DATA SHEET

PCF1303T
18-element bar graph LCD driver

Product specification
File under Integrated Circuits, IC01

November 1986

Philips Semiconductors

PHILIPS

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.

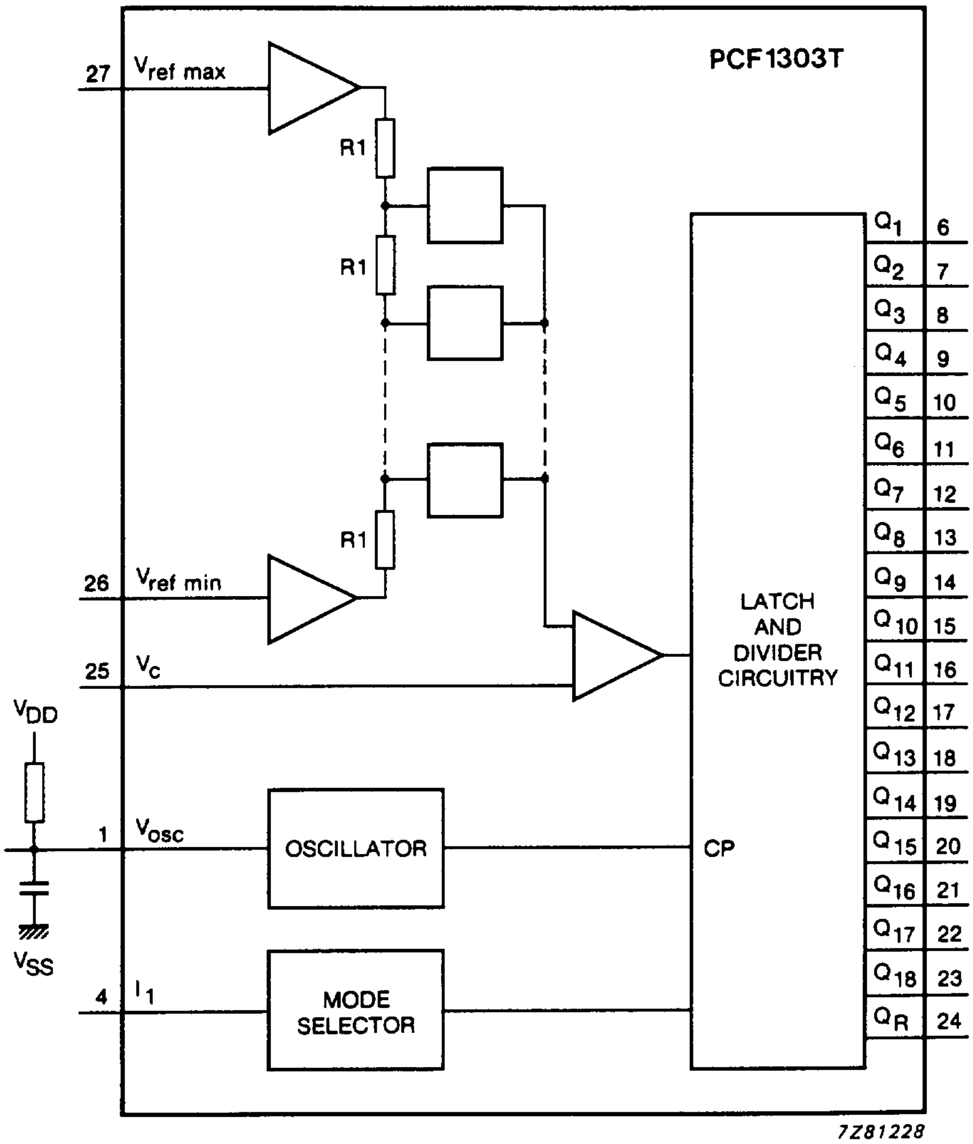


Fig.1 Block diagram.

PACKAGE OUTLINE

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

PIN DESCRIPTION

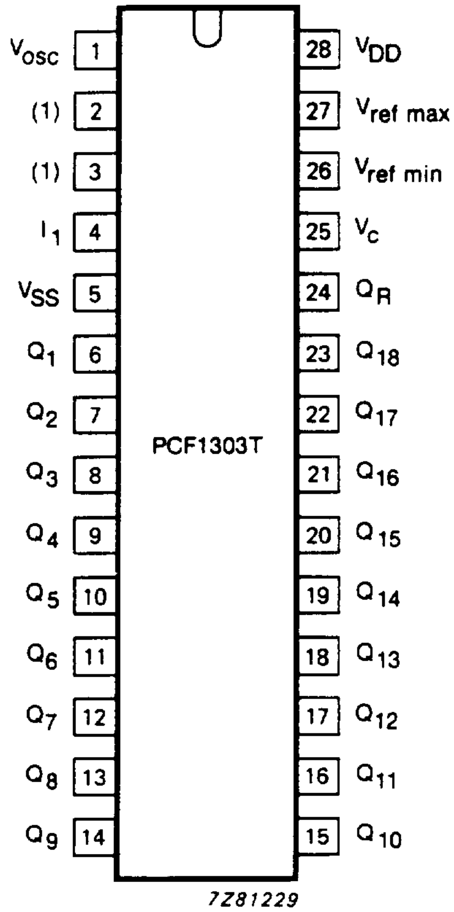
PIN NO.	SYMBOL	NAME AND FUNCTION
1	V_{osc}	oscillator pin
4	I_1	mode select input
5	V_{SS}	ground (0 V)
6 to 23	Q_1 to Q_{18}	segment outputs
24	Q_R	back-plane output
25	V_c	control voltage
26 27	$V_{ref\ min}$ $V_{ref\ max}$	reference voltage inputs
28	V_{DD}	positive supply voltage

FUNCTION TABLE

I_1	MODE
L H	pointer thermometer

H = HIGH voltage level

L = LOW voltage level



(1) Pins 2 and 3 should be connected to V_{SS}.

Fig.2 Pin configuration.

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

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

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

ΔV_{step} is the differential on V_{step}.

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

ΔV_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 $V_{T(bar)n}$;

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

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

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

ΔV_1 is the offset voltage for the on-chip comparator.

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

Note to equation (3)

For ΔV_2 the same sign (+ or –) should be used as in equation (2).

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_{DD} V	SYMBOL	T_{amb} (°C) –40 MIN.	–40 MAX.	+25 MIN.	+25 TYP.	+25 MAX.	+85 MIN.	+85 MAX.	UNIT	NOTES
Quiescent device current	10,0	I_{DD}		1200			1200		1200	µA	1
Operating supply current	8,2	I_{DD}		2,0			2,0		2,0	mA	2
Input leakage current	6,0 8,2 10,0	$\pm I_I$ $\pm I_I$ $\pm I_I$		300 300 300			300 300 300		1000 1000 1000	nA nA nA	3
HIGH level input voltage select input I_1	6,0 8,2 10,0	V_{IH} V_{IH} V_{IH}	4,2 5,8 7,0		4,2 5,8 7,0			4,2 5,8 7,0		V V V	
LOW level input voltage select input I_1	6,0 8,2 10,0	V_{IL} V_{IL} V_{IL}		1,8 2,4 3,0	 2,4 		1,8 2,4 3,0		1,8 3,0	V V V	
HIGH level output voltage	6,0 8,2 10,0	V_{OH} V_{OH} V_{OH}	5,95 8,15 9,95		5,95 8,15 9,95			5,95 8,15 9,95		V V V	4
LOW level output voltage	6,0 8,2 10,0	V_{OL} V_{OL} V_{OL}		0,05 0,05 0,05			0,05 0,05 0,05		0,05 0,05 0,05	V V V	4
Output current HIGH	6,0 8,2 10,0	$-I_{OH}$ $-I_{OH}$ $-I_{OH}$	0,6 0,85 1,0		0,5 0,7 0,85			0,35 0,45 0,6		mA mA mA	5
Output current LOW	6,0 8,2 10,0	I_{OL} I_{OL} I_{OL}	0,65 1,0 1,3		0,5 0,8 1,0			0,4 0,6 0,8		mA mA mA	6

PARAMETER	V_{DD} V	SYMBOL	T_{amb} (°C) –40 MIN.	–40 MAX.	+25 MIN.	+25 TYP.	+25 MAX.	+85 MIN.	+85 MAX.	UNIT	NOTES
Input voltage control input V_c	6,0	V_{IC}	0,0	6,0	0,0		6,0	0,0	6,0	V	
	8,2	V_{IC}	0,0	8,2	0,0		8,2	0,0	8,2	V	
	10,0	V_{IC}	0,0	10,0	0,0		10,0	0,0	10,0	V	
Input voltage $V_{ref\ max}$ input	6,0	$V_{IR\ max}$	3,6	5,5	3,6		5,5	3,6	5,5	V	
	8,2	$V_{IR\ max}$	3,6	7,7	3,6		7,7	3,6	7,7	V	
	10,0	$V_{IR\ max}$	3,6	9,5	3,6		9,5	3,6	9,5	V	
Input voltage $V_{ref\ min}$ input	6,0	$V_{IR\ min}$	0,5	1,0	0,5		1,0	0,5	1,0	V	
	8,2	$V_{IR\ min}$	0,5	4,5	0,5		4,5	0,5	4,5	V	
	10,0	$V_{IR\ min}$	0,5	6,0	0,5		6,0	0,5	6,0	V	
$V_{ref\ max} - V_{ref\ min}$	6,0	ΔV_I	3,0		3,0			3,0		V	
	8,2	ΔV_I	3,0		3,0			3,0		V	
	10,0	ΔV_I	3,0		3,0			3,0		V	
DC component bar output to back-plane output	8,2	$\pm V_{BP}$		25		10	25		25	mV	7
Back-plane frequency	8,2	f_{BP}	90	110		100		90	110	Hz	8
Input offset voltage	8,2	$\pm V_{IO}$		120			120		120	mV	9
Step voltage variation	8,2	$\pm \Delta V_{step}$		50			50		50	mV	10
Input voltage slew rate V_c 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	

Notes to D.C. characteristics

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

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

   For n = 18:

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

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

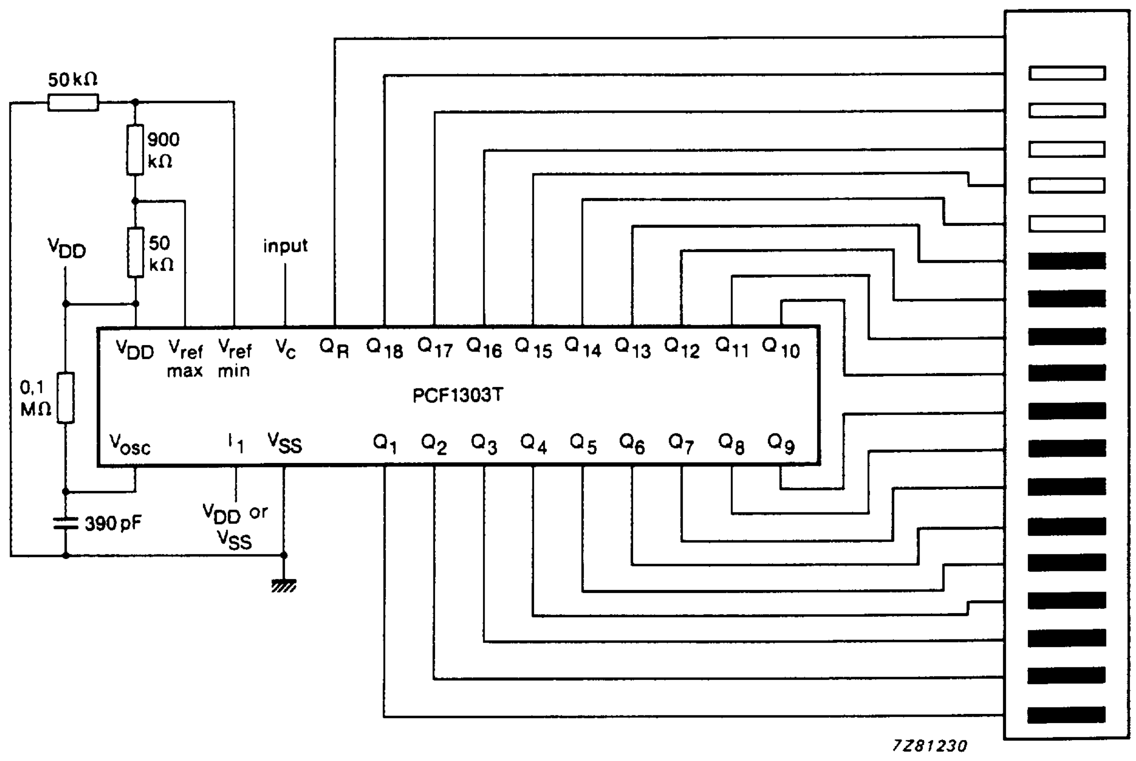
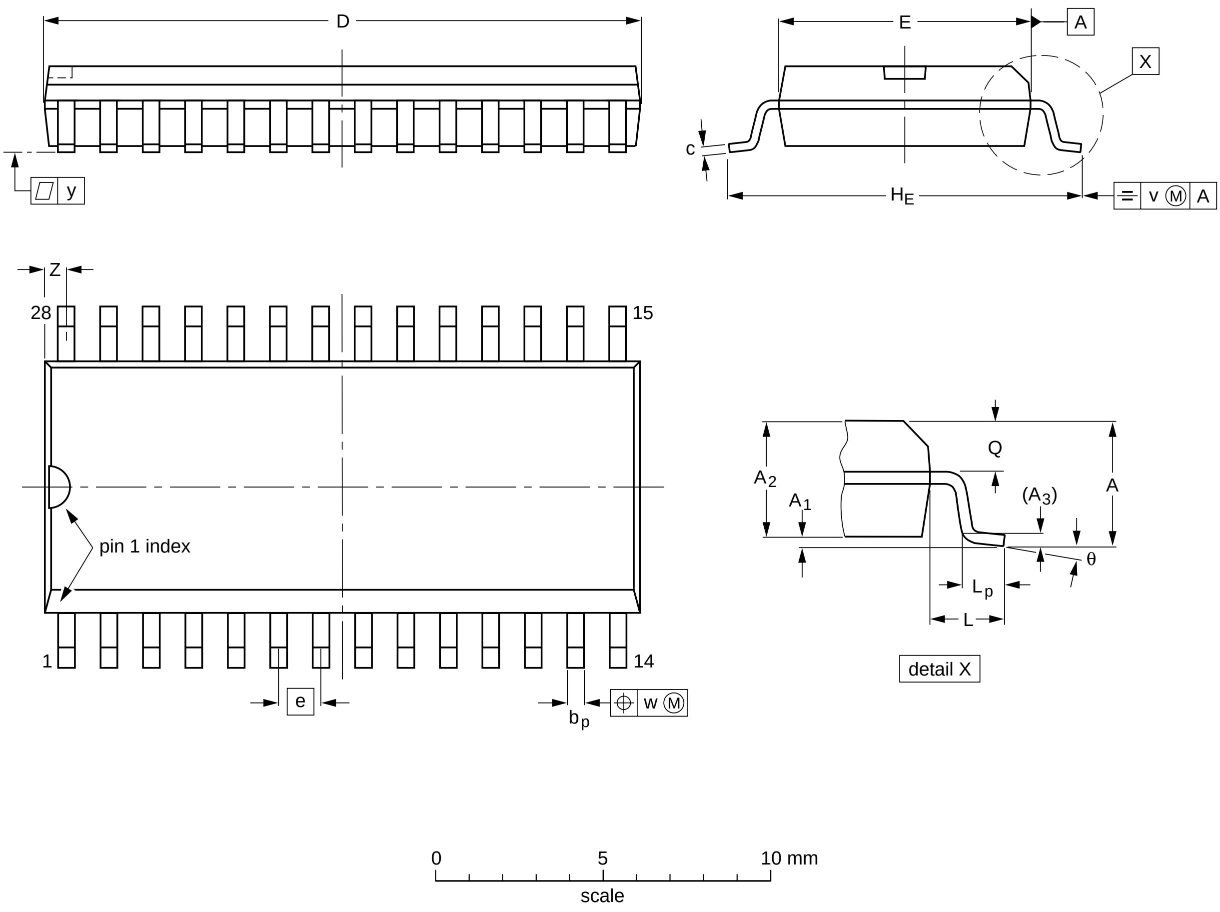


Fig.3 Typical application.

PACKAGE OUTLINE

SO28: plastic small outline package; 28 leads; body width 7.5 mm | **SOT136-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	18.1 17.7	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.71 0.69	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT136-1	075E06	MS-013AE				~~95-01-24~~ 97-05-22

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.

DEFINITIONS

Data sheet status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.