do not necessarily represent available devices.

This standard is one of the series of Sri Lanka Standards for Graphical Symbols used in electrotechnology. Separate standards for graphical symbols used in different departments of electrical engineering are being prepared. This standard is the third in the series; others so far prepared are:

Part I Architectural and installations diagrams

Part II Kinds of current distribution systems, methods of connection and circuit elements.

In selecting and devising these symbols the object has been to ensure that symbols, as far as possible, are self explanatory and easy to draw in general use. It may be necessary in detailed diagrams to indicate the physical structure of the apparatus, the actual position of the terminals and so forth, but where possible, the principle of the standard symbols should be followed.

In the preparation of this standard the assistance derived from the publications of the International Electrotechnical Commission, the British Standards Institution and the Indian Standards Institution is gratefully acknowledged.

## 1 SCOPE

This standard contains graphical symbols for analogue elements in fields such as computation and control, to be used in diagrams.

The symbols and descriptions have been prepared with a veiw to electrical applications, but may also be applied to non-electrical systems (for example : pneumatic, hydraulic or mechanical).

This standard is not necessarily applicable to programming applications using general purpose analogue computers equipped with a removable patch (programming) panel.

## 2 GENERAL RULES

2.1 In many figures lower-case letters appear which are not part of the symbols and are added only for the purpose of identification of inputs and outputs as referenced in the description.

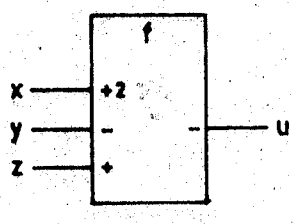
2.2 The symbols for sign indication are + and -. They are placed inside the outline of the symbol adjacent to each relevant input and output.

2.3 Weighting factors applied to the input signals are each indicated by a sign indicator in combination with a numerical value placed inside the outline of the symbol adjacent to the relevant input.

In this standard $w_1$, $w_2$, ...$w_n$ which are understood to include the proper sign, will be used to denote the values of the weighting factors. When the weighting factor is +1 or -1, the number may be omitted.

2.4 The symbol $f$ is used to denote the function of an analogue element. $f$ may be replaced by a symbol or a graph denoting the actual function.

Example




Element in which:

$u = -f(2x, -y, z)$

## 3 QUALIFYING SYMBOLS FOR SIGNAL IDENTIFICATION

The symbols 3.1 and 3.2 shall be used only when it is necessary to distinguish between analogue and digital signals.

| No. | Symbol | Description |
|---|---|---|
| 3.1 | ∩ | Identifier of analogue signals. |
| 3.2 | # | Identifier of digital signals.<br>*NOTE - A time-sequenced number (m) of bits may be denoted by m #.* |

## 4 QUALIFYING SYMBOLS FOR AMPLIFIERS

*NOTES*

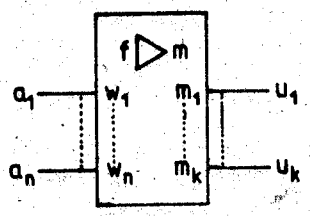
*1 When an element performs a specific function in addition to amplification, "f" may be replaced by the appropriate qualifying symbol (see symbols* 4.1 *to* 4.4*) or may be omitted if no confusion can arise.*

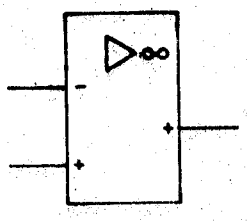
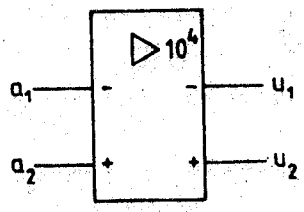
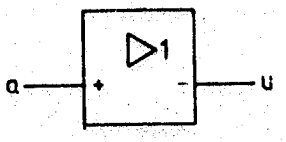
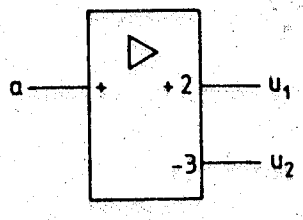
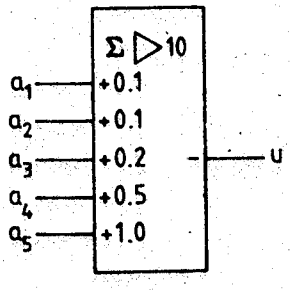
*2 In particular cases, for example integrating amplifiers, special purpose inputs may be defined using symbols* 4.5 *to* 4.11*. If these symbols are not sufficient, controlling inputs should be labelled* $C_1$, $C_2$ *...etc., and the effects of these should be defined in an associated table.*

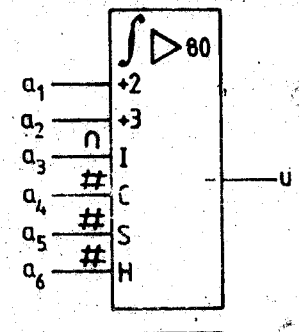
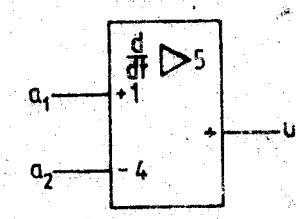
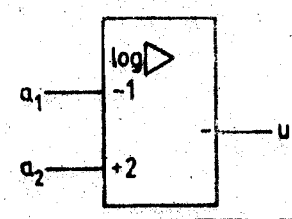
| No. | Symbol | Description |
|---|---|---|
| 4.1 | $\Sigma$ | Summing. |
| 4.2 | $\int$ | Integrating. |
| 4.3 | $\frac{d}{dt}$ | Differentiating. |

| No. | Symbol | Description |
|---|---|---|
| 4.4 | log | Logarithmic. |
| 4.5 | F | Frequency compensation. |
| 4.6 | I | Initial condition, analogue value of integration. |
| 4.7 | C | Control:the defined 1-state allows integration. |
| 4.8 | H | Hold:the defined 1-state holds last value. |
| 4.9 | R | Reset:the defined 1-state resets the output condition to zero. |
| 4.10 | S | Set:the defined 1-state sets to initial condition. |
| 4.11 | V | Supply voltage (to be used if special requirements exist). Any necessary identification of the supply (numeric) or polarity (+ or -) follows the letter V. |

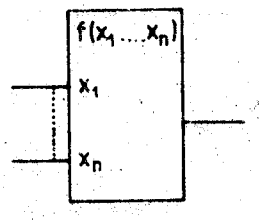
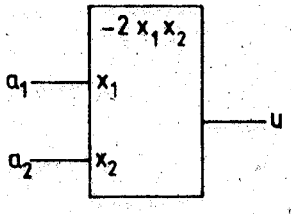
5 AMPLIFIERS

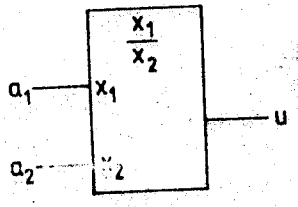
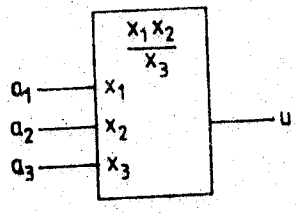
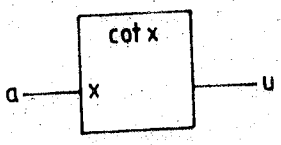
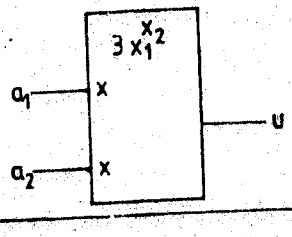
| | | |
|---|---|---|
| 5.1 |  | Amplifier for analogue computation. General symbol.<br>$w_1..,w_n$ represent the signed values of the weighting factors.<br>$m_1..,m_k$ represent the signed values of the amplification factors.<br>$u_1 = m.m_1.f(w_1.a_1, w_2.a_2,..., w_n.a_n)$<br>where ; i = 1, 2, ..., k<br>The sign of the amplification factor is to be maintained at each of the outputs, except for those being digital in nature.<br>When there is only one amplification factor for the whole element, or there is a common factor resulting from weighting factors and amplification factors, the *m* in the qualifying symbol may be replaced by the absolute value.. |

| No. | Symbol | Description |
|---|---|---|
| 5.1 |  | When $m$=1, the nubmer "1" may be omitted. Signs should always be maintained at analogue outputs.<br><br>The use of the sign ∞ as an amplification factor is recommended where the nominal open loop gain is very high and the knowledge of its exact value is not of particular concern.<br><br>Examples:<br><br>(a) High gain differential amplifier (operational amplifier). |
| |  | (b) High gain amplifier with a nominal amplification of 10 000 and two complementary outputs.<br><br>$u_1 = -10^4(-a_1+a_2) = 10^4(a_1-a_2)$<br><br>$u_2 = +10^4(-a_1+a_2) = 10^4(a_2-a_1)$ |
| |  | (c) Inverting amplifier with an amplification of 1.<br><br>$u = -1.a = -a$ |
| |  | (d) Amplifier with two outputs, the upper, non inverting, has an amplification of 2, the lower, inverting output, has an amplification of 3.<br><br>$u_1 = 2a$<br><br>$u_2 = -3a$ |
| |  | (e) Summing amplifier.<br><br>$u = -10(0.1a_1+0.1a_2+0.2a_3+$<br>$0.5a_4+1.0a_5)$<br>$= -(a_1+a_2+2a_3+5a_4+10a_5)$ |

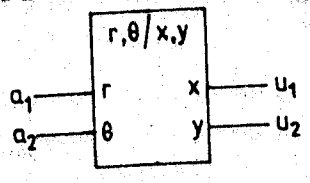
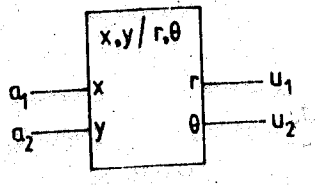
| No. | Symbol | Description |
|---|---|---|
| 5.1 |  | (f) Integrating amplifier (Integrator)<br>If $a_4 = 1$, $a_5 = 0$ and $a_6 = 0$<br>then:<br>$u = -80\left(a_3(t=0) + \int (2a_1 + 3a_2)\,dt\right)$<br>*Note : The symbols for signal identification (∩ and #) may be omitted if no ambiguity arises.* |
| |  | (g) Differentiating amplifier (differentiator).<br>$u = 5\,\frac{d}{dt}\,(a_1 - 4a_2)$ |
| |  | (h) Logarithmic amplifier<br>$u = -\log\,(-a_1 + 2a_2)$ |

## 6 FUNCTION GENERATORS

| | | |
|---|---|---|
| 6.1 |  | Function generator, general symbol.<br>$x_1 \ldots\ldots, x_n$ represent the arguments of the function and may each be replaced by an appropriate indication, provided that no ambiguity can arise. All weighting factors are assigned the value +1 and are therefore omitted.<br>$f(x_1 \ldots., x_n)$ shall be replaced by an appropriate indication of, or reference to, the function (see e.g. IEC Publication 27-1: Letter Symbols to be used in Electrical Technology, Part 1: General).<br>*Note - The graphic "/" shall not be used for the indication of the division because of ambiguity with the symbols for the level converter and the code conveter.*<br>Examples:<br>(a) Multiplier with weighting factor -2.<br>$u = -2a_1\,a_2$ |
| |  | |

| No. | Symbol | Description |
|---|---|---|
| 6.1 |  | (b) Divider<br>$u = \frac{a_1}{a_2}$ |
| |  | (c) Multiplier-divider<br>$u = \frac{ac_2}{a_3}$ |
| |  | (d) Cotangent function<br>$u = \cot a$ |
| |  | (e) Exponential function<br>$u = 3a_1^{a_2}$ |

## 7 COORDINATE CONVERTERS

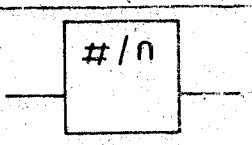
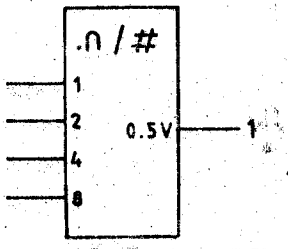
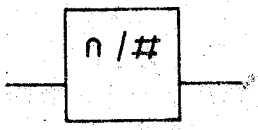
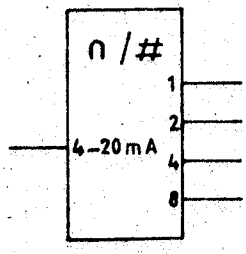
| | | |
|---|---|---|
| 7.1 |  | Coordinate converter, polar to rectangular<br>$u_1 = a_1 \cdot \cos a_2$<br>$u_2 = a_1 \cdot \sin a_2$ |
| 7.2 |  | Coordinate converter, rectangular to polar.<br>$u_1 = \sqrt{a_1^2 + a_2^2}$<br>$u_2 = \arctan \frac{a_2}{a_1}$ |

## 8 SIGNAL CONVERTERS

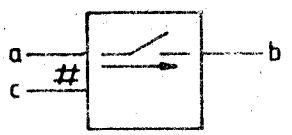
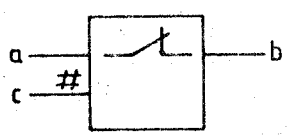
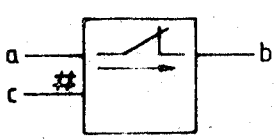
*NOTES*

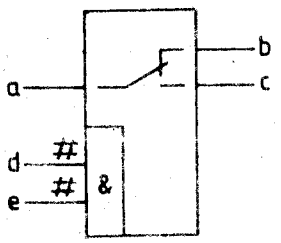
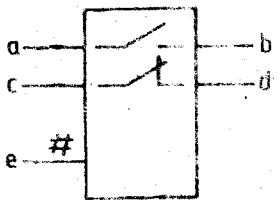
*1 The indication of the specific relation between inputs and outputs may be shown inside the outline.*

*2 If the digital information is serial, the most significant bit is presented first unless otherwise indicated.*

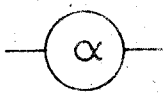
| No. | Symbol | Description |
|---|---|---|
| 8.1 |  | Digital to analogue converter. General symbol. |
| |  | Example :<br><br>Digital to analogue converter which converts 4-bit weighted binary code to an analogue output 0 V to 5 V. |
| 8.2 |  | Analogue to digital converter. General symbol. |
| 8.3 |  | Example :<br><br>Analogue to digital converter which converts the input range 4 mA to 20 mA into a 4-bit weighted binary code. |

## 9 ELECTRONIC SWITCHES

| No. | Symbol | Description |
|---|---|---|
| 9.1 |  | Bidirectional switch (make), general symbol.<br>The analogue signal can pass in either direction between a and b as long as the digital input c stands at its defined 1-state.<br>*Note - An arrow may be added to indicate an unidirectional switch (make).*<br>Example :<br>The analogue signal can pass only in the direction indicated by the arrows as long as the digital input c stands as its defined 1-state. |
| |  | |
| 9.2 |  | Bidirectional switch (break), general symbol.<br>The analogue signal can pass in either direction between a and b as long as the digital input c stands at its defined 0-state.<br>*Note - An arrow may be added to indicate an unidirectional switch (break).*<br>Example :<br>The analogue signal can pass in the only in the direction indicated by the arrow as long as the digital input c stands at its defined 0-state. |
| |  | |

| No. | Symbol | Description |
|---|---|---|
| 9.3 |  | Bidirectional transfer switch operated by the AND function of two digital inputs. |
| 9.4 |  | Two independent bidirectional switches (one make and one break), both operated by the same binary input. |

## 10 COEFFICIENT SCALER

| No. | Symbol | Description |
|---|---|---|
| 10.1 |  | Coefficient scaler.<br><br>*Note - The value of the coefficient may be shown adjacent to and outside the outline of the symbol.* |

## SRI LANKA STANDARDS INSTITUTION

The Sri Lanka Standards Institution (SLSI) is the National Standards Organization of Sri Lanka established under the Sri Lanka Standards Institution Act No. 6 of 1984 which repealed and replaced the Bureau of Ceylon Standards Act No. 38 of 1964. The Institution functions under the Ministry of Science & Technology.

The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

The Institution is financed by Government grants, and by the income from the sale of its publications and other services offered for Industry and Business Sector. Financial and administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The development and formulation of National Standards is carried out by Technical Experts and representatives of other interest groups, assisted by the permanent officers of the Institution. These Technical Committees are appointed under the purview of the Sectoral Committees which in turn are appointed by the Council. The Sectoral Committees give the final Technical approval for the Draft National Standards prior to the approval by the Council of the SLSI.

All members of the Technical and Sectoral Committees render their services in an honorary capacity. In this process the Institution endeavours to ensure adequate representation of all view points.

In the International field the Institution represents Sri Lanka in the International Organization for Standardization (ISO), and participates in such fields of standardization as are of special interest to Sri Lanka.

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