



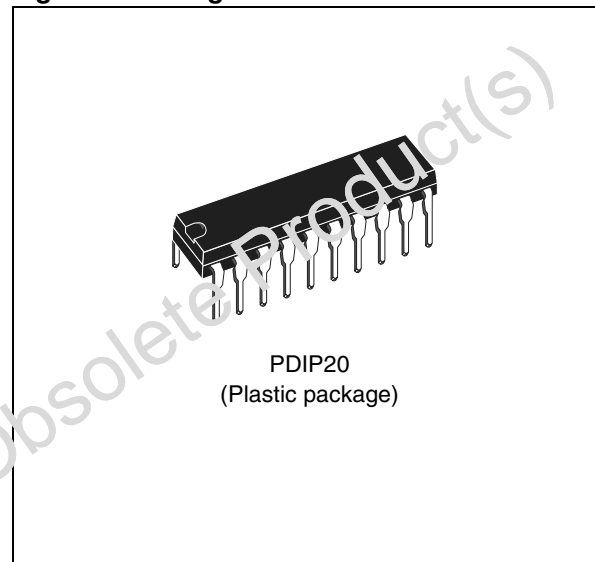
LED DISPLAY DRIVER

FEATURES SUMMARY

- 2 DIGIT LED DRIVER (14 segments)
- CURRENT GENERATOR OUTPUTS (no resistor required)
- CONTINUOUS BRIGHTNESS CONTROL
- SERIAL DATA INPUT
- DATA ENABLE
- WIDE SUPPLY VOLTAGE OPERATION
- TLL COMPATIBILITY
- APPLICATION EXAMPLES
- MICROPROCESSOR DISPLAYS
- INDUSTRIAL CONTROL INDICATOR
- RELAY DRIVER
- INSTRUMENTATION READOUTS

through a variable resistor connected either to V_{DD} or to a separate supply of 13.2V maximum. The M5481 is a pin-to-pin replacement of the NS MM 5481.

Figure 1. Package



PDIP20
(Plastic package)

DESCRIPTION

The M5481 is a monolithic MOS integrated circuit produced with a N-channel silicon gate technology. It uses the M5450 die packaged in a 20-pin plastic package copper frame, making it ideal for a 1-digit display. A single pin controls the LED display brightness by setting a reference current

Figure 2. Pin Connections

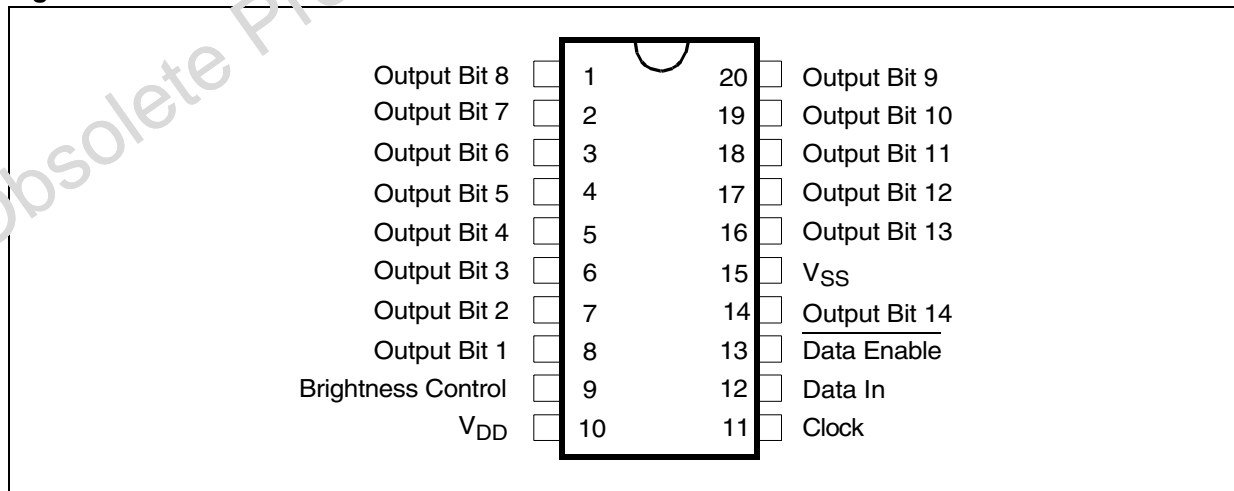


Figure 3. Block Diagram

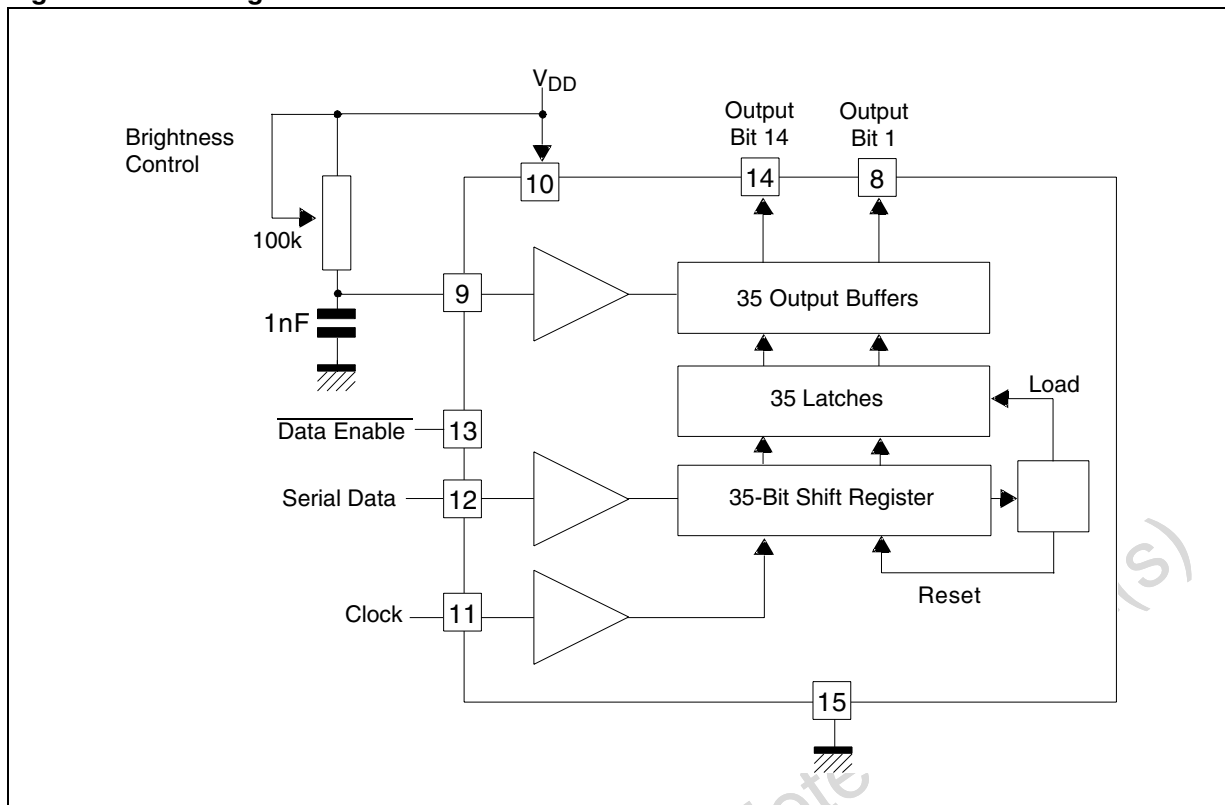


Table 1. Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|--------------|---|-------------|------|
| V_{DD} | Supply Voltage | - 0.3 to 15 | V |
| V_I | Input Voltage | - 0.3 to 15 | V |
| $V_{O(off)}$ | Off State Output Voltage | 15 | V |
| I_o | Output Sink Current | 40 | mA |
| P_{TOT} | Total Package Power Dissipation at 25°C | 1.5 | W |
| | Total Package Power Dissipation at 85°C | 800 | mW |
| T_j | Junction Temperature | 150 | °C |
| T_{OP} | Operating Temperature Range | - 25 to 85 | °C |
| T_{STG} | Storage Temperature Range | - 65 to 150 | °C |

Note: Stresses exceeding those listed under "Absolute Maximum Ratings" may cause permanent damage to the device and affect its reliability.

Table 2. Static Electrical Characteristics(T_{amb} within operating range, V_{DD} = 4.75V to 13.2V, V_{SS} = 0V, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------------|---|--|---------------------|------|-----------------|------|
| V _{DD} | Supply Voltage | | 4.5 | | 13.2 | V |
| I _{DD} | Supply Current | V _{DD} = 13.2V | | | 7 | mA |
| V _I | Input Voltage Logical "0" Level Logical "1" Level | ± 10μA Input Bias | - 0.3 | | 0.8 | V |
| | | 4.75 ≤ V _{DD} ≤ 5.25 | 2.2 | | V _{DD} | V |
| | | V _{DD} > 5.25 | V _{DD} - 2 | | V _{DD} | V |
| I _B | Brightness Input Current (note 2) | | 0 | | 0.75 | mA |
| V _B | Brightness Input Voltage (pin 9) | Input Current = 750μA, T _{amb} = 25°C | 3 | | 4.3 | V |
| V _{O(off)} | Off State Out. Voltage | | | | 13.2 | V |
| I _O | Out. Sink Current (note 3) Segment OFF Segment ON | V _O = 3V | | | 10 | μA |
| | | V _O = 1V (note 4) | | | | |
| | | Brightness In. = 0μA | 0 | | 10 | μA |
| | | Brightness In. = 100μA | 2 | 2,7 | 4 | mA |
| | | Brightness In. = 750μA | 12 | 15 | 25 | mA |
| f _{clock} | Input Clock Frequency | | 0 | | 0.5 | MHz |
| I _O | Output Matching (note 1) | | | | ± 20 | % |

Note: 1. Output matching is calculated as the percent variation from $I_{MAX} + I_{MIN}/2$.

2. With a fixed resistor on the brightness input some variation in brightness will occur from one device to another.

3. Absolute maximum for each output should be limited to 40mA.

4. The V_O voltage should be regulated by the user.**FUNCTIONAL DESCRIPTION**

The M5481 uses the M5450 die which is packaged to operate 2-digit alphanumeric displays with minimal interface with the display and the data source.

Serial data transfer from the data source to the display driver is accomplished with 2 signals, serial data and clock. using a format of a leading "1" followed by the 35 data bits allows data transfer without an additional load signal.

The 35 data bits are latched after the 36th bit is complete, thus providing non-multiplexed, direct drive to the display. Outputs change only if the serial data bits differ from the previous time. Display brightness is determined by control of the output current for LED displays. A 1nF capacitor should

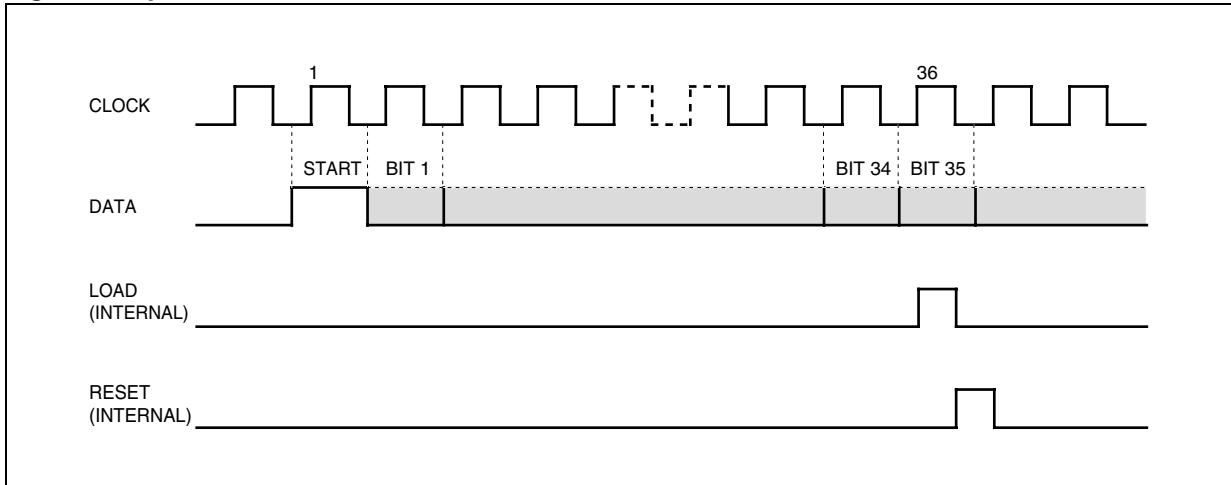
be connected to brightness control (pin 9) to prevent possible oscillations.

A block diagram is shown on Figure 3. The output current is typically 20 times greater than the current into pin 9, which is set by an external variable resistor.

The latter is an internal limiting resistor of 400Ω nominal value.

Figure 4 shows the input data format. A start bit of logical "1" precedes the 35 bits of data. At the 36th clock a LOAD is generated synchronously with the high state of the clock, which loads the 35 bits of the shift registers into the latches.

Figure 4. Input Data Format



At the low state of the clock a RESET signal is generated which clears all the shift registers for the next set of data. The shift registers are static master slave configurations. There is no clear for the master portion of the first shift register, thus allowing continuous operation.

There must be a complete set of 36 clocks or the shift registers will not clear.

When power is first applied to the chip an internal power ON reset signal is generated which resets all registers and all latches. The START bit and the first clock reset the chip to its normal operation.

Figure 5 shows the timing relationships between Data, Clock and DATA ENABLE.

A maximum clock frequency of 0.5MHz is assumed.

Table 3 shows the Output Data Format for the M5481. Because it uses only 14 of the possible outputs, 21 of the bits (including bit 35 which was already unused in the M5450) are "Don't Cares".

For applications where a lesser number of outputs are used it is possible to either increase the current per output or operate the part at higher than 1V V_{out} .

The following equation can be used for calculations.

$$T_j = [(V_{out}) (I_{LED}) (\text{No. of segments}) + V_{DD} \times 7\text{mA}] \times (80^\circ\text{C/W}) + T_{amb}$$

where:

T_j = junction temperature (150°Cmax)

V_{out} = voltage at the LED driver outputs

I_{LED} = LED current

80°C/W = thermal coefficient of the package

T_{amb} = ambient temperature

Figure 5.

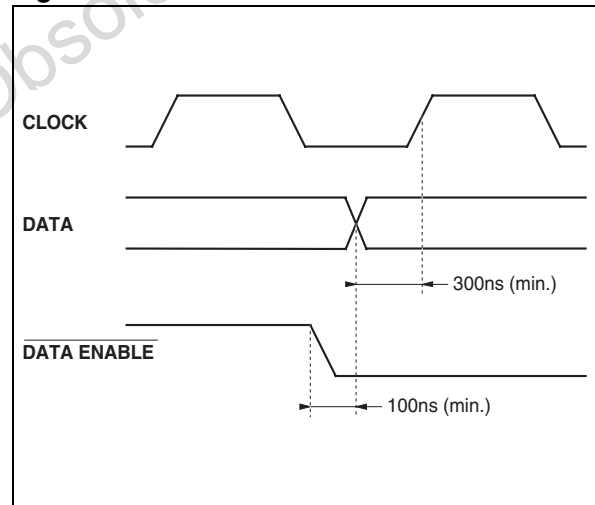
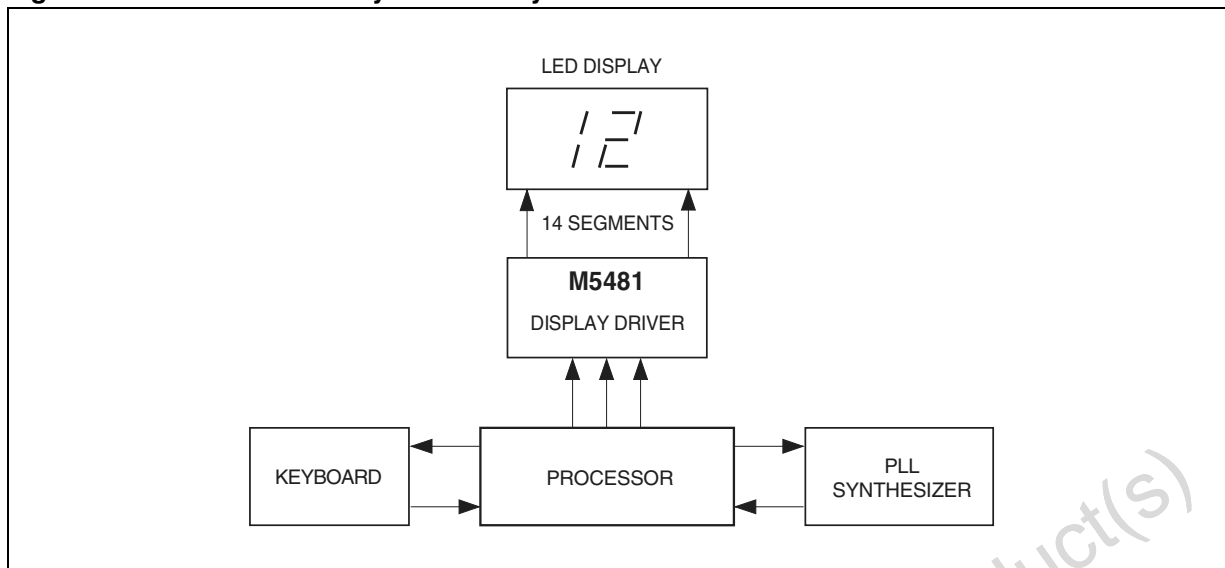


Table 3. Serial Data Bus / Outputs Correspondance

| | | | | | | | | | | | | | | | | | | | |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|-------|
| 5451 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | START |
| 5481 | X | X | X | X | X | 14 | 13 | X | X | X | X | 12 | 11 | 10 | 9 | X | X | X | START |
| 5450 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | START | |
| 5481 | X | 8 | 7 | 6 | 5 | X | X | X | X | 4 | 3 | 2 | 1 | X | X | X | X | START | |

TYPICAL APPLICATION

Figure 6. BASIC electronically tuned TV system



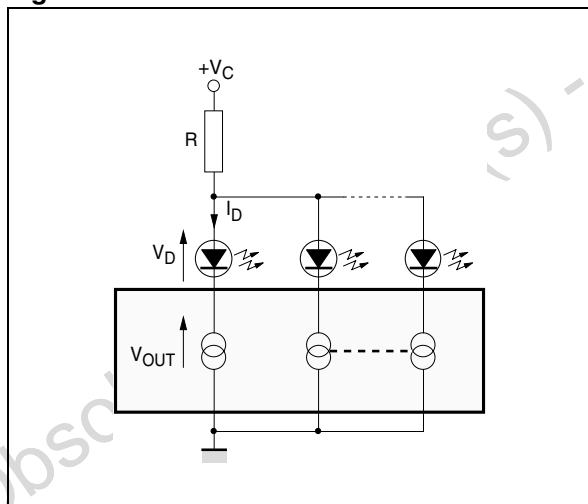
POWER DISSIPATION OF THE IC

The power dissipation of the IC can be limited using different configurations.

In this application R must be chosen taking into account the worst operating conditions.

R is determined by the maximum number of segments activated.

Figure 7.



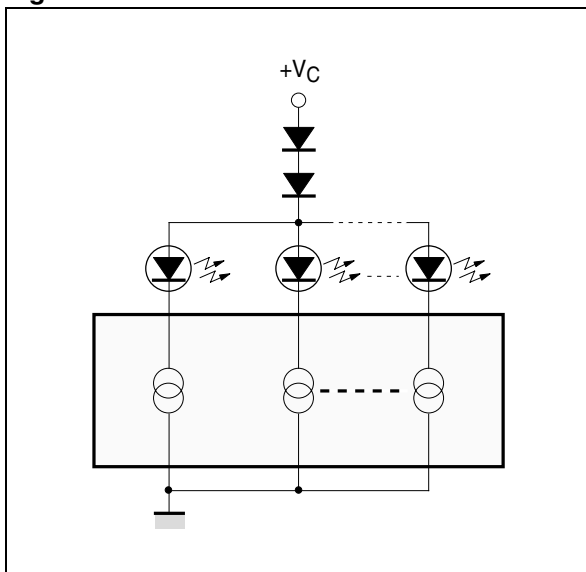
$$R = \frac{V_C - V_{D\text{MAX}} - V_{O\text{MIN}}}{N_{\text{MAX}} I_D}$$

The worst case condition for the device is when roughly half of the maximum number of segments are activated.

It must be checked that the total power dissipation does not exceed the absolute maximum ratings of the device.

In critical cases more resistors can be used in conjunction with groups of segments. In this case the current variation in the single resistor is reduced and P_{tot} limited.

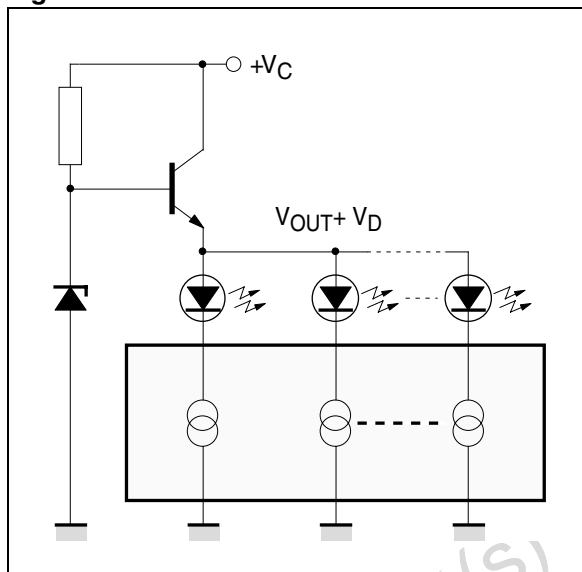
Figure 8.



In this configuration the drop on the serial connected diodes is quite stable if the diodes are properly chosen.

The total power dissipation of the IC depends only, in first approximation, on the number of segments activated.

Figure 9.



In this configuration $V_{OUT} + V_D$ is constant. the total power dissipation of the IC depends only on the number of segments activated.

Obsolete Product(s) - Obsolete Product(s)

PART NUMBERING**Table 4. Order Codes**

| Part Number | Package | Temperature Range |
|-------------|---------|-------------------|
| M5481 B7 | PDIP | -25 to 85 °C |

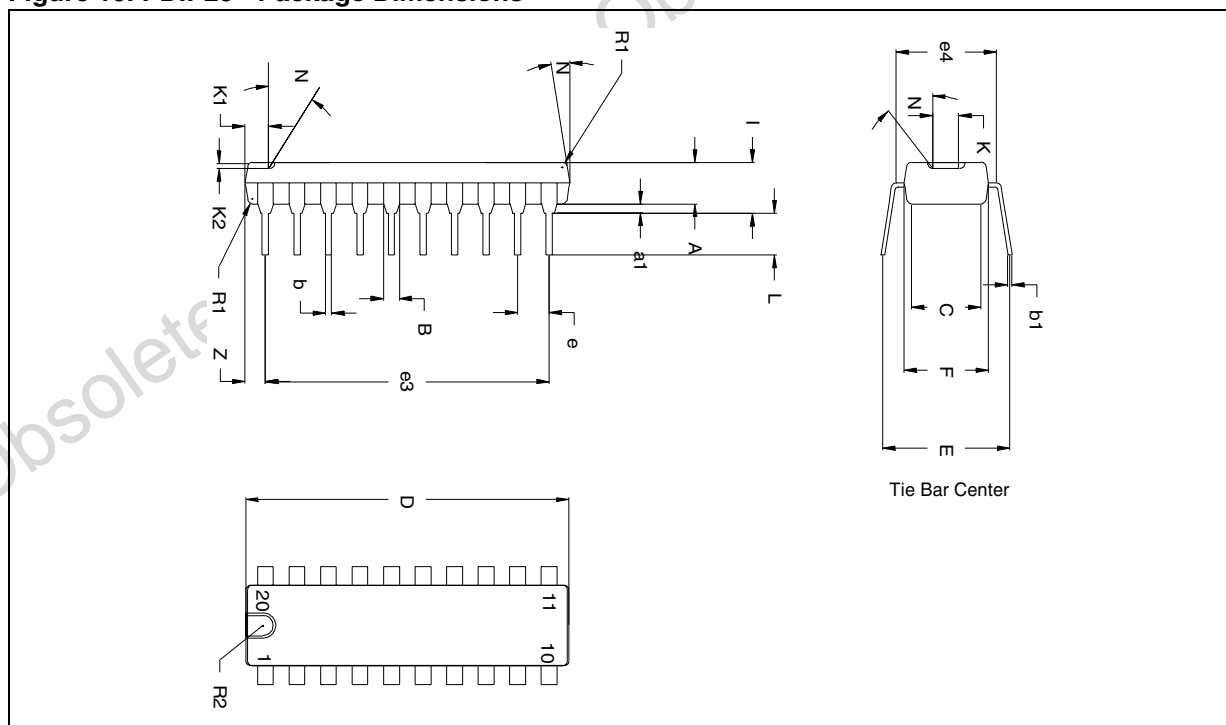
Obsolete Product(s) - Obsolete Product(s)

PACKAGE MECHANICAL

Table 5. PDIP20 - Mechanical Data

| Symbol | millimeters | | | inches | | |
|--------|-------------|-------|-------|--------|-------|-------|
| | Typ | Min | Max | Typ | Min | Max |
| A | 3.25 | 3.30 | 3.35 | 0.128 | 0.130 | 0.132 |
| a1 | | 0.508 | | | 0.020 | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | 0.381 | 0.457 | 0.533 | 0.015 | 0.018 | 0.021 |
| b1 | 0.20 | 0.254 | 0.30 | 0.008 | 0.010 | 0.012 |
| C | 5.20 | 5.33 | 5.46 | 0.205 | 0.210 | 0.215 |
| D | 24.9 | 25.15 | 25.4 | 0.980 | 0.990 | 1.000 |
| E | 7.8 | 8.5 | 9.1 | 0.307 | 0.335 | 0.358 |
| e | 2.29 | 2.54 | 2.79 | 0.090 | 0.100 | 0.110 |
| e3 | 22.60 | 22.86 | 23.11 | 0.890 | 0.900 | 0.910 |
| e4 | 7.36 | 7.62 | 7.87 | 0.290 | 0.300 | 0.310 |
| F | 6.22 | 6.35 | 6.50 | 0.245 | 0.250 | 0.255 |
| I | 3.42 | 3.68 | 3.93 | 0.135 | 0.145 | 0.155 |
| L | 3.17 | 3.30 | 3.42 | 0.125 | 0.130 | 0.135 |
| N | | 7d | | | 7d | |
| R1 | | 0.152 | | | 0.006 | |
| R2 | | 0.762 | | | 0.030 | |
| K | | 1.524 | | | 0.060 | |
| K1 | | 0.762 | | | 0.030 | |
| K2 | | 0.762 | | | 0.030 | |
| Z | | 1.27 | 1.34 | | 0.050 | 0.053 |

Figure 10. PDIP20 - Package Dimensions



Note: Drawing is not to scale

REVISION HISTORY**Table 6. Revision History**

| Date | Revision | Description of Changes |
|--------------|-----------------|---------------------------------------|
| October-2000 | 1 | First Issue |
| 14-Apr-2004 | 2 | Stylesheet update. No content change. |

Obsolete Product(s) - Obsolete Product(s)

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics.
All other names are the property of their respective owners

© 2004 STMicroelectronics - All rights reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States

www.st.com