

# DATA SHEET

## **PCF1303T** 18-element bar graph LCD driver

Product specification  
File under Integrated Circuits, IC01

November 1986

18-element bar graph LCD driver

PCF1303T

GENERAL DESCRIPTION

The PCF1303T is an 18-element bar graph LCD driver with linear relation to control voltage ( $V_c$ ) when in pointer or thermometer mode.

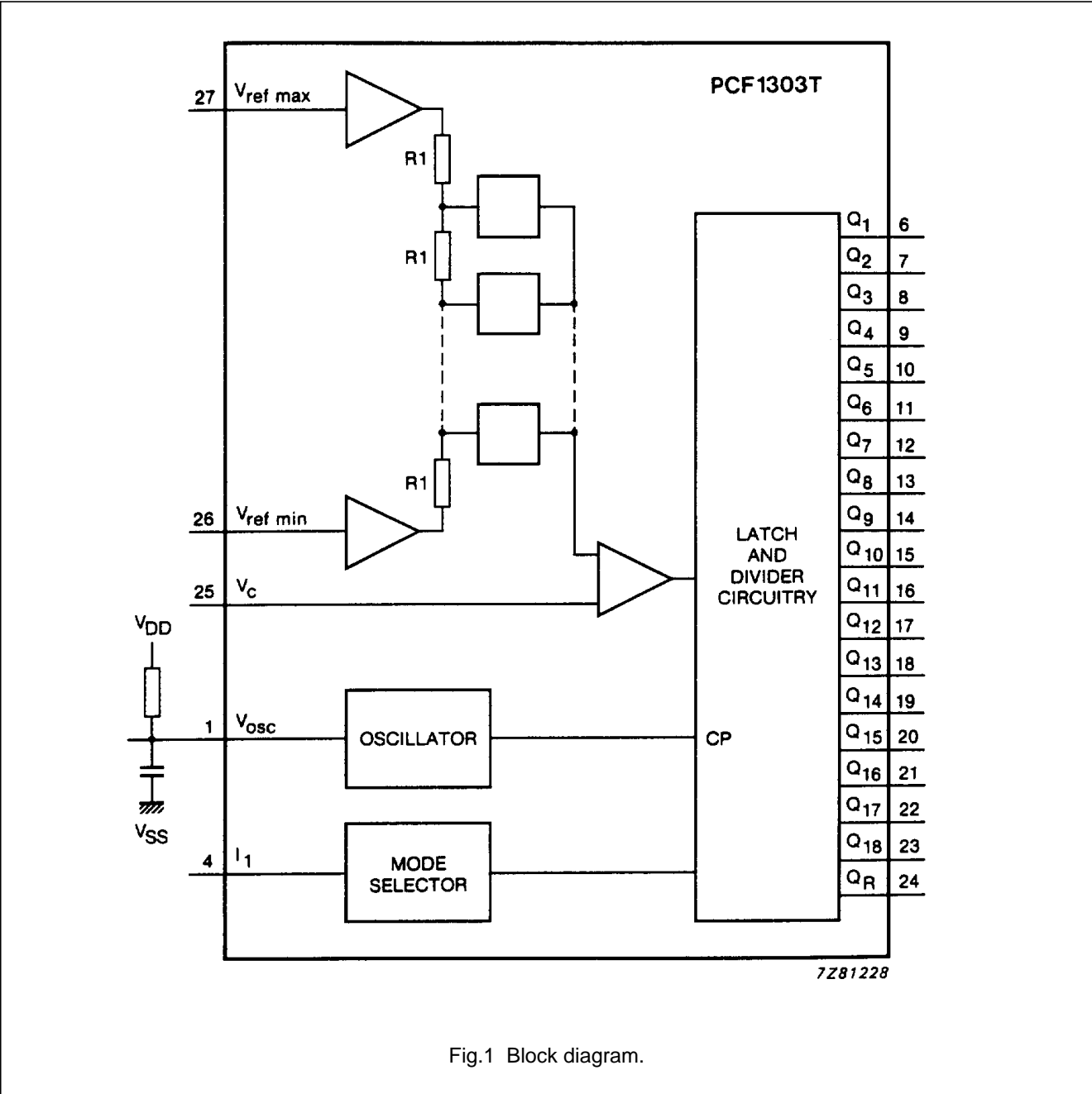


Fig.1 Block diagram.

PACKAGE OUTLINE

PCF1303T: 28-lead mini-pack; plastic (SO28; SOT136A); SOT136-1; 1996 September 02.

18-element bar graph LCD driver

PCF1303T

PIN DESCRIPTION

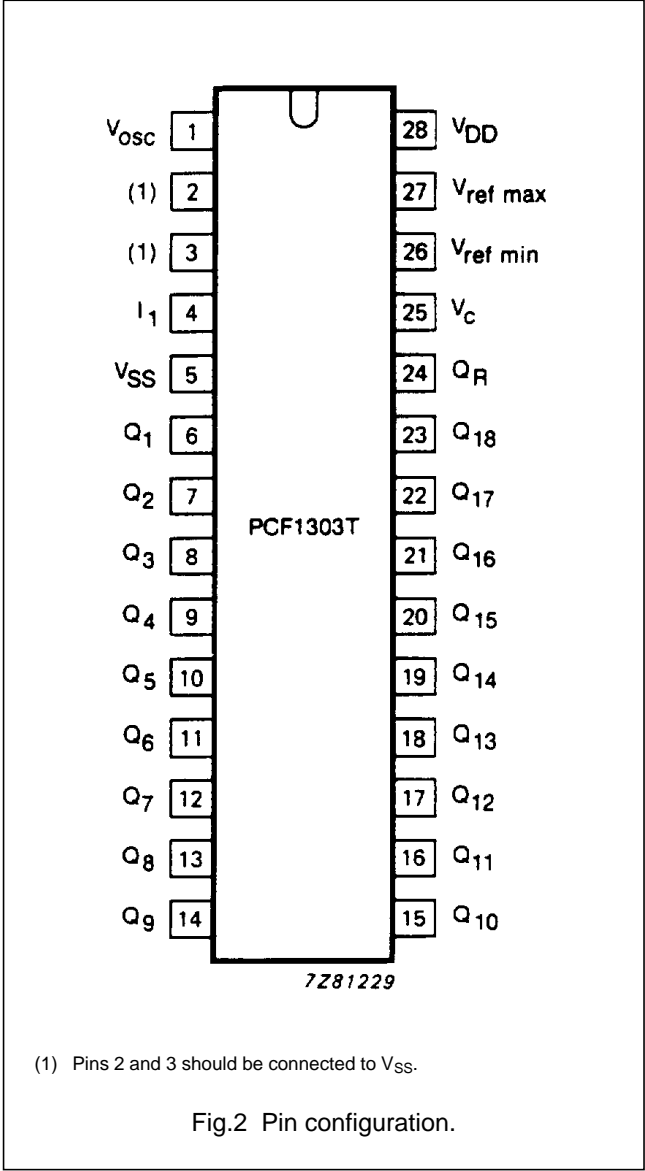
PIN NO.	SYMBOL	NAME AND FUNCTION
1	$V_{osc}$	oscillator pin
4	$I_1$	mode select input
5	$V_{SS}$	ground (0 V)
6 to 23	$Q_1$ to $Q_{18}$	segment outputs
24	$Q_R$	back-plane output
25	$V_c$	control voltage
26	$V_{ref\ min}$	reference voltage inputs
27	$V_{ref\ max}$	
28	$V_{DD}$	positive supply voltage

FUNCTION TABLE

$I_1$	MODE
L	pointer
H	thermometer

H = HIGH voltage level

L = LOW voltage level



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## PCF1303T

### FUNCTIONAL DESCRIPTION

The PCF1303T is an 18-element bar graph LCD driver with linear relation to the control voltage when in pointer or thermometer mode.

The first segment will energize when the control voltage is less than the trigger voltage ( $V_{T(bar)2}$  see equation (3)).

The circuit has analogue and digital sections.

The analogue section consists of a comparator with the inverting input coupled to the input control voltage. The non-inverting input of the comparator is connected via 17 analogue switches to the nodes of an 18-element resistor divider. The extremities of the resistor divider are coupled via high-input impedance amplifiers to the maximum reference voltage input and the minimum reference voltage input.

The control input functions with Schmitt trigger action.

The digital section has one reference output ( $Q_R$ ) to drive the back-plane and 18 outputs ( $Q_1$  to  $Q_{18}$ ) to drive the segments.

The segment outputs incorporate two latches and some gates.

The circuit is driven by an on-chip oscillator with external resistors and capacitors. The outputs are driven at typical 100 Hz.

### LINEARITY

$$V_{step} = V_{step'} \pm \Delta V_{step} \quad (1)$$

$V_{step'}$  is the voltage drop (internal) across the resistor-ladder network.

$\Delta V_{step}$  is the differential on  $V_{step}$ .

$$V_{step'} = \frac{(V_{ref\ max} \pm \Delta V_{2'}) - (V_{ref\ min} \pm \Delta V_2)}{18} \quad (2)$$

$\Delta V_2$  and  $\Delta V_{2'}$  are the maximum offset voltage spread of the on-chip voltage followers.

### ABSOLUTE VOLTAGE TRIGGER LEVEL

The absolute voltage trigger level at the  $V_c$  pin is  $V_{T(bar)n}$ ;

$$V_{T(bar)n} = (V_{ref\ min} \pm \Delta V_2) + \{ (n - 1) V_{step'} \pm \Delta V_R \} \pm \Delta V_1 \pm V_H \quad (3)$$

$n$  = number of segments;  $2 \leq n \leq 18$ .

$\Delta V_R$  is the voltage deviation at step  $n$  of the resistor-ladder network (for  $n = 2$  or  $18$ ,  $\Delta V_R = \Delta V_{step}$ ).

$\Delta V_1$  is the offset voltage for the on-chip comparator.

$V_H$  is the hysteresis voltage:  $30\% V_{step} \geq V_H \geq 10\% V_{step}$ .

**Note** to equation (3)

For  $\Delta V_2$  the same sign (+ or -) should be used as in equation (2).

## 18-element bar graph LCD driver

## PCF1303T

**RATINGS**

Limiting values as in accordance with the Absolute Maximum System (IEC 134)

Supply voltage	$V_{DD}$	–0,5 to + 15	V
Voltage on any input	$V_I$	–0,5 to $V_{DD} + 0,5$	V
D.C. current into any input or output	$\pm I_I$	max. 10	mA
Storage temperature range	$T_{stg}$	–25 to + 125	°C
Operating ambient temperature range	$T_{amb}$	–40 to + 85	°C

**D.C. CHARACTERISTICS** $V_{SS} = 0$  V

PARAMETER	V <sub>DD</sub> V	SYMBOL	T <sub>amb</sub> (°C)							UNIT	NOTES
			−40		+25			+85			
			MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.		
Quiescent device current	10,0	I <sub>DD</sub>		1200			1200		1200	μA	1
Operating supply current	8,2	I <sub>DD</sub>		2,0			2,0		2,0	mA	2
Input leakage current	6,0	± I <sub>I</sub>		300			300		1000	nA	3
	8,2	± I <sub>I</sub>		300			300		1000	nA	
	10,0	± I <sub>I</sub>		300			300		1000	nA	
HIGH level input voltage select input I <sub>1</sub>	6,0	V <sub>IH</sub>	4,2		4,2			4,2		V	
	8,2	V <sub>IH</sub>	5,8		5,8			5,8		V	
	10,0	V <sub>IH</sub>	7,0		7,0			7,0		V	
LOW level input voltage select input I <sub>1</sub>	6,0	V <sub>IL</sub>		1,8			1,8		1,8	V	
	8,2	V <sub>IL</sub>		2,4	2,4		2,4			V	
	10,0	V <sub>IL</sub>		3,0			3,0		3,0	V	
HIGH level output voltage	6,0	V <sub>OH</sub>	5,95		5,95			5,95		V	4
	8,2	V <sub>OH</sub>	8,15		8,15			8,15		V	
	10,0	V <sub>OH</sub>	9,95		9,95			9,95		V	
LOW level output voltage	6,0	V <sub>OL</sub>		0,05			0,05		0,05	V	4
	8,2	V <sub>OL</sub>		0,05			0,05		0,05	V	
	10,0	V <sub>OL</sub>		0,05			0,05		0,05	V	
Output current HIGH	6,0	−I <sub>OH</sub>	0,6		0,5			0,35		mA	5
	8,2	−I <sub>OH</sub>	0,85		0,7			0,45		mA	
	10,0	−I <sub>OH</sub>	1,0		0,85			0,6		mA	
Output current LOW	6,0	I <sub>OL</sub>	0,65		0,5			0,4		mA	6
	8,2	I <sub>OL</sub>	1,0		0,8			0,6		mA	
	10,0	I <sub>OL</sub>	1,3		1,0			0,8		mA	

## 18-element bar graph LCD driver

## PCF1303T

PARAMETER	V <sub>DD</sub> V	SYMBOL	T <sub>amb</sub> (°C)							UNIT	NOTES
			−40		+25			+85			
			MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.		
Input voltage control input V <sub>C</sub>	6,0	V <sub>IC</sub>	0,0	6,0	0,0		6,0	0,0	6,0	V	
	8,2	V <sub>IC</sub>	0,0	8,2	0,0		8,2	0,0	8,2	V	
	10,0	V <sub>IC</sub>	0,0	10,0	0,0		10,0	0,0	10,0	V	
Input voltage V <sub>ref max</sub> input	6,0	V <sub>IR max</sub>	3,6	5,5	3,6		5,5	3,6	5,5	V	
	8,2	V <sub>IR max</sub>	3,6	7,7	3,6		7,7	3,6	7,7	V	
	10,0	V <sub>IR max</sub>	3,6	9,5	3,6		9,5	3,6	9,5	V	
Input voltage V <sub>ref min</sub> input	6,0	V <sub>IR min</sub>	0,5	1,0	0,5		1,0	0,5	1,0	V	
	8,2	V <sub>IR min</sub>	0,5	4,5	0,5		4,5	0,5	4,5	V	
	10,0	V <sub>IR min</sub>	0,5	6,0	0,5		6,0	0,5	6,0	V	
V <sub>ref max</sub> − V <sub>ref min</sub>	6,0	ΔV <sub>I</sub>	3,0		3,0			3,0		V	
	8,2	ΔV <sub>I</sub>	3,0		3,0			3,0		V	
	10,0	ΔV <sub>I</sub>	3,0		3,0			3,0		V	
DC component bar output to back-plane output	8,2	± V <sub>BP</sub>		25		10	25		25	mV	7
Back-plane frequency	8,2	f <sub>BP</sub>	90	110		100		90	110	Hz	8
Input offset voltage	8,2	± V <sub>IO</sub>		120			120		120	mV	9
Step voltage variation	8,2	± ΔV <sub>step</sub>		50			50		50	mV	10
Input voltage slew rate V <sub>C</sub> input	6,0	SR		50			50		50	V/s	11
	8,2	SR		50			50		50	V/s	
	10,0	SR		50			50		50	V/s	

## 18-element bar graph LCD driver

## PCF1303T

**Notes to D.C. characteristics**

1.  $V_{\text{ref min}} = 0,5 \text{ V}$ ,  $V_{\text{ref max}} = 9,5 \text{ V}$ ,  $V_c = V_{\text{osc}} = 0 \text{ V}$ ,  $I_1$  at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ .
2. See Fig.2.
3. Pin under test at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ . All other inputs simultaneously at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ .
4.  $I_O = 0$ , all inputs at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ .
5.  $V_{\text{OH}} = V_{\text{DD}} - 0,5 \text{ V}$ , all inputs at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ .
6.  $V_{\text{OL}} = 0,4 \text{ V}$ , all inputs at  $V_{\text{SS}}$  or  $V_{\text{DD}}$ .
7.  $f_{\text{BP}} = 100 \text{ Hz}$ , load segment outputs to back-plane output.  
 $C_1 - C_{18} \leq 0,01 \mu\text{F}$ ,  $C_{\text{BP}} = C_1 + C_2 + \dots + C_{18} \leq 0,05 \mu\text{F}$ ,  $R_1 - R_{18} \geq 2 \text{ M}\Omega$ .
8.  $R_{\text{osc}} = 0,1 \text{ M}\Omega$ ,  $C_{\text{osc}} = 390 \text{ pF}$ .
9. Number of segments 2 or 18.  
 For  $n = 2$ :

$$V_{\text{IO}} = V_c - V_{\text{ref min}} - \frac{(V_{\text{ref max}}) - (V_{\text{ref min}})}{18} \pm V_H$$

For  $n = 18$ :

$$V_{\text{IO}} = V_c - V_{\text{ref max}} + \frac{(V_{\text{ref max}}) - (V_{\text{ref min}})}{18} \pm V_H$$

10. See equation (1).
11. Condition applies with clock oscillator such that  $f_{\text{BP}} = 100 \text{ Hz}$ .

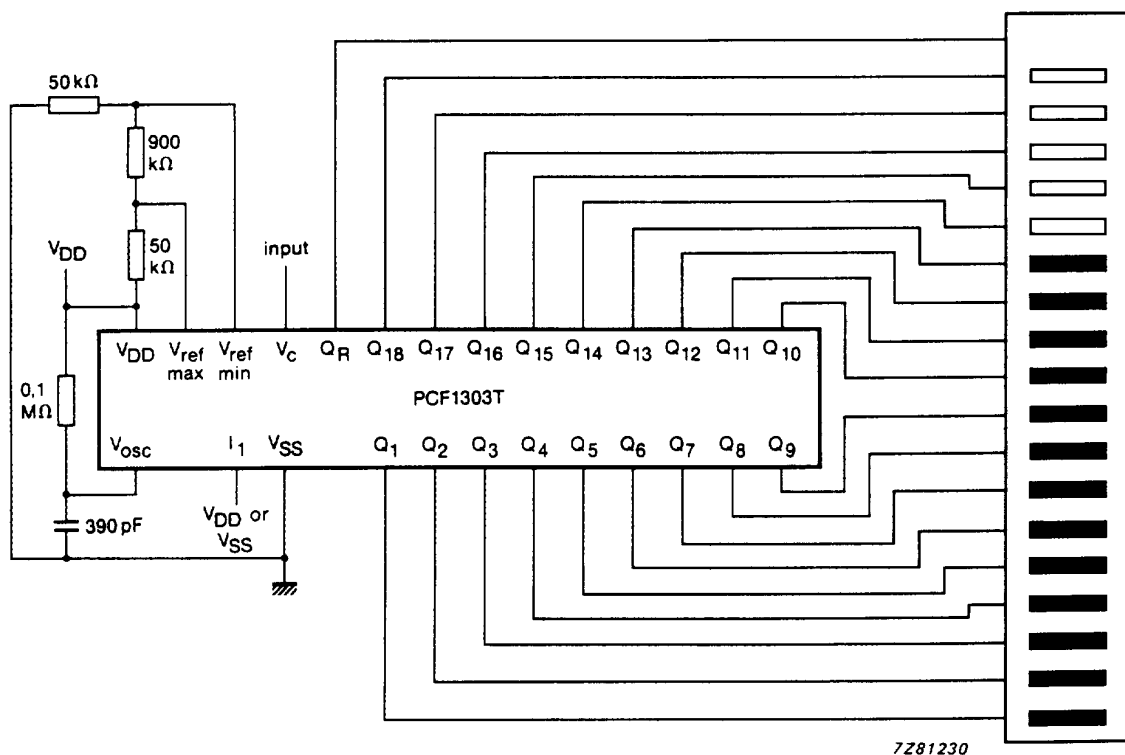


Fig.3 Typical application.

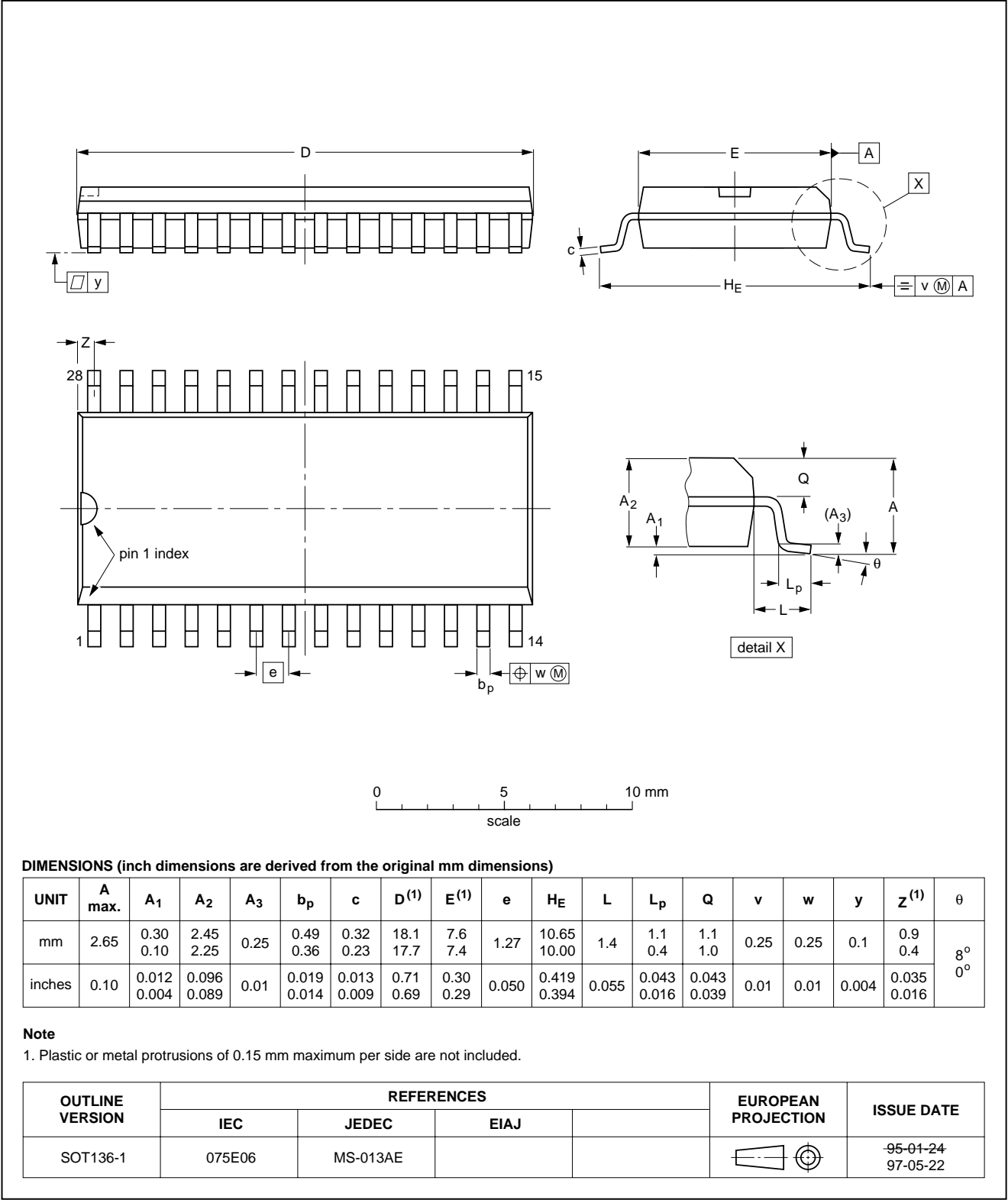
18-element bar graph LCD driver

PCF1303T

PACKAGE OUTLINE

SO28: plastic small outline package; 28 leads; body width 7.5 mm

SOT136-1





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## PCF1303T

### SOLDERING

#### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

#### Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

#### Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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18-element bar graph LCD driver

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PCF1303T

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**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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