SL486

INFRA RED REMOTE CONTROL PREAMPLIFIER

(Supersedes version in April 1994 Consumer IC Handbook, HB3120 - 2.0)

The SL486 is a high gain preamplifier designed to form an interface between an infra-red receiving diode and the digital input of remote control receiving circuits. The device contains two other circuit elements, one to provide a stretched output pulse facility and a voltage regulator to allow operation from a wide range of supplies.

FEATURES

- Fast Acting AGC Improves Operation In Noisy Environments
- Differential Inputs Reduce Noise Pick-up and Improve Stability
- Gyrator Circuit Allows Operation in Environments with High Brightness Background Light Levels
- Output Pulse Stretcher for use with Microprocessor Decoders
- On-chip Regulator allows Operation from Wide Range of Power Supplies
- Low Noise Output

ORDERING INFORMATION

SL486 NA DP
SL486 NA MP

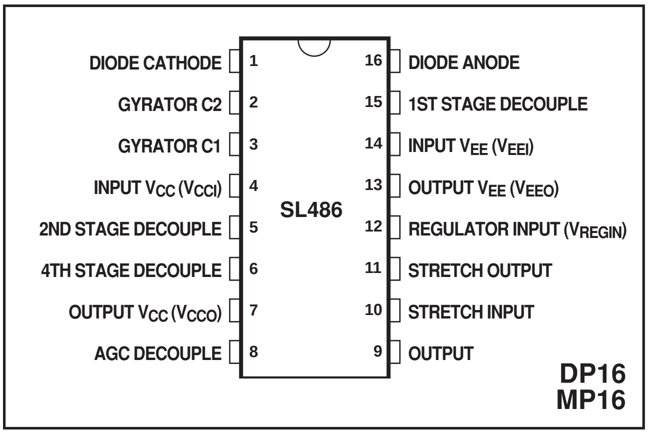
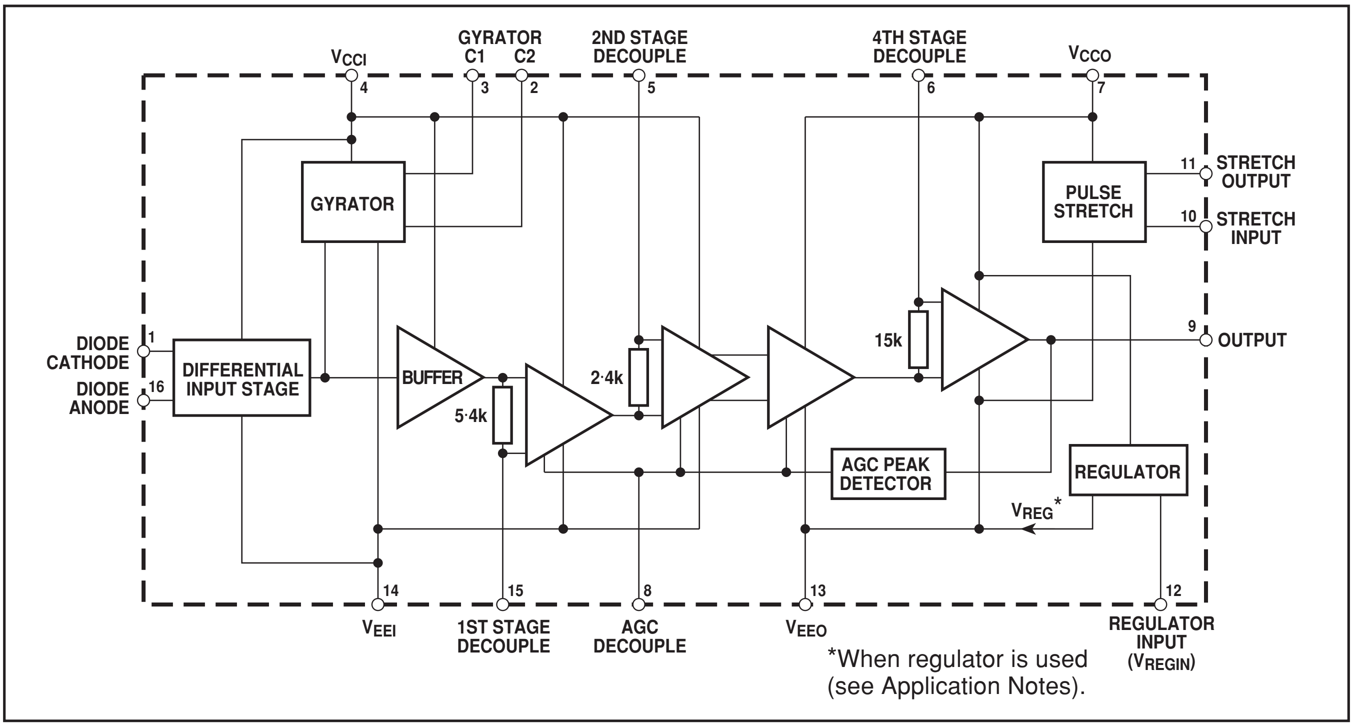


Fig. 1 Pin connections - top view

ABSOLUTE MAXIMUM RATINGS

Supply voltage, V_{CCI}	$+10V$ wrt V_{EEI}
Supply voltage, V_{CCO}	$+10V$ wrt V_{EEO}
Regulator input voltage, V_{REGIN}	$-20V$ wrt V_{CCO}
Output current	5mA
Stretch output current	5mA
Operating temperature range	0°C to +70°C
Storage temperature	−55°C to+150°C



*When regulator is used (see Application Notes).

Fig. 2 SL486 block diagram

ELECTRICAL CHARACTERISTICS

These characteristics are guaranteed over the following conditions (unless otherwise stated):

T_{AMB} = +25°C, $V_{CCI} = V_{CCO} = V_{CC}$ = +4·5V to +7·0V, $V_{EEI} = V_{EEO} = V_{EE}$ = 0V

Characteristic	Pin	Value			Units	Conditions
		Min.	Typ.	Max.		
Supply current (see note 1)	4,7 4 4,7	 3·5+3I_D 	6·5 4·2+3I_D 8·5	9·0 5+3I_D 10	mA mA mA	V_{CC} = 5·0V, I_D = 1·0µA V_{CC} = 4·5V, $I_D \leqslant$ 1·5mA V_{CC} = 18V, I_D = 1·0µA, V_{REGIN} = 0V
Low voltage supply wrt V_{EEI} &V_{EEO}	4,7	4·5		9·5	V	
High voltage supply wrt V_{REGIN}	4,7	8·4		18	V	$V_{EEI} = V_{EEO} = V_{REG}$ (see Figs. 4 & 6)
Int. regulated voltage, $V_{REG,}$ wrt V_{CCO}	13	5·9	6·2	6·5	V	$V_{CCO}+V_{REGIN}$ = +16V
$\lvert V_{CCI}-V_{CCO}\rvert$	4,7			1·5 1·1	V V	 T_{AMB} = +70°C
Minimum sensitivity of differential input	1,16	9·0 74·0 168·0		2·3 18·5 42·0	nA nA nA	I_D = 1·0µA I_D = 100µA I_D = 0·5mA
Common mode rejection	1,16		35		dB	
Maximum signal input	1,16	3·0	4·0		mA (pk)	
AGC range			68·0		dB	
Output and Stretch output internal pull-up resistance	9, 11		55·0		kΩ	
Stretch output pulse width, t_P	11		2·4		ms	Capacitance pin 9 to pin 10 (C8 on Figs. 4 and 8) = 10nF; $t_P \approx -R_X C_8 \log_e\left[\frac{1{\cdot}5}{V_{CC}}\right]$ ms where R_X = 200kΩ ±25% and R_X = internal resistance)
Temperature coefficient of R_X			0·7		%/°C	
Output low voltage	9			V_{EEO}+0·35	V	I_{SINK} = 0·2mA max.
Output high voltage	9	V_{CCO}−0·5			V	I_{SOURCE} = 5µA
Stretch output low voltage	11			V_{EEO}+0·5	V	I_{SINK} = 1·6mA max.
Stretch output high voltage	11	V_{CCO}−0·1			V	I_{SOURCE} = 5µA, output open circuit
V_{CCI} supply rejection	4		1·5		V (pk)	Ripple amplitude at 100Hz, V_{REGIN} = 0V
			0·8		V (pk)	Ripple amplitude at 100Hz, V_{EEO} and V_{EEI} = 0V

NOTE 1. I_D = IR diode forward current

APPLICATION NOTES - REFER TO FIG. 4

Diode Anode and Cathode (Pins 1 and 16) The infra-red receiving diode is connected between pins 1 and 16. The input circuit is configured so as to reject signals common to both pins. This improves the stability of the device, and greatly reduces the sensitivity to radiated electrical noise, The diode is reverse biased by a nominal 0·65V

Gyrator C2 and C1 (Pins 2 and 3) The decoupling, provided by gyrator C2 and C1, rolls off the gain of the feedback loop which balances the DC component of the infra-red diode current. The values of C2 and C1 are chosen to produce a low frequency cut-off characteristic below a nominal 2kHz. Hence, the gyrator produces approximately 20dB rejection at 100Hz.

The gyrator consists of two feedback loops operating in tandem. Only one feedback path is functional when the DC component of the diode current is less than 200µA. This loop is decoupled by gyrator C2. For diode currents between 200µA and 1·5mA the second control loop is operative, and this is decoupled by gyrator C1.

The decoupling capacitors, gyrator C2 and C1, must be connected between pins 2 and 3, to pin 4. The series impedance of C2 and C1 should be kept to a minimum.

First Stage Decouple (Pin 15) The capacitor on pin 15 decouples the signal from the non-inverting input of the first difference amplifier (see also Fig. 2). The capacitance of 15nF is chosen to produce a 2kHz low frequency roll-off. The capacitor must be connected between pins 15 and 14 (the input ground).

Second Stage Decouple (Pin 5) The capacitor on pin 5 decouples the signal from the non-inverting input of the second difference amplifier. The capacifance of 33nF is chosen to produce a 2kHz low frequency roll-off. The capacitor must be connected between pins 5 and 4 (the input V_{CC}).

Fourth Stage Decouple (Pin 6) The capacitor on pin 6 decouples the signal from the non-inverting input of the fourth difference amplifier. The capacitance of 4.7nF is chosen to produce a 2kHz low frequency roll-off. The capacitor must be connected between pins 6 and 7 (the output V_{CC}).

AGC Decouple/Delay Adjust (Pin 8) The output of the fourth difference amplifier is followed by a peak detector, which is used to provide an AGC control level. This produces a current source which is limited to 10mA at pin 8. The AGC decoupling capacitor (C5 normally 150nF) filters the pulsed input, and the resultant level controls the gain of the first three difference amplifiers.

The AGC control level exhibits a fast attack/slow decay characteristic. Immediately infra-red pulses are detected, the gain will be reduced, so that any weaker noise pulses that are also received will not be seen at the output. Thus, provided the infra-red pulses are the most intense, it is possible to receive data in noisy environments. The slow decay keeps the AGC level intact during data reception, and produces a delay before any received noise may become present at the output, when transmission ceases.

Output (Pin 9) The output will be low, pulsing high with a source impedance of a nominal 55kΩ , for a received infra-red pulse. It is a linear amplification of the input and swings between output ground and output V_{CC}.

Stretch Input and Stretch Output (Pins 10 and 11) A typical infra-red PPM system transmits very narrow pulses. The duration of these pulses is typically 15µs, so in order to use a microprocessor-based decoder system it is necessary to lengthen the received pulse. This stretched output can be obtained from pin 11 when a capacitor is connected between pins 9 and 10 (C8 in Fig. 4).

The width of the pulse is determined by the value of this coupling capacitor and is defined in the Electrical Characteristics. The stretch output is normally high, pulsing low for a received infra-red pulse and swings between V_{CCO} and V_{EEO}.

It must be noted that the stretch output logic sense is inverse to that of the output on pin 9 so must be re-inverted for microprocessor applications.

Regulator Input, V_{REGIN} (Pin 12) The device can be operated with supplies of between 4·5V and 9·0V connected between input/output ground (pins 14 and 13) and input and output V_{CC} (pins 4 and 7) as shown in Fig. 3. The device can also be operated with supplies in excess of 9·0V by using the on-chip regulator. In this case connections are made between V_{CCO} (pin 7) and the regulator input V_{REGIN}(pin 12) as shown in Fig. 4. A supply voltage of between 9·0V and 18V will then cause V_{EEO} (pin 13) to be regulated at a level nominally 6·4V below V_{CCO}(pin 7). The regulator will, however, lose control with a potential difference of less than 9·0V. Below this level the voltage on pin 13 will track nominally 1·5V above the level of pin 12. When the regulator is not used (low voltage operation), pin 12 must be connected to V_{EEO} (pin 13).

OPERATING NOTES - REFER TO FIGS. 3 AND 4

Gyrator C1 (Pin 3) If the environment in which the device is operating limits the background light such that the DC component of the diode current has a maximum of 200µA, it may be desirable to omit (as in Fig. 3) the more bulky and costly 68µF capacitor (gyrator C1 shown in Fig. 4). In this case pin 3 can be left open circuit. The resultant application will then have a characteristic of greatly reduced gain when the ambient light causes the DC current to rise above this threshold. Alternatively,the 68µF capacitor can be replaced by a resistor.

The outcome of this is to further reduce the gain in ambient light levels above the 200µA threshold. Below this threshold the overall gain is slightly enhanced as the light level approaches the threshold value. If chosen, this resistance should lie between 10kΩ and 200kΩ .

Noise Immunity The stretch output can also be used as a means of improving performance relating to a receiver system, over and above its main purpose of providing a microprocessor interface. Including C8 (Fig. 4) causes the output pulses (from pin 9) to be subjected to the stretch input threshold. Thus any noise pulses from pin 9 that are below this threshold will not be seen at the stretch output (pin 11). A further improvement can be made, using this stretch input threshold, by including some additional filtering of the output (C10 in Fig. 4). This can be adjusted in value (typically 100pF) to reduce some of the noise pulses that otherwise cross the threshold, to a level below the threshold.

Screening Use of screening for the device, and associated components, improves the performance and immunity to externally radiated noise. The screening method used must protect the sensitive front-end of the device; provided that the diode, pin 1-pin 16, C2 (pin 2) and the first stage decoupling (pin 15) are screened, it may be found that for the application considered, the remalning circuitry need not be so protected. In applications where externally radiated noise is minimal, it may be possible to reduce any screening to pins 1 and 16 and the diode connections only. Screening may not be necessary in some instances, but this largely depends on the level of radiated noise, the decoupling/filtering employed and the receiver's decoding technique.

Decoupling Typical decoupling arrangements for use with or without the regulator are given in Figs. 4 and 3, respectively. When using the regulator, further improvements in high frequency supply rejection are possible by the inclusion of R2. The value can be chosen so as to keep the pin 12 end of R2 within the $-9{\cdot}0$ to -18V (wrt pin 7) specified voltage range. For example, if the SL486 is used in a system with a supply of 16V, a typical value tor R2 would be 200Ω. Note that the regulator is a low impedance point between pins 12 and 13. C7 thus maintains a low impedance path between pins 4 and 12 at high frequencies.

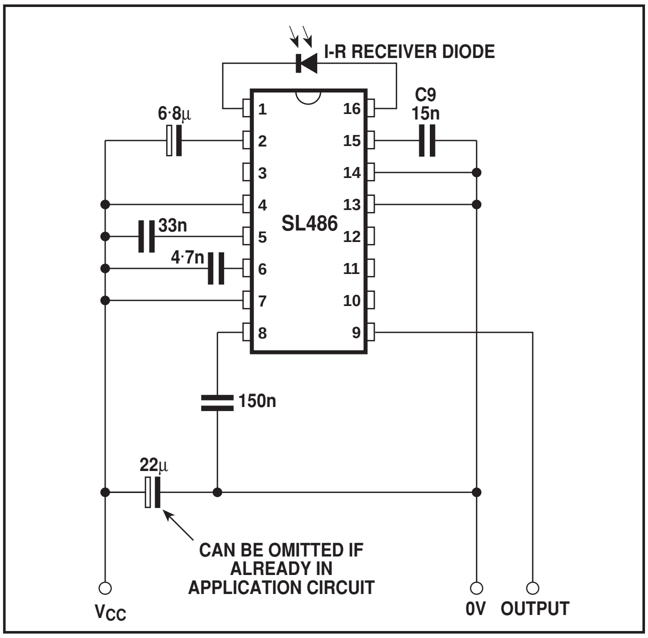


Fig. 3 Circuit diagram of minimum component application (low voltage operation)

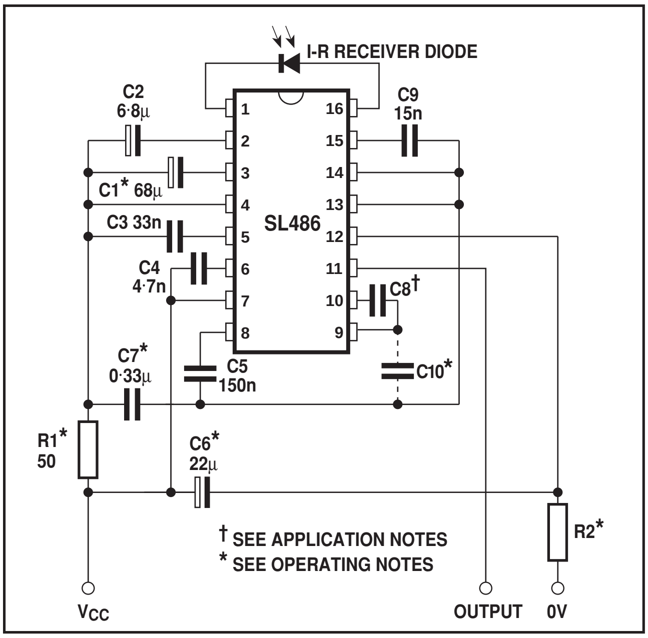


Fig. 4 SL486 application diagram showing all optional components (Note: supply decoupling and connections for use of voltage regulator, also pulse stretch output)

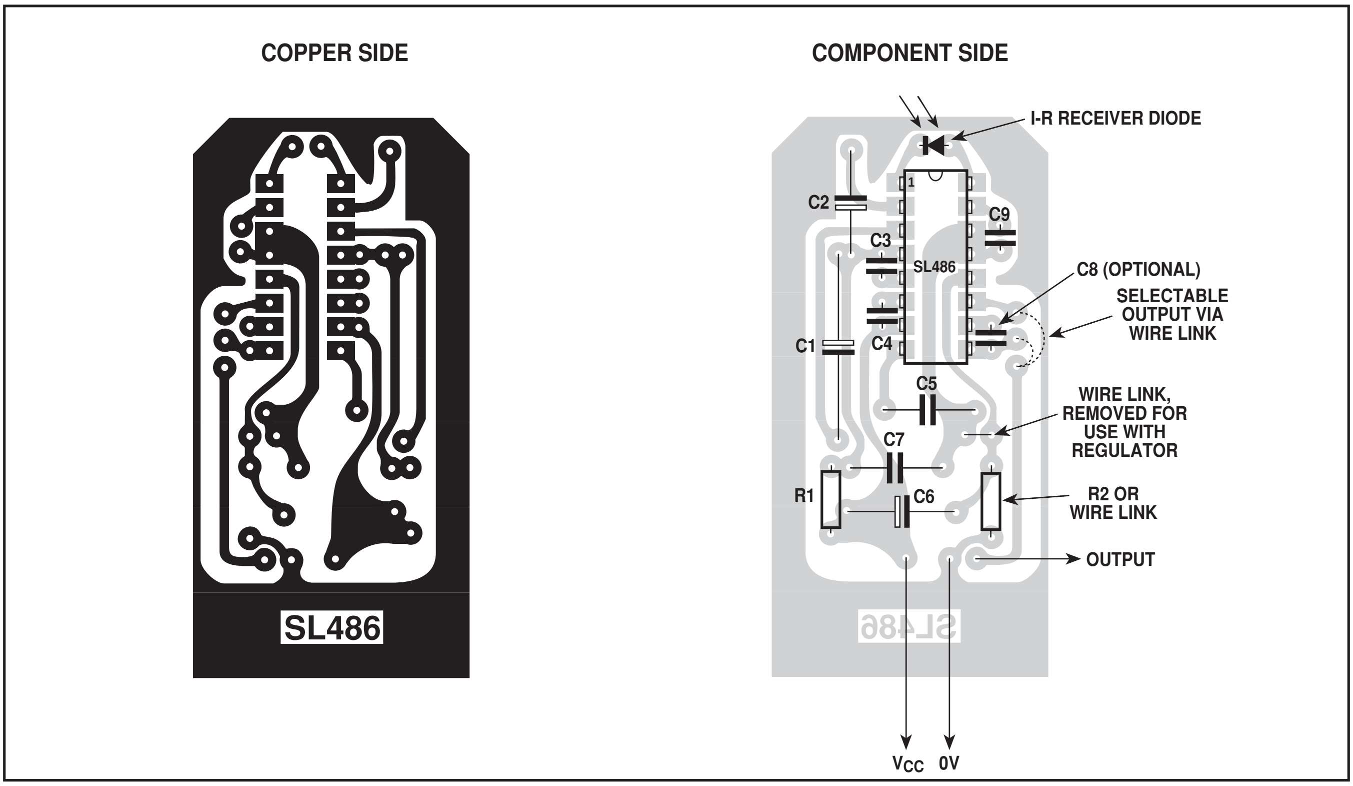


Fig. 5 PCB track (actual size)and component layout for the circuit of Fig. 4, using SL486 in DP16 package

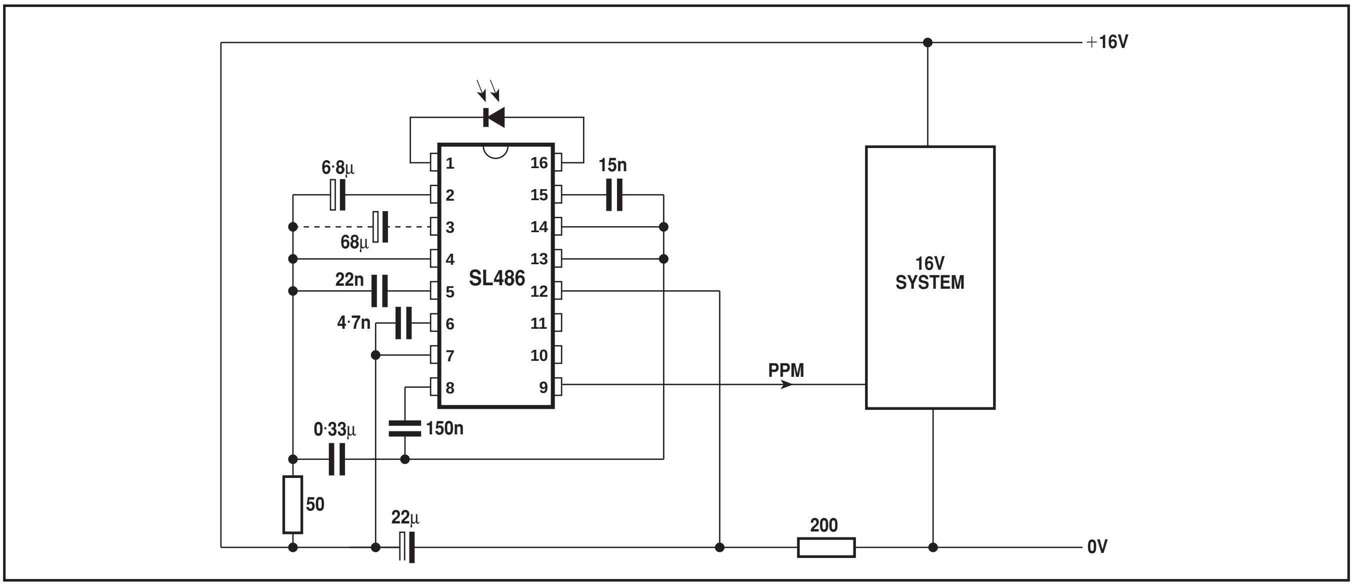


Fig. 6 SL486 application showing the use of the on-chip regulator

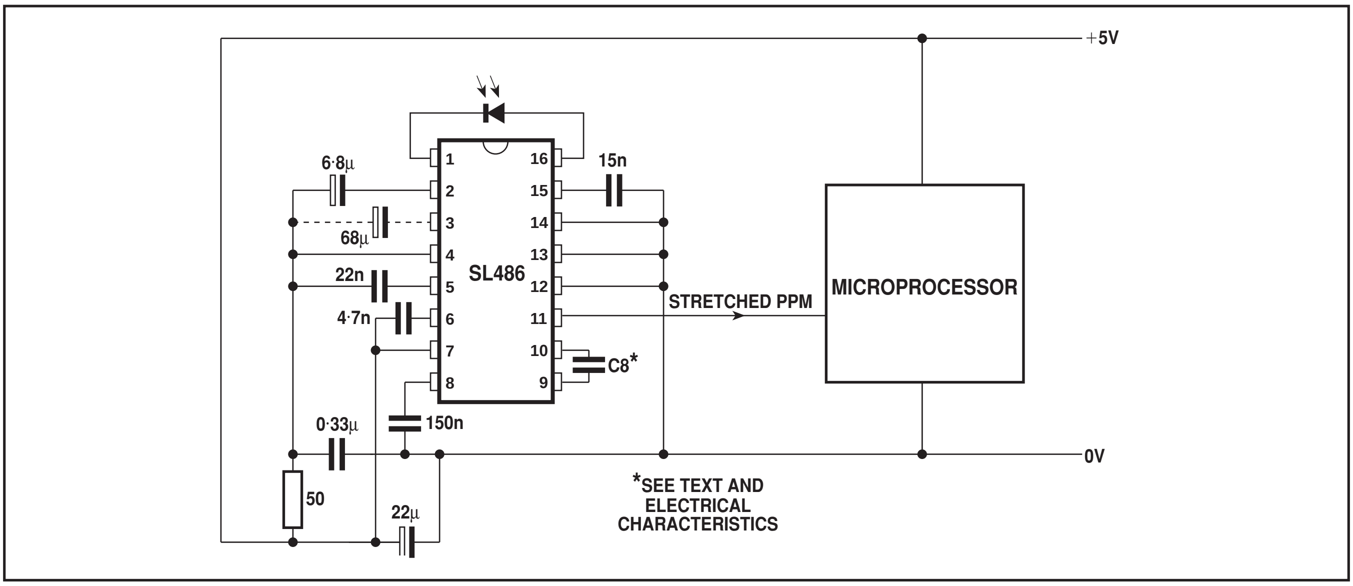
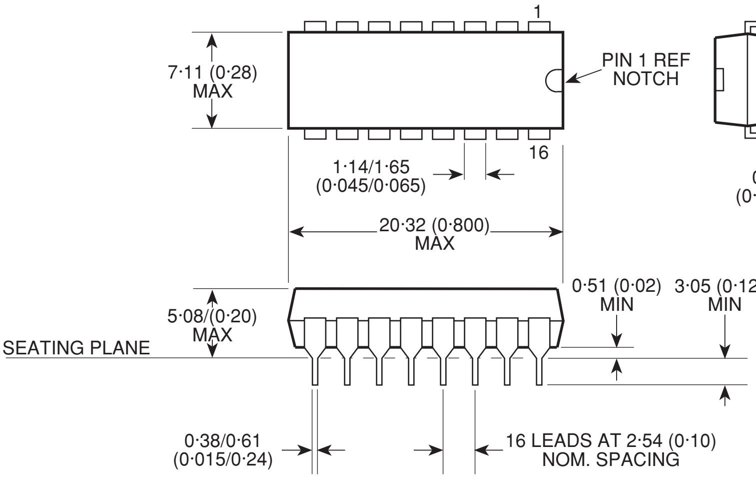


Fig. 7 Microprocessor interface, using the SL486 pulse stretching facility

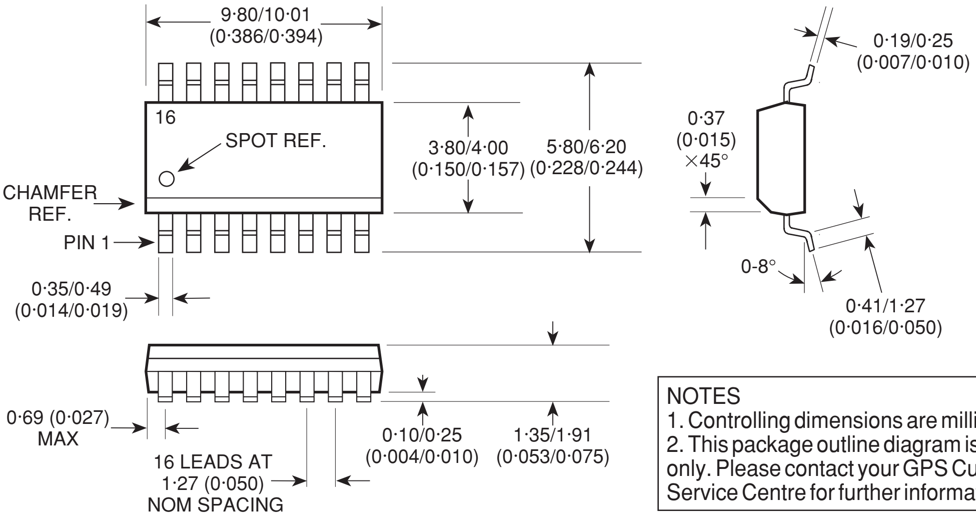
PACKAGE DETAILS

Dimensions are shown thus: mm (in)



NOTES
1. Controlling dimensions are inches.
2. This package outline diagram is for guidance only. Please contact your GPS Customer Service Centre for further information.

16-LEAD PLASTIC DIL – DP16



NOTES
1. Controlling dimensions are millimetres.
2. This package outline diagram is for guidance only. Please contact your GPS Customer Service Centre for further information.

16-LEAD MINIATURE PLASTIC DIL - MP16

GEC PLESSEY
SEMICONDUCTORS

HEADQUARTERS OPERATIONS
GEC PLESSEY SEMICONDUCTORS
Cheney Manor, Swindon,
Wiltshire SN2 2QW, United Kingdom.
Tel: (0793) 518000
Fax: (0793) 518411

GEC PLESSEY SEMICONDUCTORS
P.O. Box 660017
1500 Green Hills Road,
Scotts Valley, CA95067-0017
United States of America.
Tel (408) 438 2900
Fax: (408) 438 5576

CUSTOMER SERVICE CENTRES

- **FRANCE & BENELUX** Les Ulis Cedex Tel: (1) 64 46 23 45 Fax : (1) 64 46 06 07
- **GERMANY** Munich Tel: (089) 3609 06-0 Fax : (089) 3609 06-55
- **ITALY** Milan Tel: (02) 66040867 Fax: (02) 66040993
- **JAPAN** Tokyo Tel: (3) 5276-5501 Fax: (3) 5276-5510
- **NORTH AMERICA** Scotts Valley, USA Tel: (408) 438 2900 Fax: (408) 438 7023.
- **SOUTH EAST ASIA** Singapore Tel: (65) 3827708 Fax: (65) 3828872
- **SWEDEN** Stockholm Tel: 46 8 702 97 70 Fax: 46 8 640 47 36
- **UK, EIRE, DENMARK, FINLAND & NORWAY**
  Swindon Tel: (0793) 518510 Fax : (0793) 518582

These are supported by Agents and Distributors in major countries world-wide.

For more information about all Zarlink products visit our Web Site at

www.zarlink.com

Information relating to products and services furnished herein by Zarlink Semiconductor Inc. or its subsidiaries (collectively “Zarlink”) is believed to be reliable. However, Zarlink assumes no liability for errors that may appear in this publication, or for liability otherwise arising from the application or use of any such information, product or service or for any infringement of patents or other intellectual property rights owned by third parties which may result from such application or use. Neither the supply of such information or purchase of product or service conveys any license, either express or implied, under patents or other intellectual property rights owned by Zarlink or licensed from third parties by Zarlink, whatsoever. Purchasers of products are also hereby notified that the use of product in certain ways or in combination with Zarlink, or non-Zarlink furnished goods or services may infringe patents or other intellectual property rights owned by Zarlink.

This publication is issued to provide information only and (unless agreed by Zarlink in writing) may not be used, applied or reproduced for any purpose nor form part of any order or contract nor to be regarded as a representation relating to the products or services concerned. The products, their specifications, services and other information appearing in this publication are subject to change by Zarlink without notice. No warranty or guarantee express or implied is made regarding the capability, performance or suitability of any product or service. Information concerning possible methods of use is provided as a guide only and does not constitute any guarantee that such methods of use will be satisfactory in a specific piece of equipment. It is the user’s responsibility to fully determine the performance and suitability of any equipment using such information and to ensure that any publication or data used is up to date and has not been superseded. Manufacturing does not necessarily include testing of all functions or parameters. These products are not suitable for use in any medical products whose failure to perform may result in significant injury or death to the user. All products and materials are sold and services provided subject to Zarlink’s conditions of sale which are available on request.

Purchase of Zarlink’s I^2C components conveys a licence under the Philips I^2C Patent rights to use these components in and I^2C System, provided that the system conforms to the I^2C Standard Specification as defined by Philips.

Zarlink, ZL and the Zarlink Semiconductor logo are trademarks of Zarlink Semiconductor Inc.

Copyright Zarlink Semiconductor Inc. All Rights Reserved.

TECHNICAL DOCUMENTATION - NOT FOR RESALE