

DATA SHEET

PCF8577C

LCD direct/duplex driver with I²C-bus interface

Product specification
Supersedes data of July 1993
File under Integrated Circuits, IC12

1995 Jun 08

LCD direct/duplex driver with I²C-bus interface

PCF8577C

FEATURES

- Direct/duplex drive modes with up to 32/64 LCD-segment drive capability per device
- Operating supply voltage: 2.5 to 6 V
- Low power consumption
- I²C-bus interface
- Optimized pinning for single plane wiring
- Single-pin built-in oscillator
- Auto-incremented loading across device subaddress boundaries
- Display memory switching in direct drive mode
- May be used as I²C-bus output expander
- System expansion up to 256 segments
- Power-on reset blanks display.



GENERAL DESCRIPTION

The PCF8577C is a single chip, silicon gate CMOS circuit. It is designed to drive liquid crystal displays with up to 32 segments directly, or 64 segments in a duplex configuration.

The two-line I²C-bus interface substantially reduces wiring overheads in remote display applications. I²C-bus traffic is minimized in multiple IC applications by automatic address incrementing, hardware subaddressing and display memory switching (direct drive mode).

ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|--------------|---------|--|----------|
| | NAME | DESCRIPTION | VERSION |
| PCF8577CP | DIP40 | plastic dual in-line package; 40 leads (600 mil) | SOT129-1 |
| PCF8577CT | VSO40 | plastic very small outline package; 40 leads | SOT158A |
| PCF8577CT | – | V6040 in blister tape | – |
| PCF8577CU/10 | – | chip on film-frame-carrier (FFC) | – |

BLOCK DIAGRAM

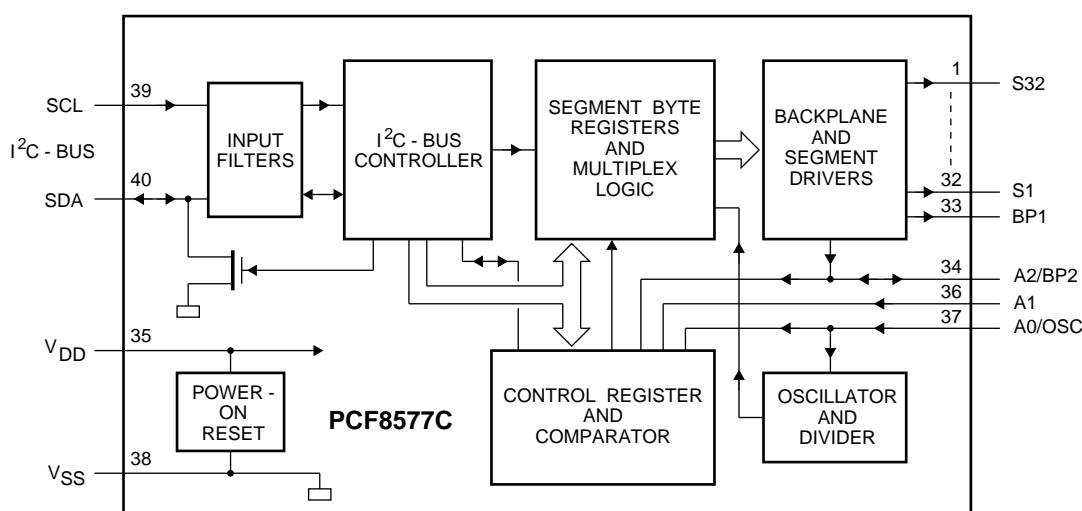


Fig.1 Block diagram.

LCD direct/duplex driver with I²C-bus interface

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PINNING

| SYMBOL | PIN | DESCRIPTION |
|-----------------|---------|---|
| S32 to S1 | 1 to 32 | segments outputs |
| BP1 | 33 | cascade sync input/backplane output |
| A2/BP2 | 34 | hardware address line and cascade sync input/backplane output |
| V _{DD} | 35 | positive supply voltage |
| A1 | 36 | hardware address line input |
| A0/OSC | 37 | hardware address line and oscillator pin input |
| V _{SS} | 38 | negative supply voltage |
| SCL | 39 | I ² C-bus clock line input |
| SDA | 40 | I ² C-bus data line input/output |

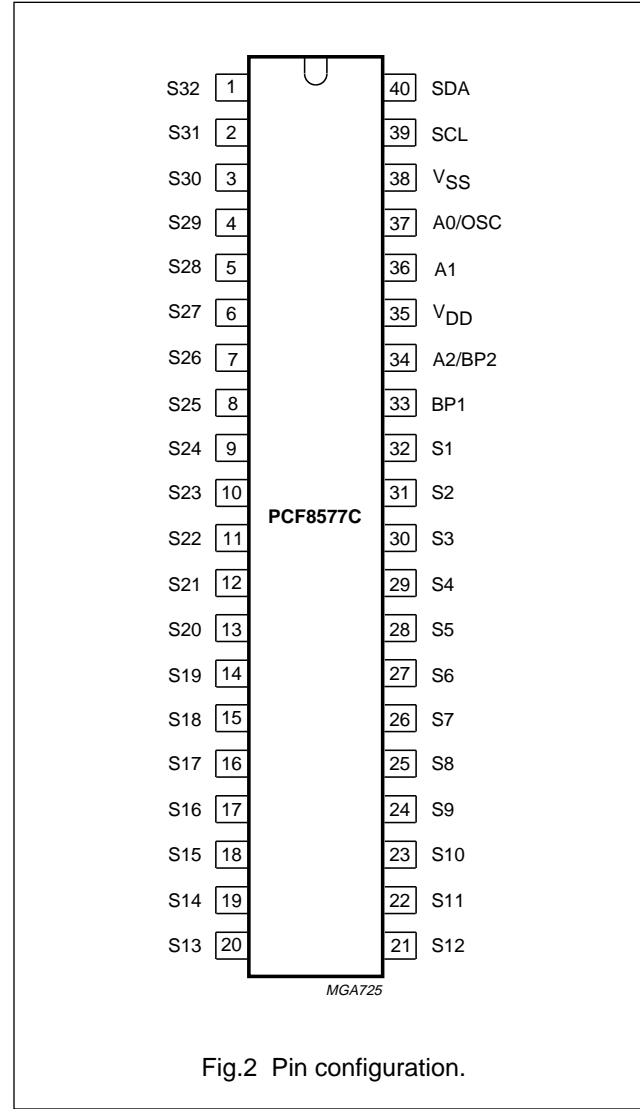


Fig.2 Pin configuration.

LCD direct/duplex driver with I²C-bus interface

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FUNCTIONAL DESCRIPTION

Hardware subaddress A0, A1, A2

The hardware subaddress lines A0, A1 and A2 are used to program the device subaddress for each PCF8577C connected to the I²C-bus. Lines A0 and A2 are shared with OSC and BP2 respectively to reduce pin-out requirements.

1. Line A0 is defined as LOW (logic 0) when this pin is used for the local oscillator or when connected to V_{SS}. Line A0 is defined as HIGH (logic 1) when connected to V_{DD}.
2. Line A1 must be defined as LOW (logic 0) or as HIGH (logic 1) by connection to V_{SS} or V_{DD} respectively.
3. In the direct drive mode the second backplane signal BP2 is not used and the A2/BP2 pin is exclusively the A2 input. Line A2 is defined as LOW (logic 0) when connected to V_{SS} or, if this is not possible, by leaving it unconnected (internal pull-down). Line A2 is defined as HIGH (logic 1) when connected to V_{DD}.
4. In the duplex drive mode the second backplane signal BP2 is required and the A2 signal is undefined. In this mode device selection is made exclusively from lines A0 and A1.

Oscillator A0/OSC

The PCF8577C has a single-pin built-in oscillator which provides the modulation for the LCD segment driver outputs. One external resistor and one external capacitor are connected to the A0/OSC pin to form the oscillator (see Figs 15 and 16). For correct start-up of the oscillator after power on, the resistor and capacitor must be connected to the same V_{SS}/V_{DD} as the chip. In an expanded system containing more than one PCF8577C the backplane signals are usually common to all devices and only one oscillator is required. The devices which are not used for the oscillator are put into the cascade mode by connecting the A0/OSC pin to either V_{DD} or V_{SS} depending on the required state for A0. In the cascade mode each PCF8577C is synchronized from the backplane signal(s).

User-accessible registers

There are nine user-accessible 1-byte registers. The first is a control register which is used to control the loading of data into the segment byte registers and to select display options. The other eight are segment byte registers, split into two banks of storage, which store the segment data. The set of even numbered segment byte registers is called BANK A. Odd numbered segment byte registers are called BANK B.

There is one slave address for the PCF8577C (see Fig.6). All addressed devices load the second byte into the control register and each device maintains an identical copy of the control byte in the control register at all times (see I²C-bus protocol Fig.7), i.e. all addressed devices respond to control commands sent on the I²C-bus.

The control register is shown in more detail in Fig.3. The least-significant bits select which device and which segment byte register is loaded next. This part of the register is therefore called the Segment Byte Vector (SBV).

The upper three bits of the SBV (V5 to V3) are compared with the hardware subaddress input signals A2, A1 and A0. If they are the same then the device is enabled for loading, if not the device ignores incoming data but remains active.

The three least-significant bits of the SBV (V2 to V0) address one of the segment byte registers within the enabled chip for loading segment data.

The control register also has two display control bits. These bits are named MODE and BANK. The MODE bit selects whether the display outputs are configured for direct or duplex drive displays. The BANK bit allows the user to display BANK A or BANK B.

Auto-incremented loading

After each segment byte is loaded the SBV is incremented automatically. Thus auto-incremented loading occurs if more than one segment byte is received in a data transfer.

Since the SBV addresses both device and segment registers in all addressed chips, auto-incremented loading may proceed across device boundaries provided that the hardware subaddresses are arranged contiguously.

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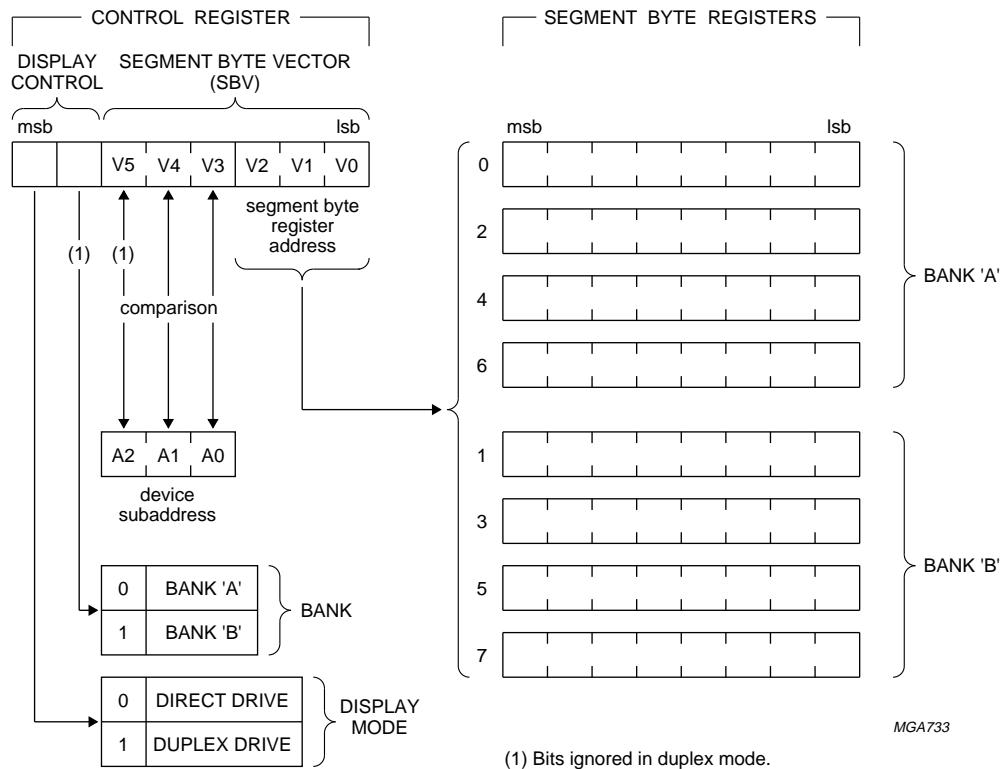
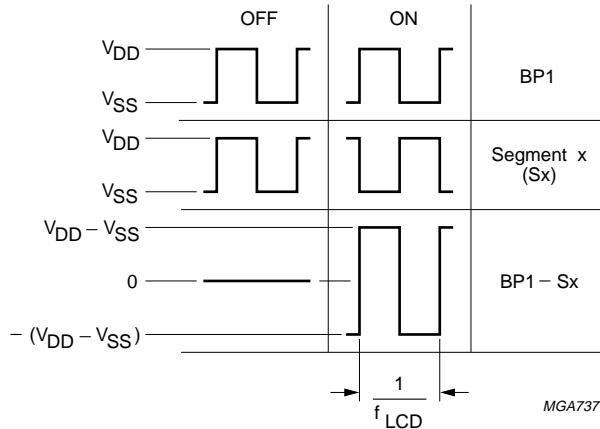


Fig.3 PCF8577C register organization.



$$V_{on(rms)} = V_{DD} - V_{SS}; V_{off(rms)} = 0.$$

Fig.4 Direct drive mode display output waveforms.

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Direct drive mode

The PCF8577C is set to the direct drive mode by loading the MODE control bit with logic 0. In this mode only four bytes are required to store the data for the 32 segment drivers. Setting the BANK bit to logic 0 selects even bytes (BANK A), setting the BANK bit to logic 1 selects odd bytes (BANK B).

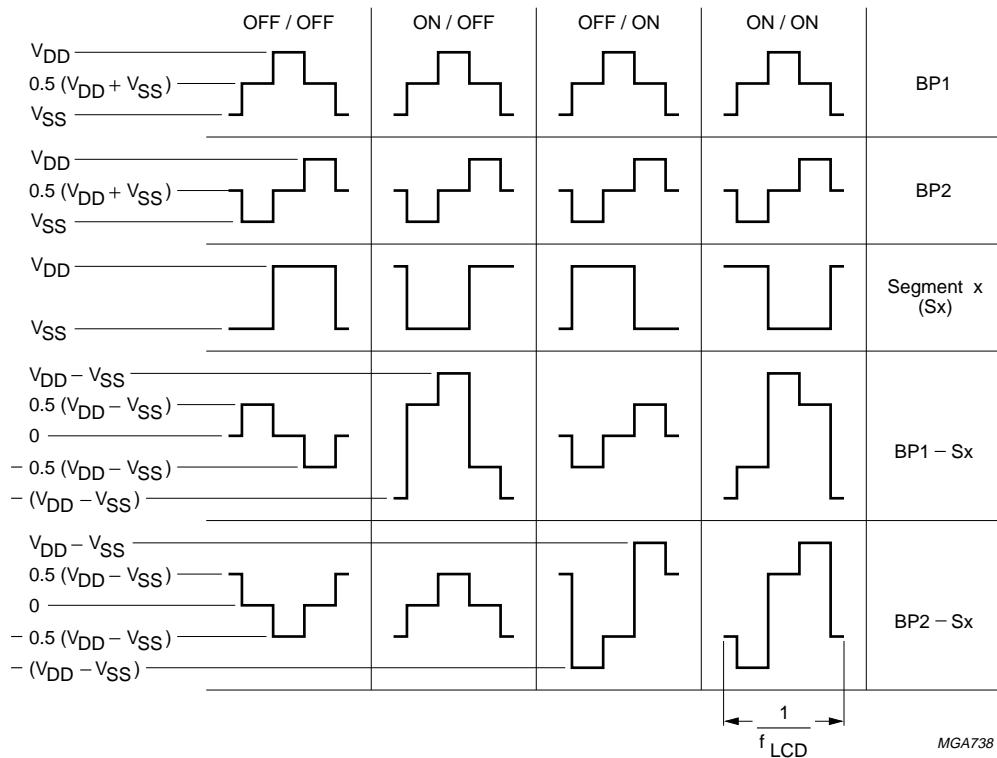
In the direct drive mode the SBV is auto-incremented by two after the loading of each segment byte register. This means that auto-incremented loading of BANK A or BANK B is possible. Either bank may be completely or partially loaded irrespective of which bank is being displayed. Direct drive output waveforms are shown in Fig.4.

Duplex mode

The PCF8577C is set to the duplex mode by loading the MODE bit with logic 1. In this mode a second backplane signal (BP2) is needed and pin A2/BP2 is used for this; therefore A2 and its equivalent SBV bit V5 are undefined. The SBV auto-increments by one between loaded bytes.

All of the segment bytes are required to store data for the 32 segment drivers and the BANK bit is ignored.

Duplex mode output waveforms are shown in Fig.5.



$$V_{on(rms)} = 0.791 (V_{DD} - V_{SS}); V_{off(rms)} = 0.354 (V_{DD} - V_{SS}).$$

$$\frac{V_{on(rms)}}{V_{off(rms)}} = 2.236$$

Fig.5 Duplex mode display output waveforms.

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Power-on reset

At power-on reset the PCF8577C resets to a defined starting condition as follows:

1. Both backplane outputs are set to V_{SS} in master mode; to 3-state in cascade mode.
2. All segment outputs are set to V_{SS}.
3. The segment byte registers and control register are cleared.
4. The I²C-bus interface is initialized.

Slave address

The PCF8577C slave address is shown in Fig.6.

Before any data is transmitted on the I²C-bus, the device which should respond is addressed first. The addressing is always done with the first byte transmitted after the start procedure.

I²C-bus protocol

The PCF8577C I²C-bus protocol is shown in Fig.7.

The PCF8577C is a slave receiver and has a fixed slave address (see Fig.6). All PCF8577Cs with the same slave address acknowledge the slave address in parallel. The second byte is always the control byte and is loaded into the control register of each PCF8577C connected to the I²C-bus. All addressed devices acknowledge the control byte. Subsequent data bytes are loaded into the segment registers of the selected device. Any number of data bytes may be loaded in one transfer and in an expanded system rollover of the SBV from 111 111 to 000 000 is allowed. If a stop (P) condition is given after the control byte acknowledge the segment data will remain unchanged. This allows the BANK bit to be toggled without changing the segment register contents. During loading of segment data only the selected PCF8577C gives an acknowledge. Loading is terminated by generating a stop (P) condition.

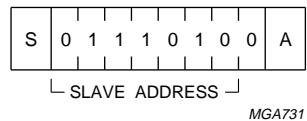


Fig.6 PCF8577C slave address.

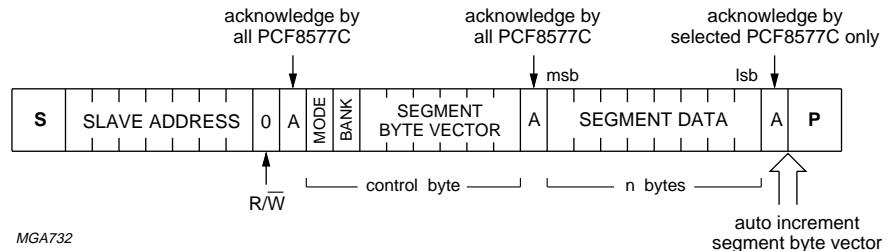


Fig.7 I²C-bus protocol.

LCD direct/duplex driver with I²C-bus interface

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Display memory mapping

The mapping between the eight segment registers and the segment outputs S1 to S32 is given in Tables 1 and 2.

Since only one register bit per segment is needed in the direct drive mode, the BANK bit allows swapping of display information. If BANK is set to logic 0 even bytes (BANK A) are displayed; if BANK is set to logic 1 odd bytes (BANK B) are displayed. BP1 is always used for the backplane output in the direct drive mode. In duplex mode even bytes (BANK A) correspond to backplane 1 (BP1) and odd bytes (BANK B) correspond to backplane 2 (BP2).

Table 1 Segment byte-segment driver mapping in direct drive mode

| MODE | BANK | V 2 | V 1 | V 0 | SEGMENT/ BIT/ REGISTER | MSB 7 | 6 | 5 | 4 | 3 | 2 | 1 | LSB 0 | BACK- PLANE |
|------|------|--------|--------|--------|------------------------------|----------|-----|-----|-----|-----|-----|-----|----------|----------------|
| 0 | 0 | 0 | 0 | 0 | 0 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 0 | 1 | 0 | 0 | 1 | 1 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 0 | 0 | 0 | 1 | 0 | 2 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 0 | 1 | 0 | 1 | 1 | 3 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 0 | 0 | 1 | 0 | 0 | 4 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 0 | 1 | 1 | 0 | 1 | 5 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 0 | 0 | 1 | 1 | 0 | 6 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |
| 0 | 1 | 1 | 1 | 1 | 7 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |

Mapping example: bit 0 of register 7 controls the LCD segment S25 if BANK bit is a logic 1.

Table 2 Segment byte-segment driver mapping in duplex mode

| MODE | BANK ⁽¹⁾ | V 2 | V 1 | V 0 | SEGMENT/ BIT/ REGISTER | MSB 7 | 6 | 5 | 4 | 3 | 2 | 1 | LSB 0 | BACK- PLANE |
|------|---------------------|--------|--------|--------|------------------------------|----------|-----|-----|-----|-----|-----|-----|----------|----------------|
| 1 | x | 0 | 0 | 0 | 0 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP1 |
| 1 | x | 0 | 0 | 1 | 1 | S8 | S7 | S6 | S5 | S4 | S3 | S2 | S1 | BP2 |
| 1 | x | 0 | 1 | 0 | 2 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP1 |
| 1 | x | 0 | 1 | 1 | 3 | S16 | S15 | S14 | S13 | S12 | S11 | S10 | S9 | BP2 |
| 1 | x | 1 | 0 | 0 | 4 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP1 |
| 1 | x | 1 | 0 | 1 | 5 | S24 | S23 | S22 | S21 | S20 | S19 | S18 | S17 | BP2 |
| 1 | x | 1 | 1 | 0 | 6 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP1 |
| 1 | x | 1 | 1 | 1 | 7 | S32 | S31 | S30 | S29 | S28 | S27 | S26 | S25 | BP2 |

Note

- Where x = don't care.

Mapping example: bit 7 of register 5 controls the LCD segment S24/BP2.

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CHARACTERISTICS OF THE I²C-BUS

The I²C-bus is for 2-way, 2-line communication between different ICs or modules. The two lines are a serial data line (SDA) and a serial clock line (SCL). Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the I²C-bus is not busy.

Bit transfer

One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse as changes in the data line at this time will be interpreted as control signals.

Start and stop conditions

Both data and clock lines remain HIGH when the I²C-bus is not busy. A HIGH-to-LOW transition of the data line, while the clock is HIGH is defined as the start condition (S). A LOW-to-HIGH transition of the data line while the clock is HIGH is defined as the stop condition (P).

System configuration

A device generating a message is a 'transmitter', a device receiving a message is the 'receiver'. The device that controls the message is the 'master' and the devices which are controlled by the master are the 'slaves'.

Acknowledge

The number of data bytes transferred between the start and stop conditions from transmitter to receiver is not limited. Each byte is followed by one acknowledge bit. The acknowledge bit is a HIGH level put on the I²C-bus by the transmitter whereas the master generates an extra acknowledge related clock pulse. A slave receiver which is addressed must generate an acknowledge after the reception of each byte. Also a master must generate an acknowledge after the reception of each byte that has been clocked out of the slave transmitter. The device that acknowledges has to pull down the SDA line during the acknowledge clock pulse, set-up and hold times must be taken into account. A master receiver must signal an end of data to the transmitter by not generating an acknowledge on the last byte that has been clocked out of the slave. In this event the transmitter must leave the data line HIGH to enable the master to generate a stop condition.

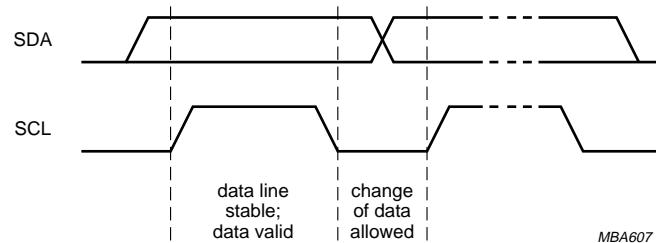


Fig.8 Bit transfer.

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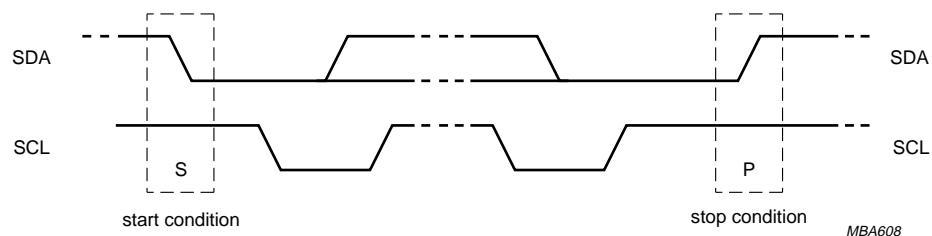


Fig.9 Definition of the start and stop conditions.

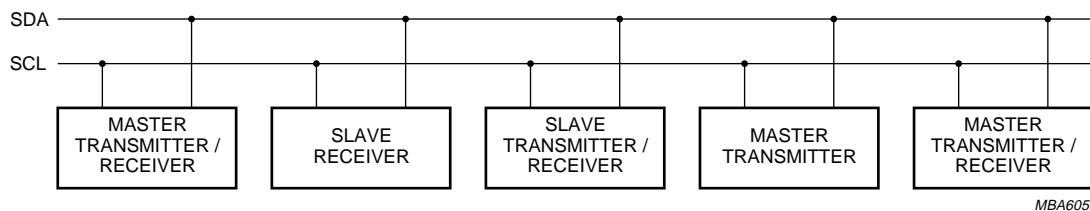
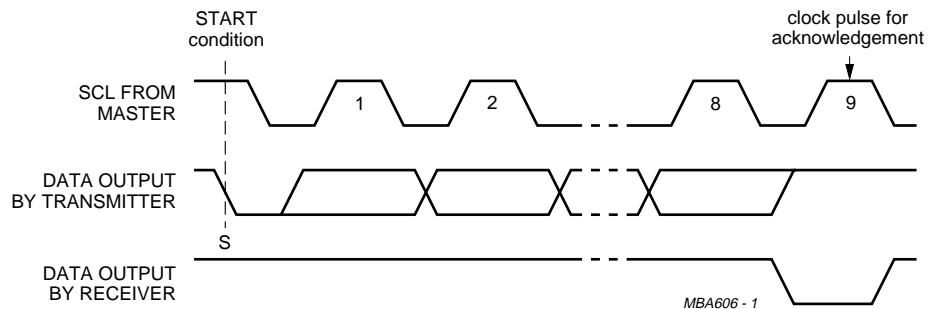


Fig.10 System configuration.

Fig.11 Acknowledgement on the I²C-bus.

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LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------------------------------|--|------------|------|-----------------------|------|
| V _{DD} | supply voltage | | -0.5 | +8.0 | V |
| V _I | input voltage on pin | | -0.5 | V _{DD} + 0.5 | V |
| I _{DD} ; I _{SS} | V _{DD} or V _{SS} current | | -50 | +50 | mA |
| I _I | DC input current | | -20 | +20 | mA |
| I _O | DC output current | | -25 | +25 | mA |
| P _{tot} | power dissipation per package | note 1 | - | 500 | mW |
| P _O | power dissipation per output | | - | 100 | mW |
| T _{stg} | storage temperature | | -65 | +150 | °C |

Note

1. Reduce by 7.7 mW/K when T_{amb} > 60 °C.

HANDLING

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe it is desirable to take normal precautions appropriate to handling MOS devices.

DC CHARACTERISTICS

V_{DD} = 2.5 to 6 V; V_{SS} = 0 V; T_{amb} = -40 to 85 °C; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|------------------|---|--|------------------------|---------------------|--------------------|------|
| Supply | | | | | | |
| V _{DD} | supply voltage | | 2.5 | - | 6 | V |
| I _{DD} | supply current for non-specified inputs at V _{DD} or V _{SS} | no load; f _{SCL} = 100 kHz; R _{osc} = 1 MΩ; C _{osc} = 680 pF | | 50 | 125 | µA |
| | | no load; f _{SCL} = 0; R _{osc} = 1 MΩ; C _{osc} = 680 pF | - | 25 | 75 | µA |
| | | no load; f _{SCL} = 0; R _{osc} = 1 MΩ; C _{osc} = 680 pF; V _{DD} = 5 V; T _{amb} = 25 °C | - | 25 | 40 | µA |
| | | no load; f _{SCL} = 0; direct mode; A0/OSC = V _{DD} ; V _{DD} = 5 V; T _{amb} = 25 °C | - | 10 | 20 | µA |
| V _{POR} | power-on reset level | note 2 | - | 1.1 | 2.0 | V |
| Input A0 | | | | | | |
| V _{IL1} | LOW level input voltage | | 0 | - | 0.05 | V |
| V _{IH1} | HIGH level input voltage | | V _{DD} - 0.05 | - | V _{DD} | V |
| Input A1 | | | | | | |
| V _{IL2} | LOW level input voltage | | 0 | - | 0.3V _{DD} | V |
| V _{IH2} | HIGH level input voltage | | 0.7V _{DD} | - | V _{DD} | V |

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| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|-----------------------|--|--|-----------------|---------------------|-------------|------------|
| Input A2 | | | | | | |
| V_{IL3} | LOW level input voltage | | 0 | – | 0.10 | V |
| V_{IH3} | HIGH level input voltage | | $V_{DD} - 0.10$ | – | V_{DD} | V |
| Input SCL; SDA | | | | | | |
| V_{IL4} | LOW level input voltage | | 0 | – | $0.3V_{DD}$ | V |
| V_{IH4} | HIGH level input voltage | | $0.7V_{DD}$ | – | 6 | V |
| C_I | input capacitance | note 3 | – | – | 7 | pF |
| Output SDA | | | | | | |
| I_{OL} | LOW level output current | $V_{OL} = 0.4$ V; $V_{DD} = 5$ V | 3 | – | – | mA |
| A1; SCL; SDA | | | | | | |
| I_{L1} | leakage current | $V_I = V_{DD}$ or V_{SS} | –1 | – | +1 | μ A |
| A2/BP2; BP1 | | | | | | |
| I_{L2} | leakage current | $V_I = V_{DD}$ or V_{SS} | –5 | – | +5 | μ A |
| A2/BP2 | | | | | | |
| I_{pd} | pull-down current | $V_I = V_{DD}$ | –5 | –1.5 | – | μ A |
| A0/OSC | | | | | | |
| I_{L3} | leakage current | $V_I = V_{DD}$ | –1 | – | – | μ A |
| Oscillator | | | | | | |
| I_{osc} | start-up current | $V_I = V_{SS}$ | – | 1.2 | 5 | μ A |
| LCD outputs | | | | | | |
| V_{BP} | DC component of LCD driver | | – | ± 20 | – | mV |
| I_{OL1} | LOW level segment output current | $V_{DD} = 5$ V; $V_{OL} = 0.8$ V; note 4 | 0.3 | – | – | mA |
| I_{OH1} | HIGH level segment output current | $V_{DD} = 5$ V; $V_{OH} = V_{DD} - 0.8$ V; note 4 | – | – | –0.3 | mA |
| R_{BP} | backplane output resistance (BP1; BP2) | $V_O = V_{SS}$ or V_{DD} or ($V_{SS} + V_{DD}$)/2; note 5 | – | 0.4 | 5 | k Ω |

Notes

1. Typical conditions: $V_{DD} = 5$ V; $T_{amb} = 25$ °C.
2. Resets all logic when $V_{DD} < V_{POR}$.
3. Periodically sampled, not 100% tested.
4. Outputs measured one at a time.
5. Outputs measured one at a time; $V_{DD} = 5$ V; $I_{load} = 100$ μ A.

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AC CHARACTERISTICS

V_{DD} = 2.5 to 6 V; T_{amb} = -40 to 85 °C; unless otherwise specified. All the timing values are valid within the operating supply voltage and ambient temperature range and refer to V_{IL} and V_{IH} with an input voltage swing of V_{SS} to V_{DD} .

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. ⁽¹⁾ | MAX. | UNIT |
|-----------|-------------------------------|--|------|---------------------|------|------|
| f_{LCD} | display frequency | $C_{osc} = 680 \text{ pF}$; $R_{osc} = 1 \text{ M}\Omega$ | 65 | 90 | 120 | Hz |
| t_{BS} | driver delays with test loads | $V_{DD} = 5 \text{ V}$ | — | 20 | 100 | μs |

I²C-bus

| | | | | | | |
|--------------|---|---|-----|---|-----|-----|
| f_{SCL} | SCL clock frequency | | — | — | 100 | kHz |
| t_{SW} | tolerable spike width on I ² C-bus | $T_{amb} = 25 \text{ }^{\circ}\text{C}$ | — | — | 100 | ns |
| t_{BUF} | I ² C-bus free time | | 4.7 | — | — | μs |
| $t_{SU;STA}$ | start condition set-up time | | 4.0 | — | — | μs |
| $t_{HD;STA}$ | start condition hold time | | 4.0 | — | — | μs |
| t_{LOW} | SCL LOW time | | 4.7 | — | — | μs |
| t_{HIGH} | SCL HIGH time | | 4.0 | — | — | μs |
| t_r | SCL and SDA rise time | | — | — | 1.0 | μs |
| t_f | SCL and SDA fall time | | — | — | 0.3 | μs |
| $t_{SU;DAT}$ | data set-up time | | 250 | — | — | ns |
| $t_{HD;DAT}$ | data hold time | | 0 | — | — | ns |
| $t_{SU;STO}$ | stop condition set-up time | | 4.0 | — | — | μs |

Note

1. Typical conditions: $V_{DD} = 5 \text{ V}$; $T_{amb} = 25 \text{ }^{\circ}\text{C}$.

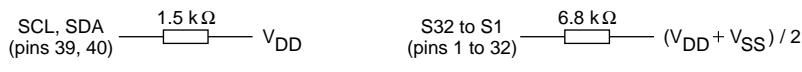


Fig.12 Test loads.

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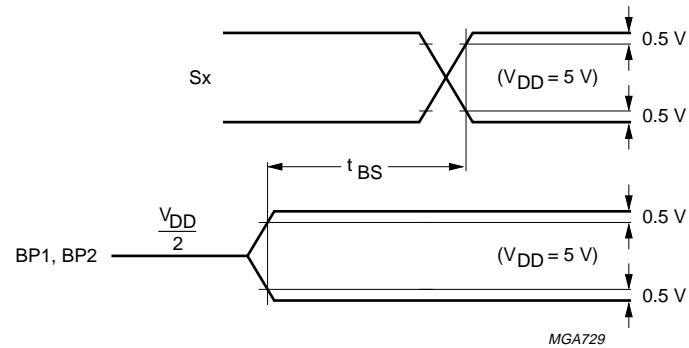
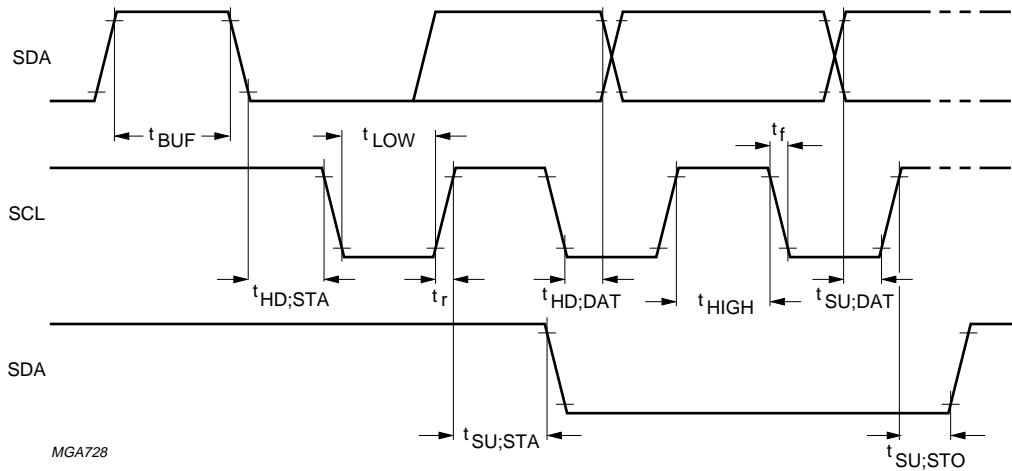


Fig.13 Driver timing waveforms.

Fig.14 I²C-bus timing diagram; rise and fall times refer to V_{IL} and V_{IH} .

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APPLICATION INFORMATION

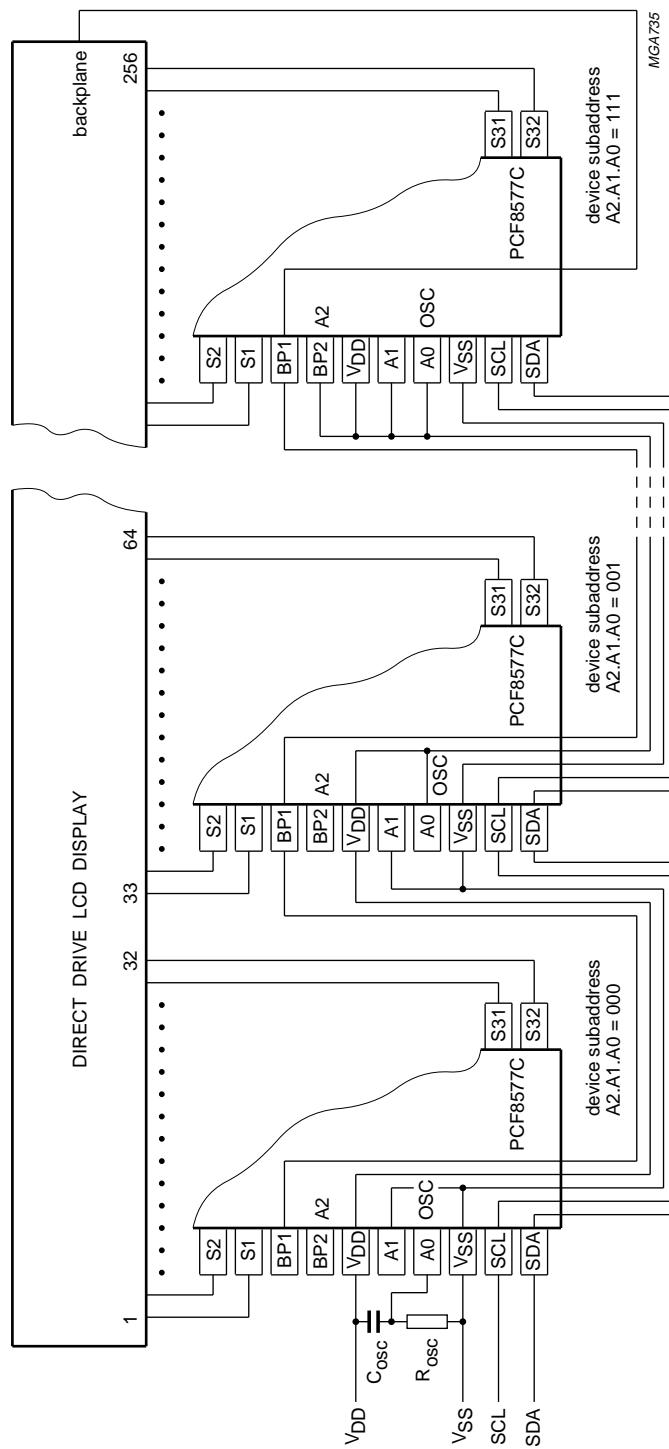


Fig.15 Direct display driver; expansion to 256 segments using eight PCF8577Cs.

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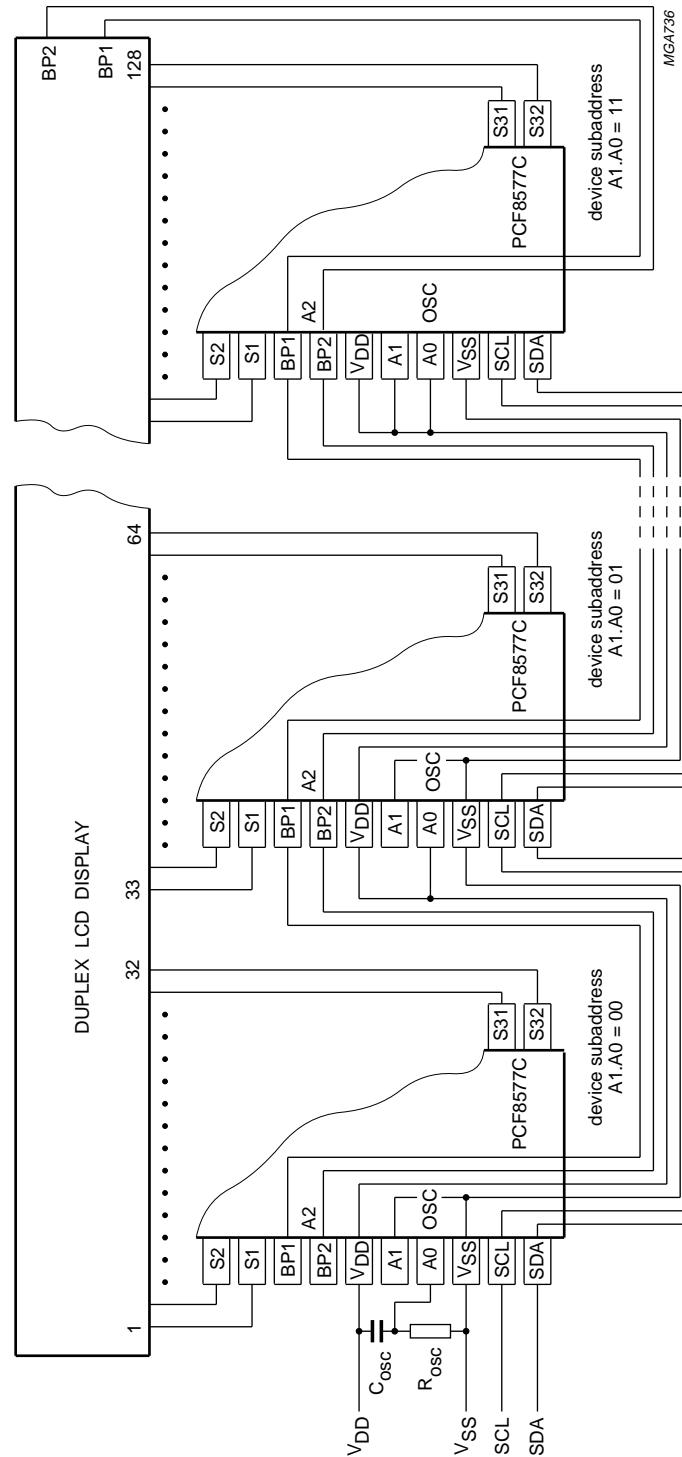
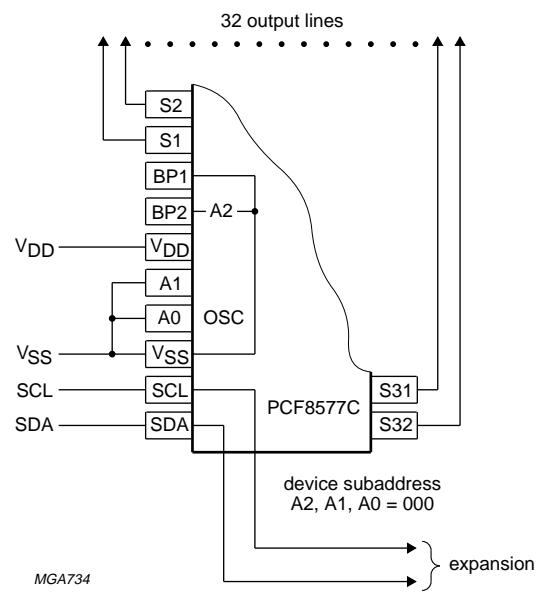


Fig.16 Duplex display; expansion to 2 × 128 segments using four PCF8577Cs.

LCD direct/duplex driver with I²C-bus interface

PCF8577C



MODE bit must always be set to logic 0 (direct drive).

BANK switching is permitted.

BP1 must always be connected to V_{SS} and A0/OSC must be connected to either V_{DD} or V_{SS} (no LCD modulation).

Fig.17 Use of PCF8577C as a 32-bit output expander in I²C-bus application.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

CHIP DIMENSIONS AND BONDING PAD LOCATIONS

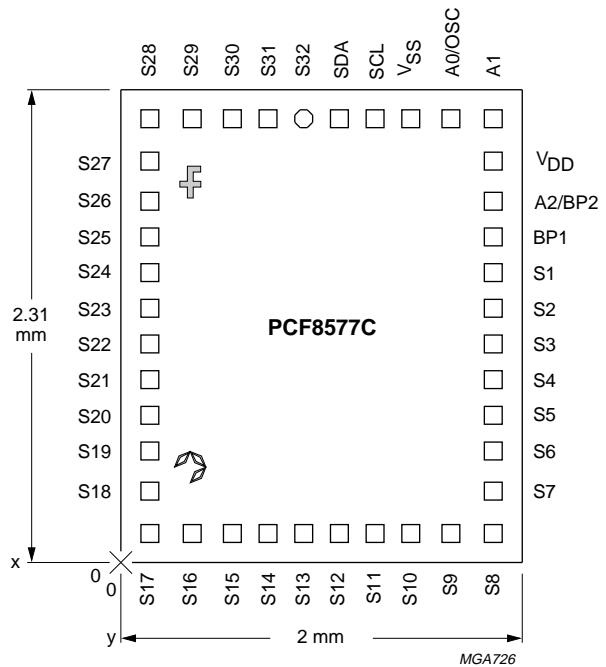


Fig.18 Bonding pad locations.

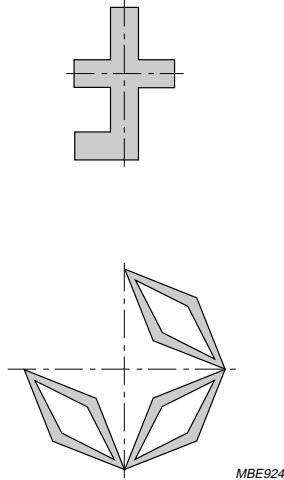


Fig.19 Reference marks.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

Table 3 Bonding pad locations (dimensions in μm)

All x and y co-ordinates are referenced to bottom left corner, see Fig.18.

| SIGNAL | PAD POSITION CENTERED | |
|--------|-----------------------|------|
| | x | y |
| S32 | -86 | 941 |
| S31 | -257 | 941 |
| S30 | -428 | 941 |
| S29 | -599 | 941 |
| S28 | -836 | 941 |
| S27 | -836 | 769 |
| S26 | -836 | 598 |
| S25 | -836 | 427 |
| S24 | -836 | 256 |
| S23 | -836 | 85 |
| S22 | -836 | -86 |
| S21 | -836 | -257 |
| S20 | -836 | -428 |
| S19 | -836 | -599 |
| S18 | -836 | -770 |
| S17 | -836 | -941 |
| S16 | -599 | -941 |
| S15 | -428 | -941 |
| S14 | -257 | -941 |
| S13 | -86 | -941 |
| S12 | 85 | -941 |
| S11 | 256 | -941 |

| SIGNAL | PAD POSITION CENTERED | |
|-----------------|-----------------------|------|
| | x | y |
| S10 | 427 | -941 |
| S9 | 598 | -941 |
| S8 | 836 | -941 |
| S7 | 836 | -770 |
| S6 | 836 | -599 |
| S5 | 836 | -428 |
| S4 | 836 | -257 |
| S3 | 836 | -86 |
| S2 | 836 | 85 |
| S1 | 836 | 256 |
| BP1 | 836 | 427 |
| A2/BP2 | 836 | 598 |
| V _{DD} | 836 | 769 |
| A1 | 836 | 941 |
| A0/OSC | 598 | 941 |
| V _{SS} | 427 | 941 |
| SCL | 256 | 941 |
| SDA | 85 | 941 |
| Recpats | | |
| C | -586 | -699 |
| F | -580 | 663 |

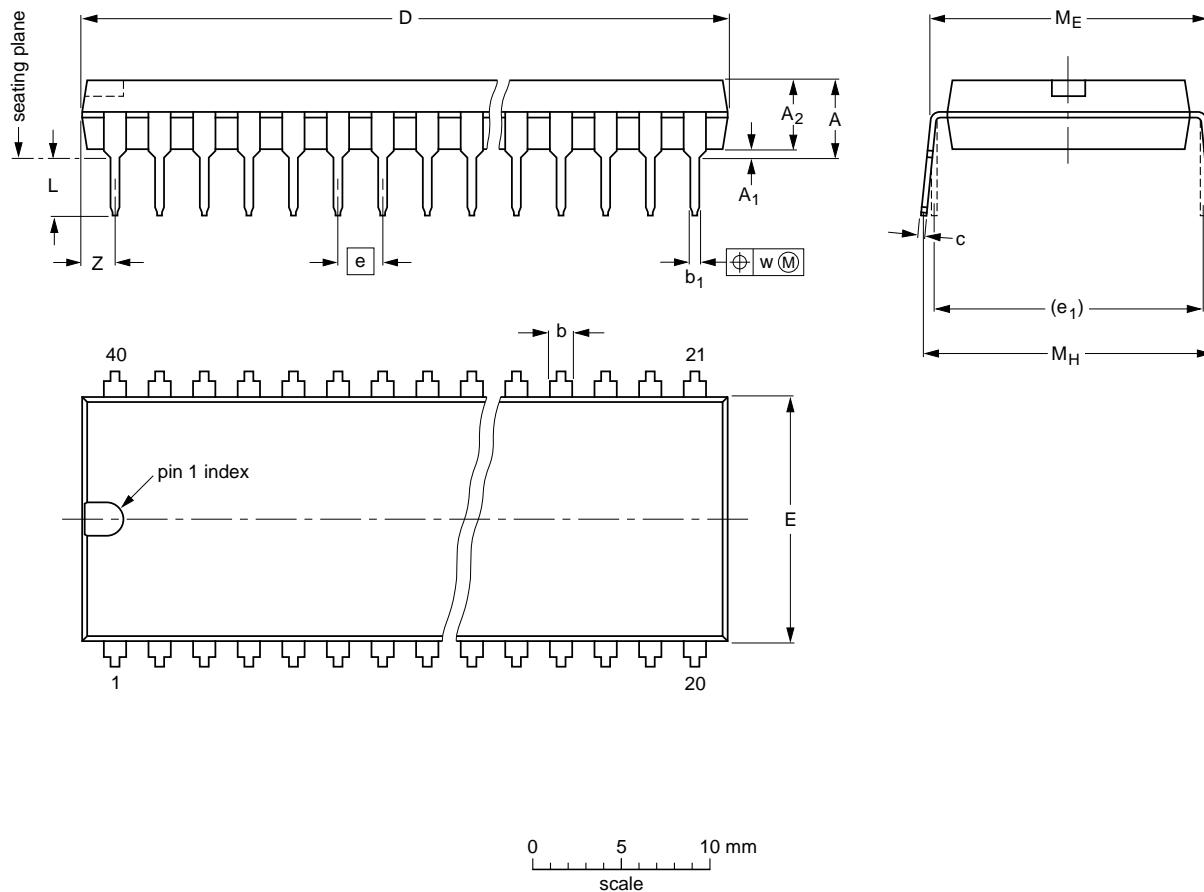
LCD direct/duplex driver with I²C-bus interface

PCF8577C

PACKAGE OUTLINES

DIP40: plastic dual in-line package; 40 leads (600 mil)

SOT129-1



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

| UNIT | A max. | A ₁ min. | A ₂ max. | b | b ₁ | c | D ⁽¹⁾ | E ⁽¹⁾ | e | e ₁ | L | M _E | M _H | w | Z ⁽¹⁾ max. |
|--------|-----------|------------------------|------------------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| mm | 4.7 | 0.51 | 4.0 | 1.70 1.14 | 0.53 0.38 | 0.36 0.23 | 52.50 51.50 | 14.1 13.7 | 2.54 | 15.24 | 3.60 3.05 | 15.80 15.24 | 17.42 15.90 | 0.254 | 2.25 |
| inches | 0.19 | 0.020 | 0.16 | 0.067 0.045 | 0.021 0.015 | 0.014 0.009 | 2.067 2.028 | 0.56 0.54 | 0.10 | 0.60 | 0.14 0.12 | 0.62 0.60 | 0.69 0.63 | 0.01 | 0.089 |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

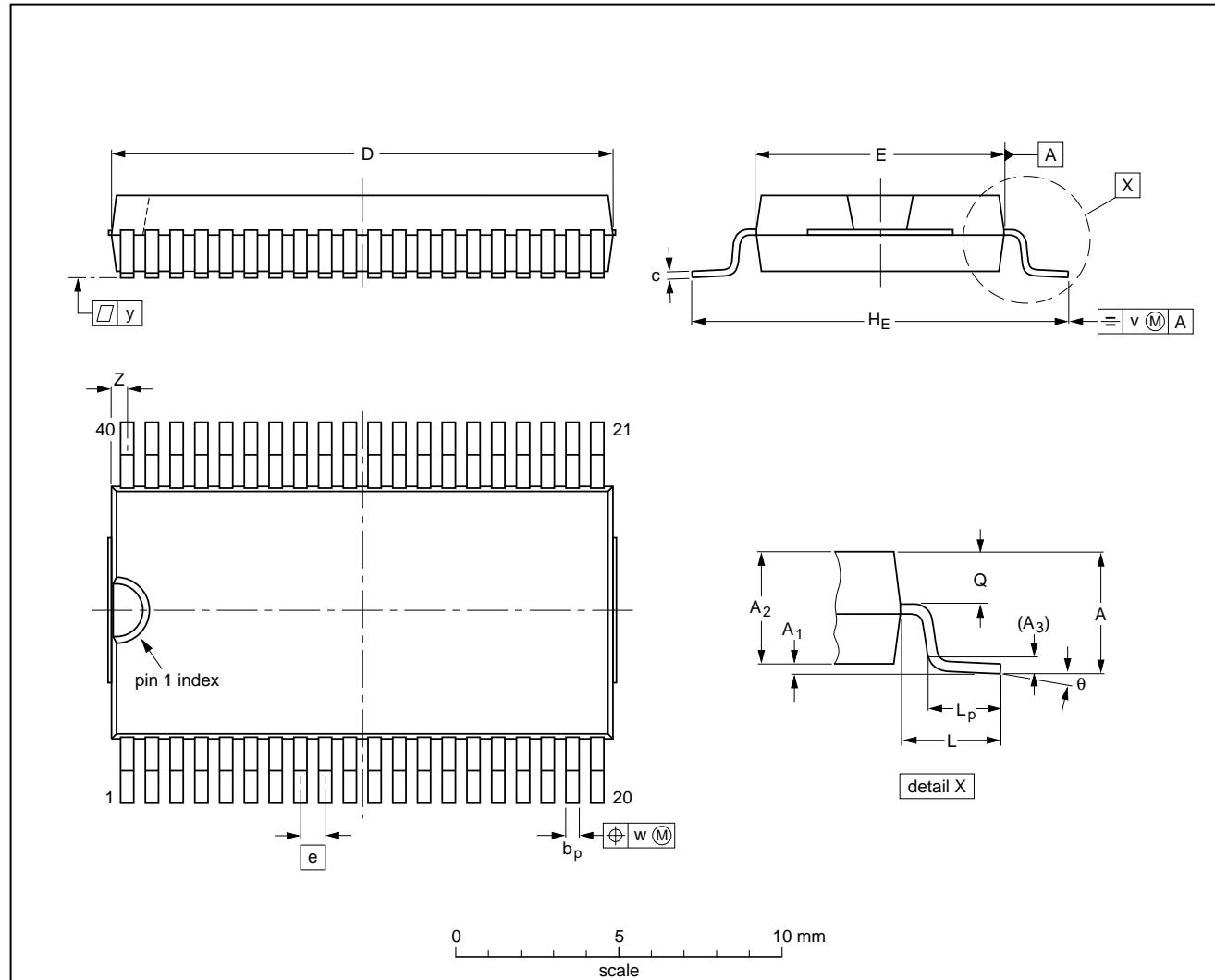
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|----------|------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT129-1 | 051G08 | MO-015AJ | | | | 92-11-17 95-01-14 |

LCD direct/duplex driver with I²C-bus interface

PCF8577C

VSO40: plastic very small outline package; 40 leads

SOT158-1



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 ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | z ⁽¹⁾ | θ |
|--------|-----------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|-------|-------|-------|------------------|----|
| mm | 2.70 | 0.3 | 2.45 | 0.25 | 0.42 | 0.22 | 15.6 | 7.6 | 0.762 | 12.3 11.8 | 2.25 | 1.7 1.5 | 1.15 1.05 | 0.2 | 0.1 | 0.1 | 0.6 0.3 | 7° |
| inches | 0.11 | 0.012 0.004 | 0.096 0.089 | 0.010 | 0.017 0.012 | 0.0087 0.0055 | 0.61 0.60 | 0.30 0.29 | 0.03 | 0.48 0.46 | 0.089 | 0.067 0.059 | 0.045 0.041 | 0.008 | 0.004 | 0.004 | 0.024 0.012 | 0° |

Notes

1. Plastic or metal protrusions of 0.4 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT158-1 | | | | | | 92-11-17 95-01-24 |

LCD direct/duplex driver with I²C-bus interface

PCF8577C

SOLDERING

Plastic dual in-line packages

BY DIP OR WAVE

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 s. The total contact time of successive solder waves must not exceed 5 s.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron below the seating plane (or not more than 2 mm above it). If its temperature is below 300 °C, it must not be in contact for more than 10 s; if between 300 and 400 °C, for not more than 5 s.

Plastic small outline packages

BY WAVE

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

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

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

BY SOLDER PASTE REFLOW

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

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to 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 min at 45 °C.

REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

LCD direct/duplex driver with I²C-bus interface

PCF8577C

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. | |

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