DATA SHEET

PCA84C122; 222; 422; 622; 822
8-bit microcontrollers for remote control transmitters

Product specification
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1 FEATURES

- 84CXXX CPU
- ROM, RAM and I/O configurations are device dependent; see Chapter 3
- Two test inputs: T0 (ANDed with Port 1 input lines) and T1
- 3 single-level vectored interrupt sources:
  - external (T0/$\overline{\text{INT}}$ and Port 1, for keypad press wake-up function)
  - timer/counter (TI)
  - hardware modulator interrupt
- 8-bit programmable timer/counter with 5-bit pre-scaler
- Power saving: Idle and Stop modes are provided
- Hardware Modulator providing pulse bursts, with:
  - programmable duty factor for each pulse
  - programmable number of pulses
- One output line from the Hardware Modulator to control the driver transistor for the infrared LED (IR-LED). Capable of sinking 27 mA at V_{DD} = 2.0 V, $V_{\overline{OUT}}$ = 1.0 V
- Watchdog Timer to keep the transmitter from being locked or malfunction
- Available packages: SO and DIP types (SO20, SO24, SO28, SDIP24 and DIP20); see Chapter 4
- On-chip oscillator: 455 kHz to 6 MHz
- Single supply voltage: 2.0 V to 5.5 V
- Operating temperature: –20 to +50 °C.

2 GENERAL DESCRIPTION

The PCA84C122 is a stand-alone microcontroller designed for use in remote control transmitters for a wide range of applications.

The PCA84C122 provides a number of dedicated hardware functions for remote controller applications. These functions include the following additional blocks to the 84CXXX core:

- Interrupt Gate
- Hardware Modulator
- Output Driver
- Watchdog Timer.

Although the PCA84C122 is specifically referred to throughout this data sheet, the information applies to all the devices. The differences between the PCA84C122 and the other devices are specified in Chapter 3.

Figure 2 shows the general block diagram of the device. The 84CXXX core plus 8 kbytes ROM and 64 bytes RAM has the same function as described in the PCF84CXXX family description (see *"Data Handbook IC14"*).

When the transmitter is not in use the microcontroller is in Stop mode and the oscillator is halted. The AND gate connected to the Port 1 (P10 to P17) lines provides the wake-up to end the Stop mode.

The Hardware Modulator produces pulse bursts according to the required protocol. The ON-time and OFF-time of each pulse (i.e. duty factor) and the number of pulses are controlled by software.

The Watchdog Timer (WDT) will reset the PCA84C122 when it has not been reloaded (reset) in time, because the program has run out of sequence (endless loop, continuous Idle mode, etc.). During Stop mode the oscillator is halted, therefore the Watchdog Timer is not running.

Automatic system reset is generated by the WDT if the timer is not reset before overflow from counting within a certain period of time.

The Output Driver can handle sufficient current to drive a single transistor, that provides the required current for the IR-LED.

2.1 Important note

This data sheet details the specific properties of the PCA84C122; PCA84C222; PCA84C422; PCA84C622 and PCA84C822. The shared characteristics of the family of microcontrollers are described in the PCF84CXXXA Family single-chip 8-bit Microcontroller of *"Data Handbook IC14"*, which should be read in conjunction with this data sheet.

3 MEMORY AND I/O CONFIGURATIONS

DEVICE	I/O LINES	ROM	RAM
PCA84C122A	16	1K	32 bytes
PCA84C122B	12		
PCA84C222A	16	2K	
PCA84C222B	12		
PCA84C422A	16	4K	
PCA84C422B	12		
PCA84C622A	16	6K	64 bytes
PCA84C622B	12		
PCA84C622C	20(1)		
PCA84C822A	16	8K	
PCA84C822B	12		
PCA84C822C	20(1)		

Note

1. 4 I/O lines with 10 mA sink capability.

4 ORDERING INFORMATION

TYPE NUMBER(1)	PACKAGE		
	NAME	DESCRIPTION	VERSION
PCA84CX22AP	SDIP24	plastic shrink dual in-line package; 24 leads (400 mil)	SOT234-1
PCA84CX22AT	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
PCA84CX22BP	DIP20	plastic dual in-line package; 20 leads (300 mil)	SOT146-1
PCA84CX22BT	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
PCA84C622CT	SO28	plastic small outline package; 28 leads; body width 7.5 mm; low stand-off height	SOT136-1
PCA84C822CT			

Note

1. ‘X’ in the type number denotes the numbers: 1, 2, 4, 6 and 8.

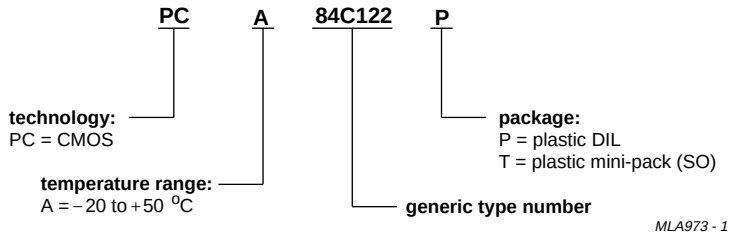


Fig.1 Numbering scheme.

5 BLOCK DIAGRAM

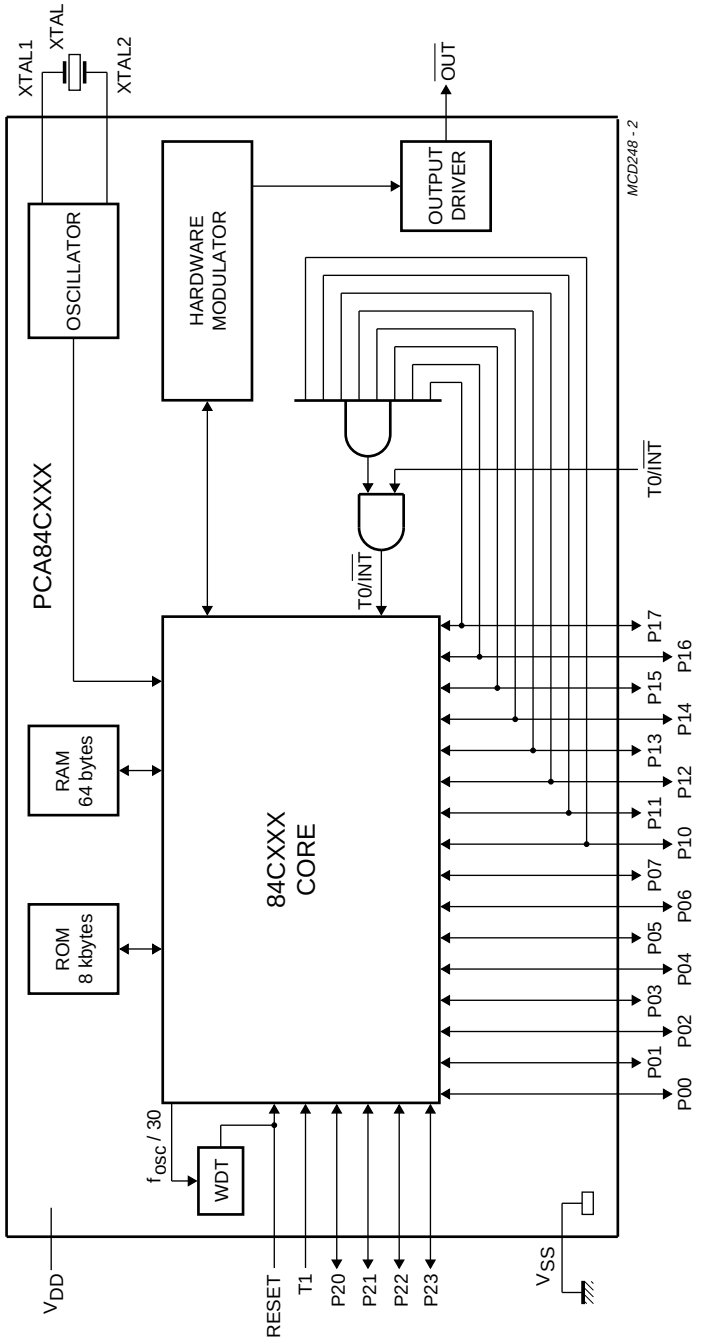


Fig.2 Block diagram.

6 PINNING INFORMATION

6.1 Pinning

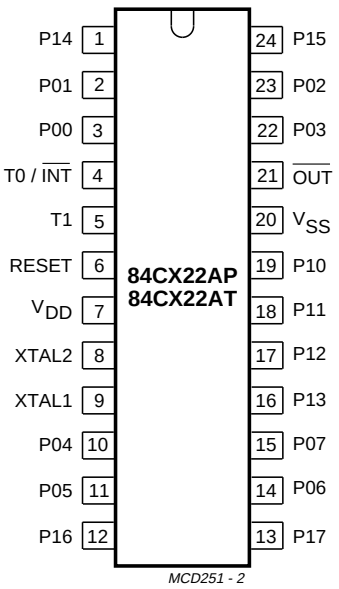


Fig.3 Pin configurations PCA84CX22AP (SDIP24) and PCA84CX22AT(SO24).

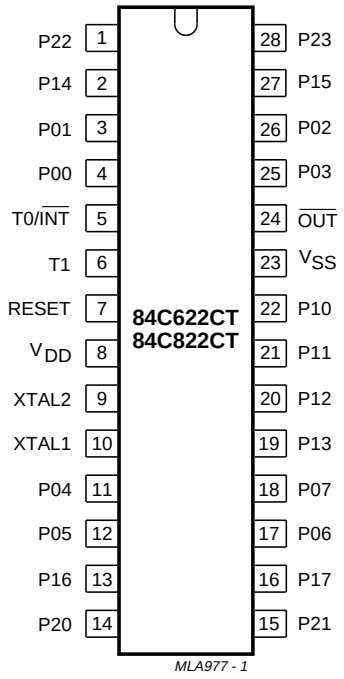


Fig.4 Pin configuration PCA84CX22CT (SO28).

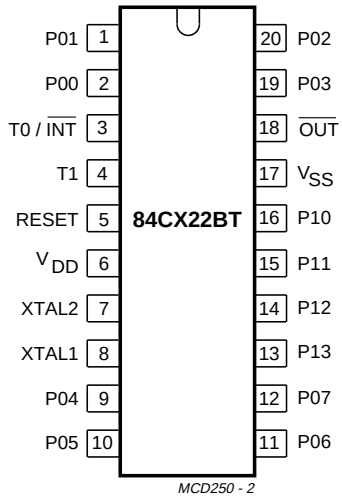


Fig.5 Pin configuration PCA84CX22BT (SO20).

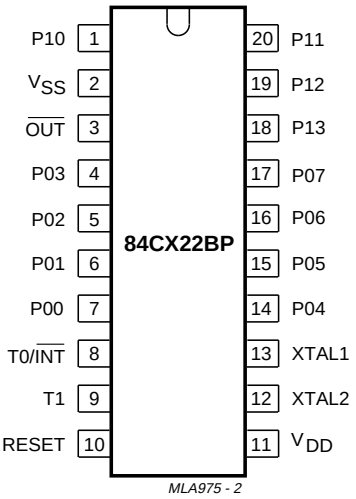


Fig.6 Pin configuration PCA84CX22BP (DIP20).

6.2 Pin description

Table 1 Pin description for PCA84CX22AP, PCA84CX22AT, PCA84CX22BP, PCA84CX22BT and PCA84CX22CT

SYMBOL	PIN				DESCRIPTION
	SDIP24/SO24 (see Fig.3)	**SO28** (see Fig.4)	**SO20** (see Fig.5)	**DIP20** (see Fig.6)	
P00 to P07	3, 2, 23, 22, 10, 11, 14, 15	4, 3, 26, 25, 11, 12, 17, 18	2, 1, 20, 19, 9, 10, 11, 12	7, 6, 5, 4, 14, 15, 16, 17	standard I/O Port lines, generally used for keypad scanning
P10 to P17	19, 18, 17, 16, 1, 22, 12, 13	22, 21, 20,19, 2, 27, 13, 16	16, 15, 14, 13	1, 20,19, 18	standard I/O Port lines, generally used for keypad sensing
P20 to P23	–	14, 15, 1, 28	–	–	standard I/O Port lines, generally used for visible LED's
T0/$\overline{\text{INT}}$	4	5	3	8	test T0 and external interrupt input
T1	5	6	4	9	test T1 input
RESET	6	7	5	10	active HIGH reset; normally connected to V_{SS}. For further information see PCF84CXXXA description in *"Data Handbook IC14"*.
XTAL1	9	10	8	13	crystal or ceramic resonator
XTAL2	8	9	7	12	
$\overline{\text{OUT}}$	21	24	18	3	pulse train output pin, capable of sinking 27 mA
V_{DD}	7	8	6	11	power supply
V_{SS}	20	23	17	2	ground

7 POWER-ON-RESET STATUS AND PORT OPTIONS

- All Port lines are standard I/O (option 1).
- RESET (Power-on-reset) level of 1.3 V.

After Power-on-reset, Port 0 is reset to LOW; Port 1, Port 2 and $\overline{\text{OUT}}$ are reset to HIGH.

8 HARDWARE MODULATOR

The Hardware Modulator is the main derivative part in the PCA84C122. Figure 7 shows the internal architecture.

The Hardware Modulator generates a pulse train whereby the ON-time of a pulse and the OFF-time between pulses can be programmed in a number of clock cycles (period = $1/f_{osc}$); see Figs 8 and 7.

The number of pulses of the train is also programmable. The time between pulse bursts is determined by software, possibly using the standard 8-bit Timer/Counter.

8.1 Interface between the 84CXXX core and derivative logic

There are three (derivative) registers and one (derivative) counter that must be loaded from the core.

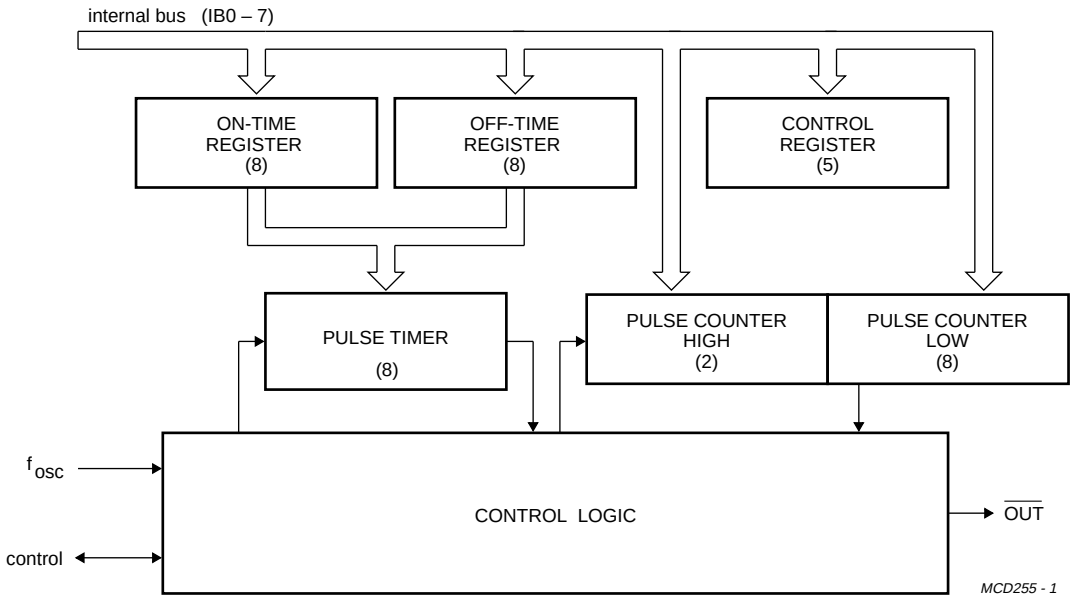


Fig.7 Hardware Modulator.

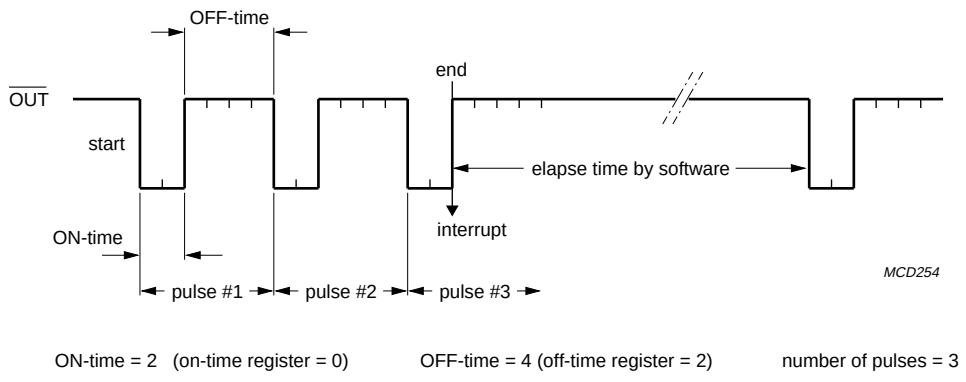


Fig.8 Example pulse train output of $\overline{OUT}$ pin.

8.1.1 ON-TIME REGISTER (ADDRESS: 00H)

This 8-bit register is loaded by software; the decimal value of its contents + 2, determine the number of oscillator cycles that the $\overline{OUT}$ pin is active.

The active period (ON-time) of $\overline{OUT} = \frac{(\text{contents} + 2)}{f_{osc}}$

8.1.2 OFF-TIME REGISTER (ADDRESS: 01H)

This 8-bit register is loaded by software; the decimal value of its contents + 2, determine the number of oscillator cycles that the $\overline{OUT}$ pin is inactive.

The inactive period (OFF-time) of $\overline{OUT} = \frac{(\text{contents} + 2)}{f_{osc}}$

8.1.3 PULSE COUNTER

The Pulse Counter, is a 10-bit register consisting of:

- Pulse Counter Low (8-bit); address 02H.
- Pulse Counter High (2-bit); address 04H.

The Pulse Counter is loaded by software with the number of pulses required in a pulse burst; loading '0' is not allowed.

8.1.4 CONTROL REGISTER (ADDRESS 03H)

The Control Register contains the bits that control various possibilities for the output pulses, plus the reset of the interrupt flip-flop and the Watchdog timer.

Table 2 Control Register (CR)

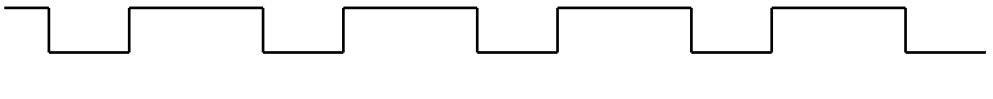
7	6	5	4	3	2	1	0
–	–	–	RWDT	Rint	PWM	LgP	HF

Table 3 Description of the CR bits

BIT	SYMBOL	DESCRIPTION
7 to 5	–	Reserved.
4	RWDT	**Reload Watchdog Timer:** This is not an actual flip-flop in the Control Register. If a logic 1 is written to this bit position the Watchdog Timer is reloaded (reset to 0); this bit is Write only.
3	Rint	**Reset Interrupt:** This is not an actual flip-flop in the Control Register. If a logic 1 is written to this bit position the interrupt flip-flop is reset; this bit is Write only.
2	PWM	**Pulse Width Modulation:** Is the standard term for a quasi analog signal. It is a square wave signal of which the duty cycle may be varied. When integrated a real analog signal may be obtained. When PWM = 1; the Pulse Counter Register is ignored and a continuous pulse train is generated (see Fig.9); this bit is Read or Write.
1	LgP	**Long Pulse:** When LgP = 1; the OFF-time Register is ignored and a single pulse of length = (ON-time) × (number of pulses) is generated. If HF = 1, this pulse is modulated with a frequency $\frac{1}{4} \times f_{osc}$ (see Fig.10); this bit is Read or Write.
0	HF	**High Frequency:** When HF = 1 the ON-time part of the generated pulse is modulated with a frequency $\frac{1}{4} \times f_{osc}$ (see Fig.11); this bit is Read or Write.

8.2 Instructions for data transfer between the 84CXXX core and derivative logic

INSTRUCTION	DESCRIPTION
MOV Dx,A	Move contents of the accumulator to the derivative register.
MOV A,Dx	Move contents of derivative register to the accumulator.
ANL Dx,A	AND derivative register contents with contents of accumulator. Result is stored in derivative register.
ORL Dx,A	OR derivative register contents with contents of accumulator. Result is stored in derivative register.

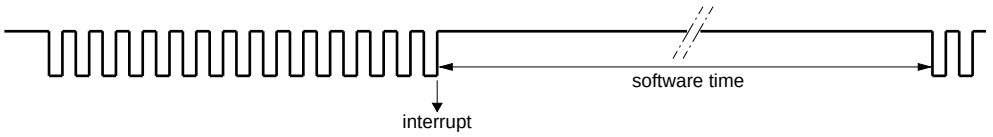


HF = 0 LgP = 0 PWM = 1 ON-time = 3 OFF-time = 5

MCD258

number of pulses = don' t care

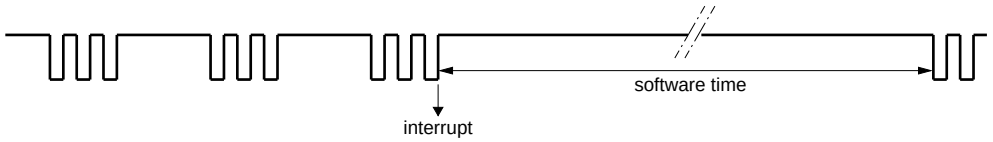
Fig.9 Analog output (PWM).



HF = 1 LgP = 1 PWM = 0 ON-time = 12 OFF-time = don' t care MCD257 - 1

number of pulses = 5

Fig.10 Long Pulse (modulated).



HF = 1 LgP = 0 PWM = 0 ON-time = 12 OFF-time = 12 MCD256 - 1

number of pulses = 3

Fig.11 Modulated by $\frac{1}{4} \times f_{osc}$.

8.3 Operation of the Hardware Modulator

First the ON-time and OFF-time registers are loaded. The number of pulses to be generated is stored in the Pulse Counter. The Hardware Modulator starts as soon as the Pulse Counter is loaded. First the signal $\overline{OUT}$ is activated and the ON-time value is stored in the Pulse Timer. Then the Pulse Timer is counted down with pulses of $1/f_{osc}$.

When the Pulse Timer reaches zero the $\overline{OUT}$ signal becomes inactive and the value held in the Pulse Counter is decreased by '1'. If the Pulse Counter is not yet zero, the OFF-time is stored in the Pulse Timer and is counted down again. When it reaches zero now, signal $\overline{OUT}$ is activated again, ON-time is loaded and the counter starts counting down etc. On the Pulse Counter reaching zero, an interrupt (Special Interrupt, SI) is sent to the CPU, indicating that the Hardware Modulator is ready.

The delay between two pulse bursts is determined by software. When a new burst must be generated with the same ON-time and OFF-time values, only the Pulse Counter is loaded with the required number of pulses and the Hardware Modulator will start automatically. The interrupt signal is reset when the Pulse Counter is loaded or can be reset directly by writing a logic 1 to bit Rint of the Control Register.

9 INTERRUPTS

There are three different interrupt sources with different vectors within the PCA84C122, these are:

- External keypad wake-up and T0/$\overline{INT}$ pin; vector address: 03H
- Hardware modulator (SI); vector address: 05H
- Internal Timer/counter (TI); vector address: 07H.

9.1 Internal timer/counter

The internal timer/counter is the same as in the other members of the PCF84CXXX family. Instructions 'EN TCNTI' and 'DIS TCNTI' are to enable/disable the interrupt.

9.2 External keypad wake-up and T0/$\overline{INT}$ pin

9.2.1 KEYPAD WAKE-UP

The keypad wake-up function generates an interrupt signal to the CPU. This signal is used to terminate the Stop mode and thus allows program execution to continue. If the external interrupt is enabled the microcontroller executes the instruction immediately following the STOP instruction, before executing the interrupt routine.

If the external interrupt is disabled, program execution continues with the instruction following the STOP instruction.

The wake-up function is activated when any of the sense lines (Port 1 pins) are pulled LOW.

9.2.2 T0/$\overline{INT}$ PIN

T0/$\overline{INT}$ must be connected to V_{DD} when not in use, because no internal pull-up or pull-down is present (floating input).

Because this pin is 'ANDed' with Port 1 inputs, the result of 'JTO' and 'JNTO' instructions and the interrupt depends on the AND of all Port 1 and T0/$\overline{INT}$ inputs.

T0/$\overline{INT}$ can serve as an extra sense line, when a pull-up resistor is connected, however, multiple keys will not be detected.

10 OUTPUT DRIVER

The output of the Hardware Modulator is amplified and able to sink a current of 27 mA when the $\overline{OUT}$ signal is active. Therefore, only one external (PNP) transistor is required to drive the IR-LED.

LOW level output sink current, minimum 27 mA at V_{DD} = 2.0 V, $V_{\overline{OUT}} < V_{DD} - 1.0$ V.

11 WATCHDOG TIMER (WDT)

The Watchdog timer consists of a 17 stage counter with a clock of $\frac{1}{30} \times f_{osc}$. A logic 1 written to RWDT bit (Control Register) clears the WDT to zero.

After a Power-on-reset, the WDT is cleared to zero; the content of the WDT is then incremented by '1' every 30 clock cycles.

If the WDT is not reset to zero before it overflows, a RESET signal is generated and the device is reset, thus preventing a lock up or malfunction. The software must clear the WDT at least $1/f_{osc} \times 30 \times 2^{16}$ seconds before it generates the RESET signal; i.e. at f_{osc} = 1 MHz, this is 1.92 s.

In the Idle mode the oscillator is still running and therefore the WDT remains active. In the Stop mode, the WDT is fully stopped and the value of the counter is kept.

12 LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DD}	supply voltage	–0.5	+7.0	V
V_I	all input voltages	–0.5	V_{DD} + 0.5	V
$I_{source(max)}$	maximum source current (all Port lines)	–	–5	mA
$I_{sink(max)}$	maximum sink current (all Port lines)	–	5	mA
$I_{\overline{OUT}}$	output current	27	–	mA
I_{rev}	maximum reverse current	–	–500	mA
P_{tot}	total power dissipation	–	500	mW
T_{stg}	storage temperature	–55	+125	°C
T_{amb}	operating ambient temperature	–20	+50	°C

13 DC CHARACTERISTICS

V_{DD} = 4.5 V to 5.5 V; V_{SS} = 0 V; T_{amb} = –20 to +50 °C; all voltages with respect to V_{SS}; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	supply voltage		2.0	3.0	5.5	V
I_{DD}	operating supply current	V_{DD} = 3 V; f_{xtal} = 3 MHz	–	0.4	0.9	mA
		V_{DD} = 5 V; f_{xtal} = 3 MHz	–	0.9	1.8	mA
$I_{DD(ID)}$	supply current Idle mode	V_{DD} = 3 V; f_{xtal} = 3 MHz	–	0.20	0.40	mA
		V_{DD} = 5 V; f_{xtal} = 3 MHz	–	0.25	0.50	mA
$I_{DD(ST)}$	supply current Stop mode	V_{DD} = 5 V; f_{xtal} = 3 MHz	–	1.20	10	µA
Inputs (RESET, T0/$\overline{INT}$, T1, Port 0: P00 to P07, Port 1: P10 to P17, Port 2: P20 to P23)						
V_{IL}	LOW level input voltage		0	–	$0.3V_{DD}$	V
V_{IH}	HIGH level input voltage		$0.7V_{DD}$	–	V_{DD}	V
I_{LI}	input leakage current	$V_{SS} < V_I < V_{DD}$	–	0.20	10	µA
Outputs (Port 0: P00 to P07, Port 1: P10 to P17, Port 2: P20 to P23)						
I_{OL}	LOW level output sink current	V_{DD} = 5 V; V_O = 0.4 V	1.6	12.0	–	mA
		V_{DD} = = 5 V; V_O = 0.4 V; P20 – P23	10	–	–	mA
I_{OH}	HIGH level pull-up output source current	V_{DD} = 5 V; V_O = $0.7V_{DD}$	–40	–100	–	µA
		V_{DD} = 5 V; V_O = V_{SS}	–140	–140	–400	µA
PULSE OUTPUT ($\overline{OUT}$)						
I_{OL}	LOW level output sink current	V_{DD} = 2 V; V_O = 1.0 V	27	–	–	mA
I_{OH}	HIGH level output source current	V_{DD} = 2 V; V_O = $0.7V_{DD}$	–1.6	–	–	mA

14 AC CHARACTERISTICS

V_{DD} = 2.0 V to 5.5 V; V_{SS} = 0 V; T_{amb} = –20 to +50 °C; all voltages with respect to V_{SS}; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Oscillator						
f_{xtal}	operating crystal frequency	V_{DD} = 2.5 V	0.455	–	6.0	MHz
		V_{DD} = 2.0 V	0.455	–	5.0	MHz
g_{mL}	Low transconductance		0.3	0.7	1.4	mS
g_{mM}	Medium transconductance		0.9	1.6	3.2	mS
g_{mH}	High transconductance		3.0	4.5	9.0	mS
R_{FB}	feedback resistor		0.3	1.0	3.0	MΩ

15 APPLICATION INFORMATION

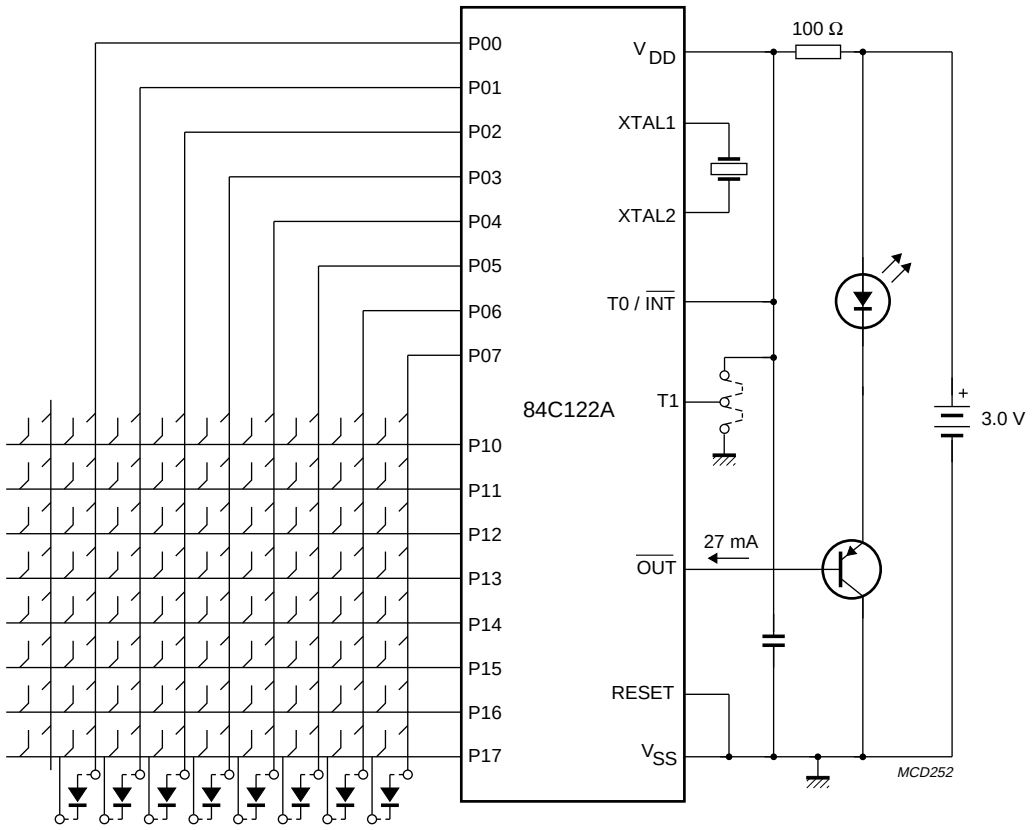


Fig.12 PCA84C122A Remote control transmitter application.

Figure 12 shows the main application of the PCA84C122 as a remote control transmitter. Each key of the transmitter keypad represents a specific command. The keys are in an orderly matrix with each key connected between an I/O line of Port 0 and an I/O line of Port 1.

The lines of Port 0 are designated 'scan' (output) lines, and the lines of Port 1 are 'sense' (input) lines.

By making each scan line a logic 0 in turn, and each time looking at the sense lines, the depressed key is detected. The corresponding command code is determined by using a software look-up table. This code together with the system address is sent according to a coding scheme or protocol (e.g. RC-5). The pulses that are generated are available at the $\overline{OUT}$ pin. This pin drives the output transistor, which provides the current for the IR-LED.

T0/$\overline{INT}$ is not used and therefore connected to V_{DD}. T1 is used for system or option selection, therefore a jumper can be connected to V_{DD} or ground.

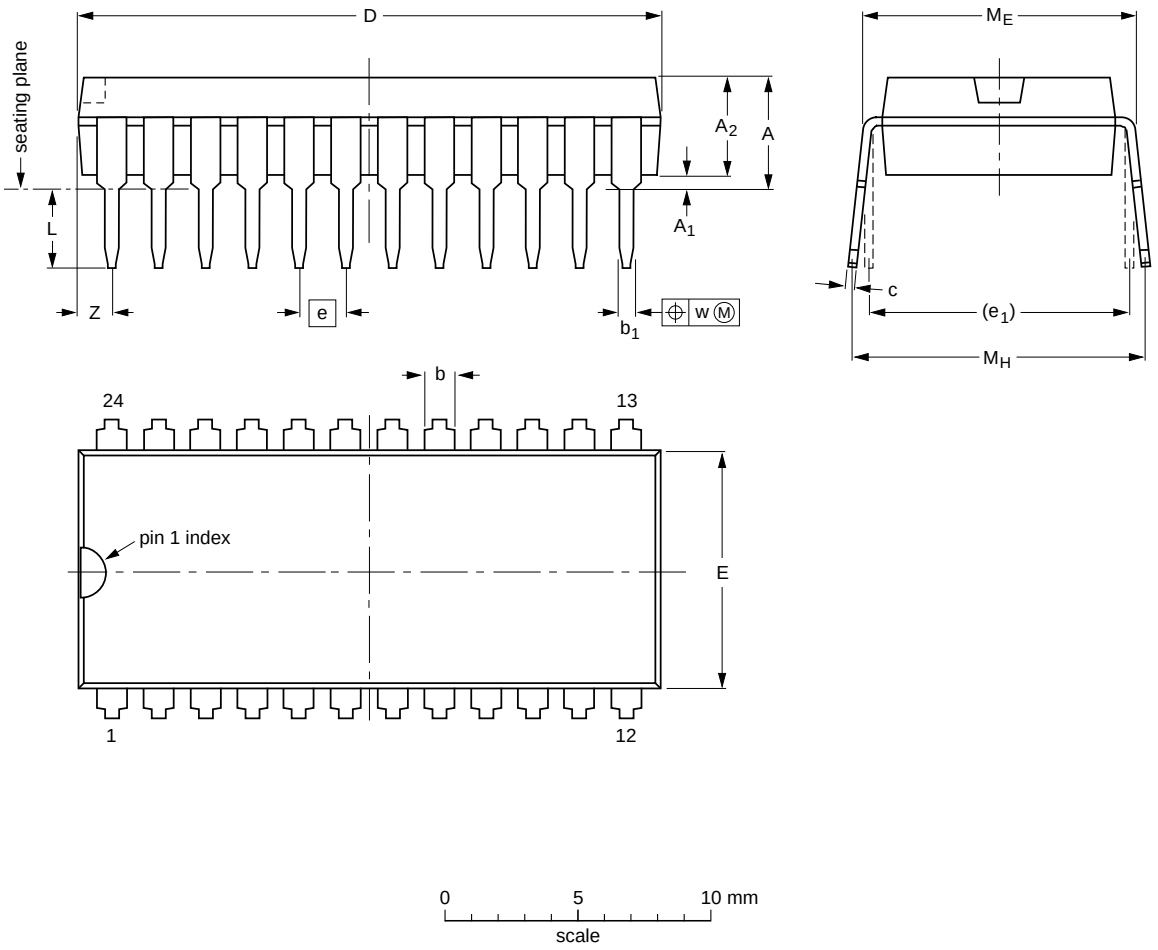
When more options must be selected, this can be done in different ways as illustrated in the following two examples:

1. When the number of keys is sufficiently low a scan line can be spared. This scan line may be used to connect a jumper wire to one of the sense lines. Normally the scan line should be logic 1. When this line is set to logic 0 the option setting can be read from the sense lines.
2. By connecting diodes between one sense line and a number of scan lines (see Fig.12). If necessary these diodes can be placed parallel to the keys. When the sense line is set to logic 0 (acts as scan line), the option setting can be read from the scan lines (which act as sense lines and should be set to logic 1 beforehand).

For the oscillator a crystal or ceramic resonator may be used. A resistor in series with the supply, limits the reverse current through the IC in the event of the supply voltage being reversed (i.e. wrong insertion of batteries).

16 PACKAGE OUTLINES

SDIP24: plastic shrink dual in-line package; 24 leads (400 mil) **SOT234-1**



DIMENSIONS (mm are the original dimensions)

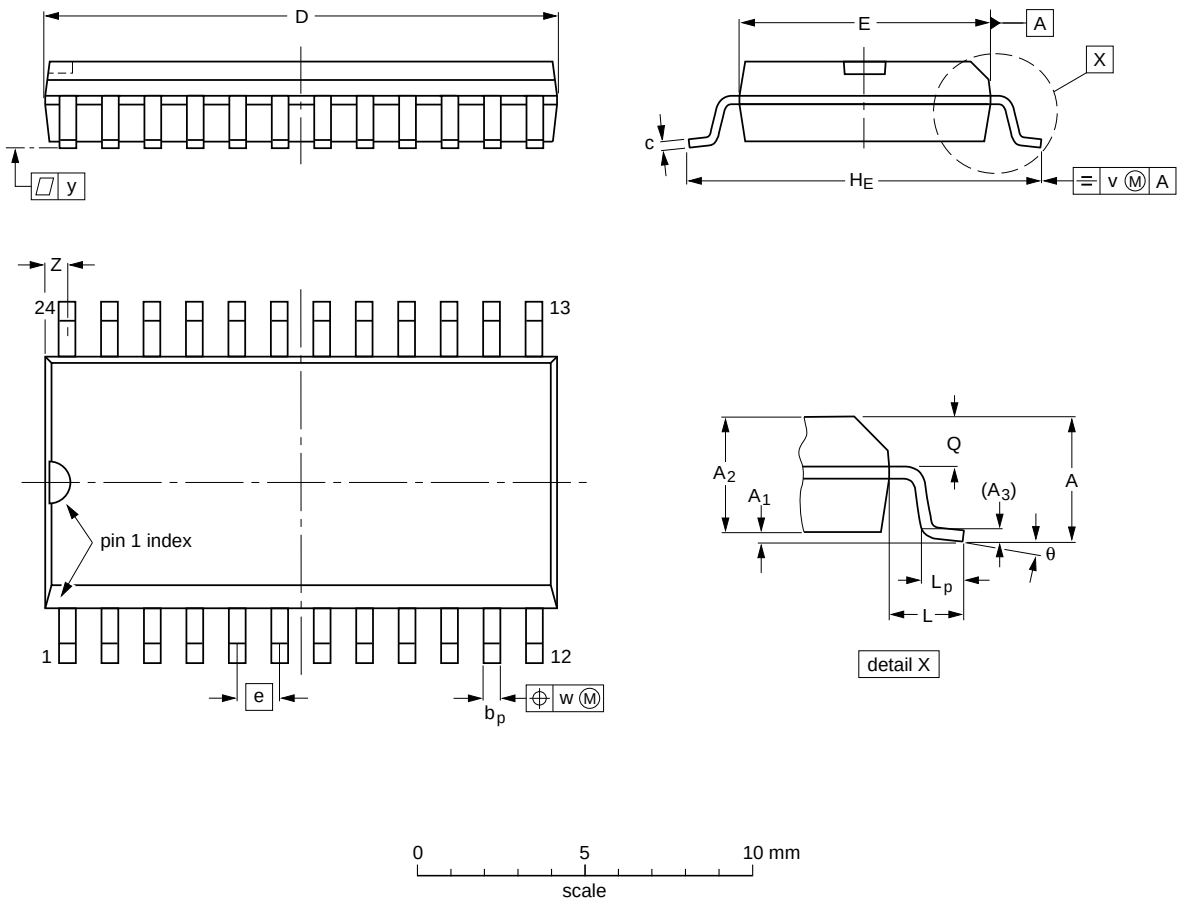
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.8	1.3 0.8	0.53 0.40	0.32 0.23	22.3 21.4	9.1 8.7	1.778	10.16	3.2 2.8	10.7 10.2	12.2 10.5	0.18	1.6

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			
SOT234-1						~~92-11-17~~ 95-02-04

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



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

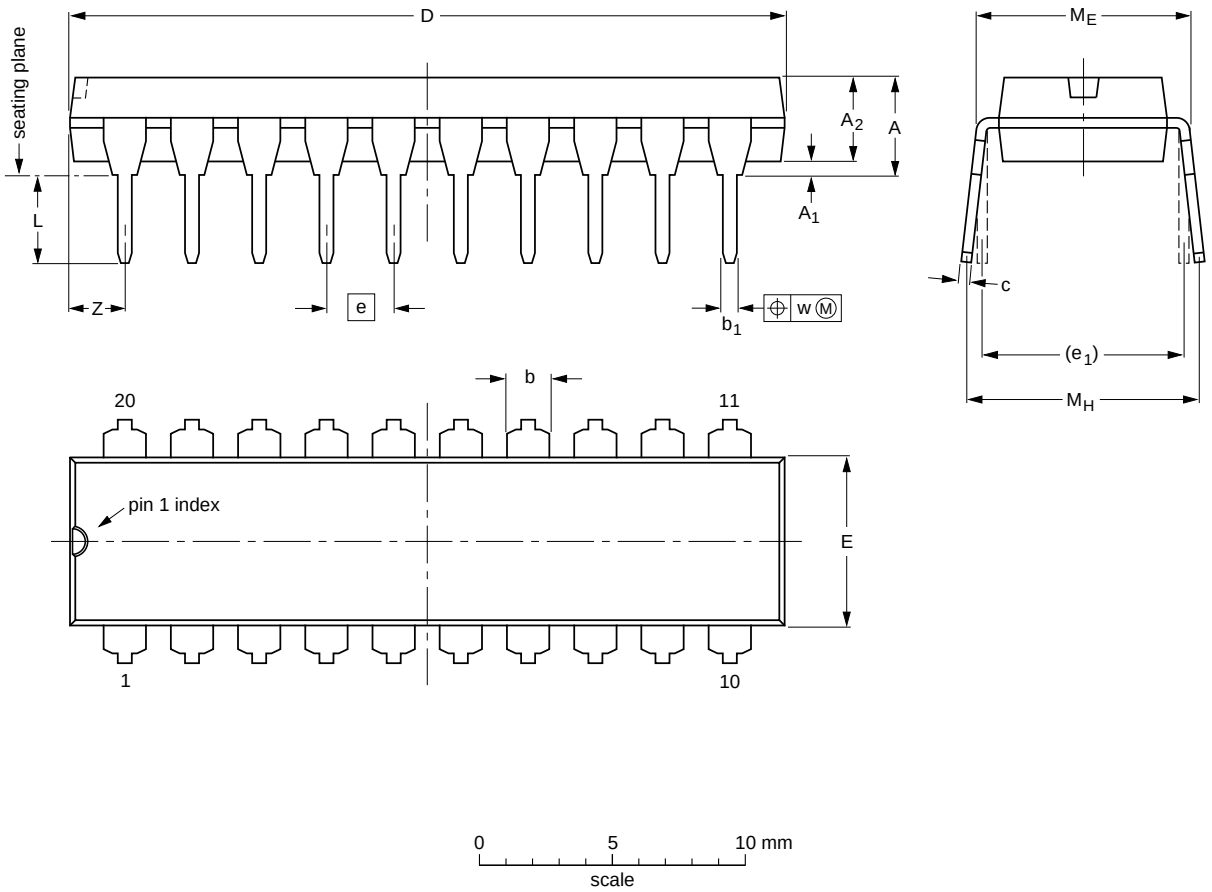
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.050	0.42 0.39	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			
SOT137-1	075E05	MS-013AD				~~92-11-17~~ 95-01-24

DIP20: plastic dual in-line package; 20 leads (300 mil) **SOT146-1**



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

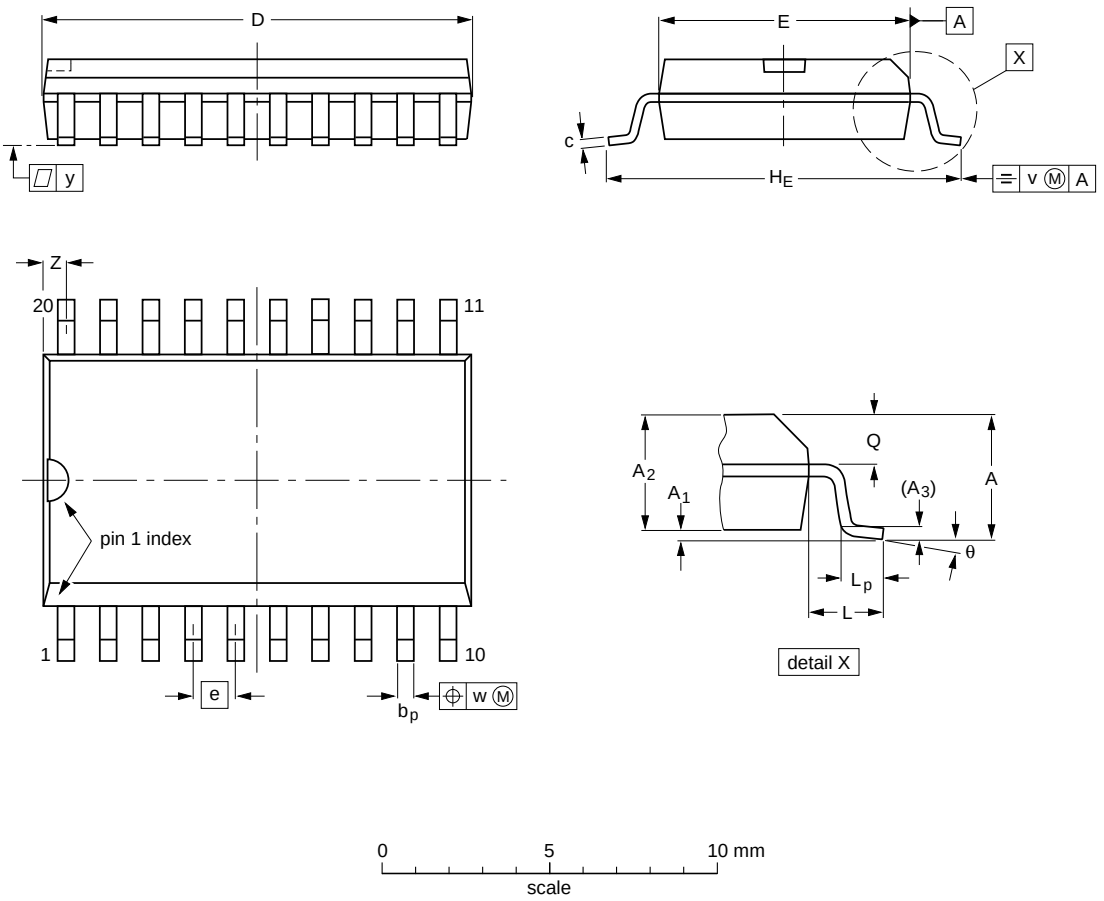
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	0.36 0.23	26.92 26.54	6.40 6.22	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.0
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.014 0.009	1.060 1.045	0.25 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.078

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			
SOT146-1			SC603			~~92-11-17~~ 95-05-24

SO20: plastic small outline package; 20 leads; body width 7.5 mm **SOT163-1**



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

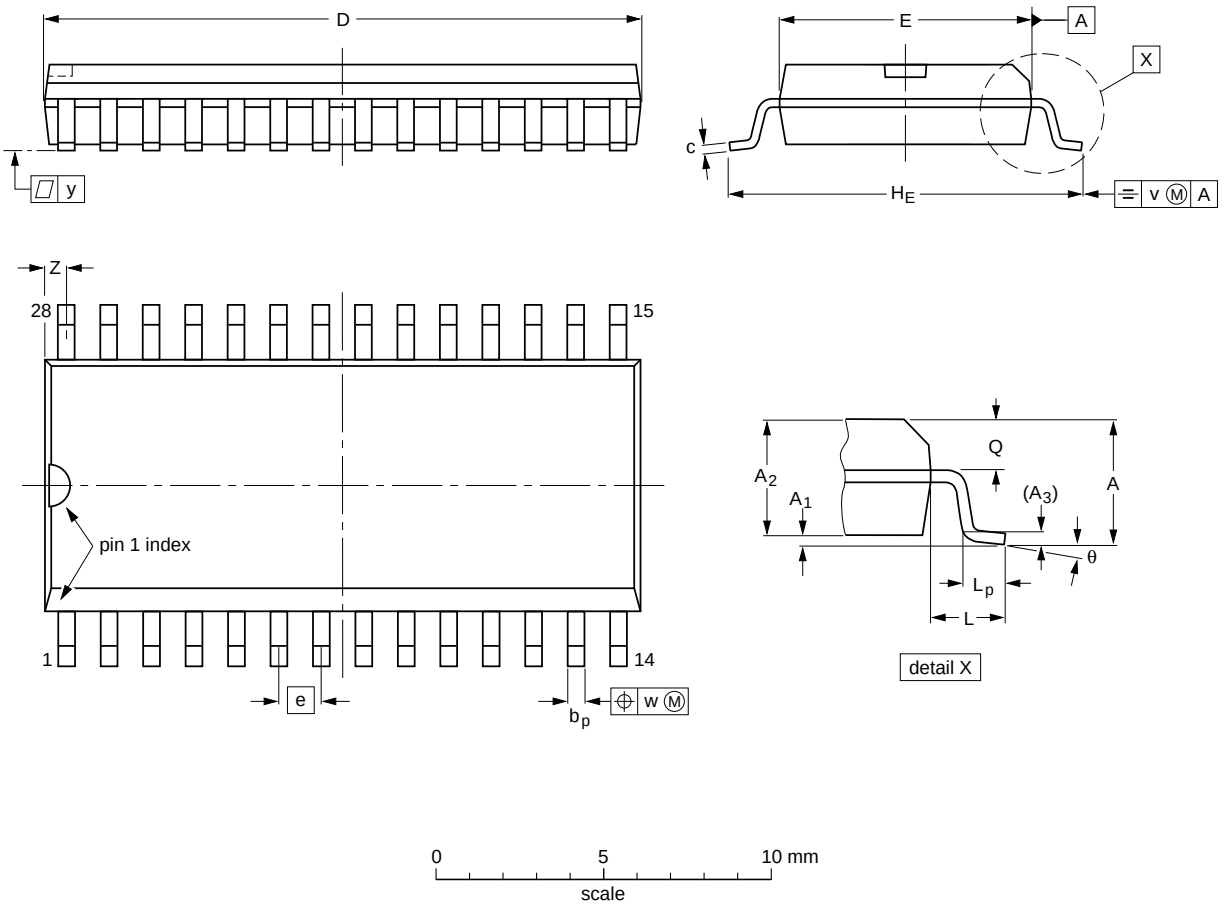
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.42 0.39	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			
SOT163-1	075E04	MS-013AC				~~92-11-17~~ 95-01-24

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^o 0^o
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	0.42 0.39	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				~~91-08-13~~ 95-01-24

17 SOLDERING

17.1 Plastic small outline packages

17.1.1 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.

17.1.2 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.

17.1.3 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.

17.2 Plastic dual in-line packages

17.2.1 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.

17.2.2 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.

18 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.	

19 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.