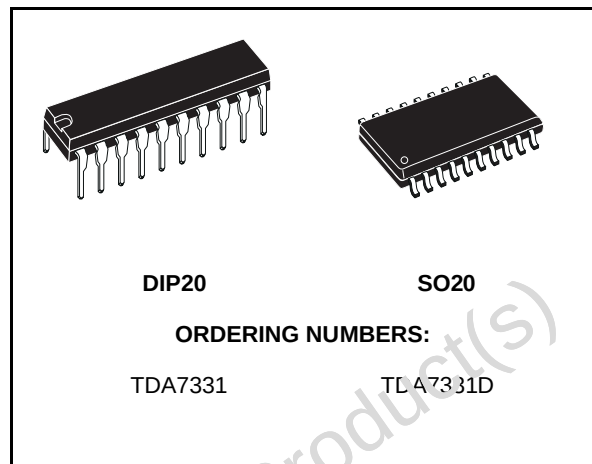




# TDA7331

## SINGLE CHIP RDS DEMODULATOR + FILTER

- VERY HIGH RDS DEMODULATION QUALITY WITH IMPROVED DIGITAL SIGNAL PROCESSING
- HIGH PERFORMANCE, 57KHz BANDPASS FILTER (8th ORDER)
- PURELY DIGITAL RDS DEMODULATION WITHOUT EXTERNAL COMPONENTS
- ARI INDICATION AND RDS SIGNAL QUALITY OUTPUTS
- 4.332MHz CRYSTAL OSCILLATOR (8.664 and 17.328MHz SELECTABLE OPTIONS)
- LOW NOISE CMOS TECHNOLOGY
- LOW RADIATION



### DESCRIPTION

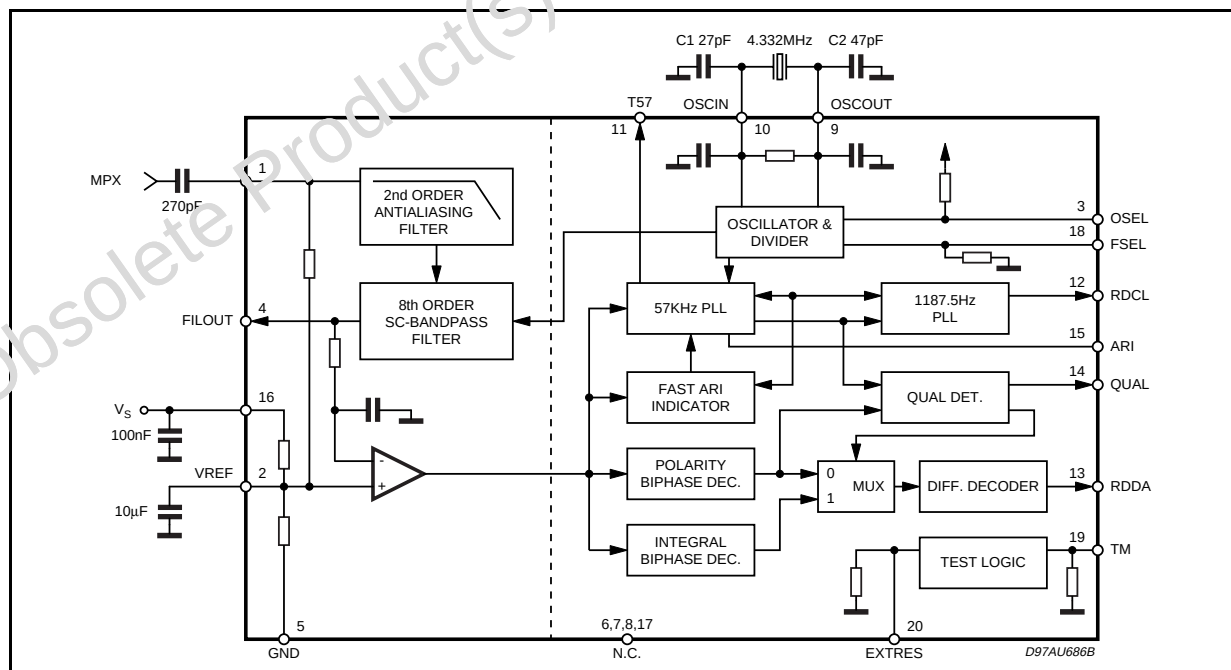
The TDA7331, an improved version of TDA7330B, recovers the additional inaudible RDS information which is transmitted by FM radio broadcasting stations and operates in accordance with the EBU (European Broadcasting Union) specifications.

The device is made up of two sections: a cas-

caded antialiasing + switched capacitors band-pass filter for precise RDS band selection and a demodulating section that performs the extraction of RDS data stream (RDDA) and clock (RDCL), to be further processed by a suitable RDS decoder.

Outputs for RDS signal quality and ARI indication are also present.

### BLOCK DIAGRAM and TEST CIRCUIT



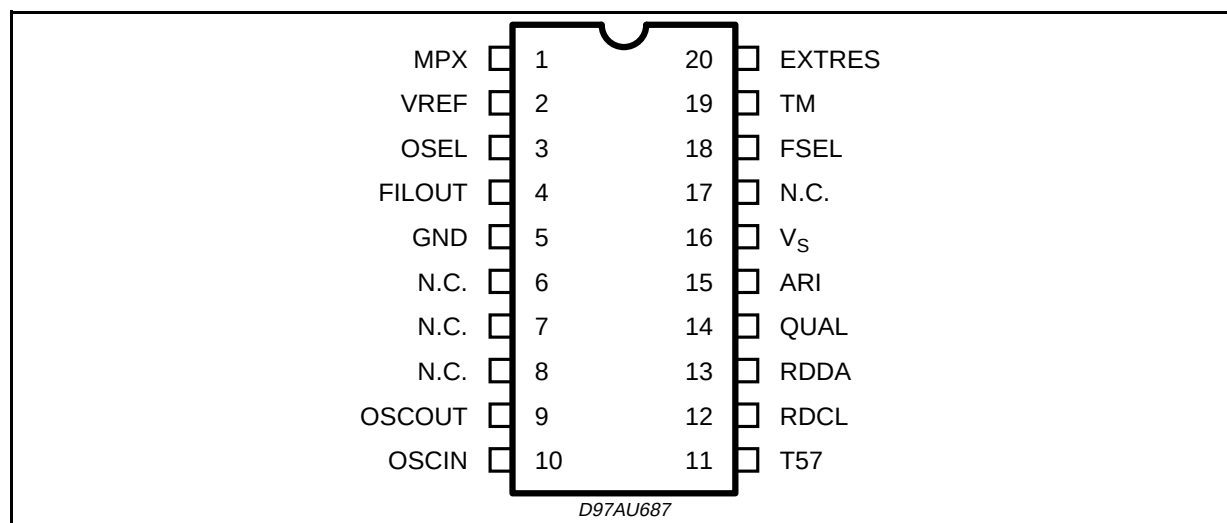
## ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                   | Value      | Unit |
|-----------|-----------------------------|------------|------|
| $V_S$     | Supply Voltage              | 7          | V    |
| $T_{op}$  | Operating Temperature Range | -40 to 85  | °C   |
| $T_{stg}$ | Storage Temperature         | -55 to 150 | °C   |

## PIN FUNCTION

| N° pin | Name   | Functional description                                                                                                                                                    |
|--------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | MPX    | RDS input signal                                                                                                                                                          |
| 2      | VREF   | Reference voltage                                                                                                                                                         |
| 3      | OSEL   | Oscillator selector pin: - open, or closed to $V_S$ = quartz oscillator<br>- closed to GND = external driven                                                              |
| 4      | FILOUT | Filter output                                                                                                                                                             |
| 5      | GND    | Ground                                                                                                                                                                    |
| 6      | nc     | Not connected                                                                                                                                                             |
| 7      | nc     | Not connected                                                                                                                                                             |
| 8      | nc     | Not connected                                                                                                                                                             |
| 9      | OSCOUT | Oscillator output                                                                                                                                                         |
| 10     | OSCIN  | Oscillator input                                                                                                                                                          |
| 11     | T57    | Testing output pin: 57kHz clock output                                                                                                                                    |
| 12     | RDCL   | RDS clock output 1187.5Hz                                                                                                                                                 |
| 13     | RDDA   | RDS data output                                                                                                                                                           |
| 14     | QUAL   | Output for signal quality indication (High = good)                                                                                                                        |
| 15     | ARI    | Output for ARI indication: - high when RDS+ARI are present<br>- high when only ARI is present<br>- low when only RDS is present<br>- undefined when nos signal is present |
| 16     | $V_S$  | Supply voltage                                                                                                                                                            |
| 17     | nc     | Not connected                                                                                                                                                             |
| 18     | FSEL   | Frequency selector pin: - 100K to $V_S$ = 17.328MHz<br>- open = 4.332MHz<br>- closed to $V_S$ = 8.664MHz                                                                  |
| 19     | TM     | Test mode pin: - open = normal operation<br>- closed to $V_S$ = testmode                                                                                                  |
| 20     | EXTRES | Reset pin: - open = run mode<br>- closed to $V_S$ = reset condition                                                                                                       |

## PIN CONNECTION



## THERMAL DATA

| Symbol          | Description                             | DIP20 | SO20 | Unit |
|-----------------|-----------------------------------------|-------|------|------|
| $R_{th\ j-amb}$ | Thermal Resistance Junction-Ambient Max | 100   | 200  | °C/W |

ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^{\circ}\text{C}$ ,  $V_S = 5\text{V}$ , unless otherwise specified).

| Symbol | Parameter      | Test Condition | Min. | Typ. | Max. | Unit |
|--------|----------------|----------------|------|------|------|------|
| $V_S$  | Supply voltage |                | 4.5  | 5    | 5.5  | V    |
| $I_S$  | Supply current |                |      | 7.5  | 11.0 | mA   |

## FILTER

|           |                          |                                                                                 |      |         |            |                                        |
|-----------|--------------------------|---------------------------------------------------------------------------------|------|---------|------------|----------------------------------------|
| $f_C$     | Center frequency         |                                                                                 | 56.5 | 57      | 57.5       | kHz                                    |
| BW        | 3dB Bandwidth            |                                                                                 | 2.5  | 3       | 3.5        | kHz                                    |
| G         | Gain                     | $f = 57\text{kHz}$                                                              | 18   | 20      | 22         | dB                                     |
| A         | Attenuation              | $\Delta f \pm 4\text{kHz}$                                                      | 18   | 22      |            | dB                                     |
|           |                          | $f = 38\text{kHz}$                                                              | 50   | 60      |            | dB                                     |
|           |                          | $f = 67\text{kHz}$                                                              | 35   | 45      |            | dB                                     |
| $R_I$     | Input impedance of MPX   |                                                                                 | 80   | 120     | 150        | K $\Omega$                             |
| $R_L$     | Load impedance on FILOUT |                                                                                 | 1    |         |            | M $\Omega$                             |
| S/N       | Signal to noise ratio    | $V_{IN} = 3\text{mV}_{RMS}$                                                     | 30   | 40      |            | dB                                     |
| $V_{IN}$  | MPX input signal         | $f = 19\text{kHz}$ ; $T_3 \leq 40\text{dB}(1)$<br>$f = 57\text{kHz}$ (RDS+ ARI) |      |         | 1000<br>50 | $\text{mV}_{RMS}$<br>$\text{mV}_{RMS}$ |
| $V_{REF}$ | Reference                |                                                                                 |      | $V_S/2$ |            | V                                      |

## DEMODULATOR

Input pins (EXTRES, FSEL, TM)  
Input pin (OSEL)

all with internal pull down resistor  
with internal pull up resistor

|          |                    |                                        |                 |                 |                 |               |
|----------|--------------------|----------------------------------------|-----------------|-----------------|-----------------|---------------|
| $I_{PD}$ | Input Current      | $V_{IN} = 5\text{V}$ (pull-down input) | 15              |                 | 30              | $\mu\text{A}$ |
| $I_{PU}$ | Input Current      | $V_{IN} = 0\text{V}$ (pull-up input)   | -25             |                 | -10             | $\mu\text{A}$ |
| $V_{IH}$ | Input voltage high |                                        | $0.7 \cdot V_S$ | $0.8 \cdot V_S$ |                 | V             |
| $V_{IL}$ | Input voltage low  |                                        |                 | $0.2 \cdot V_S$ | $0.3 \cdot V_S$ | V             |

## Output pins (RDCL, RDDA, ARI, QUAL, T57)

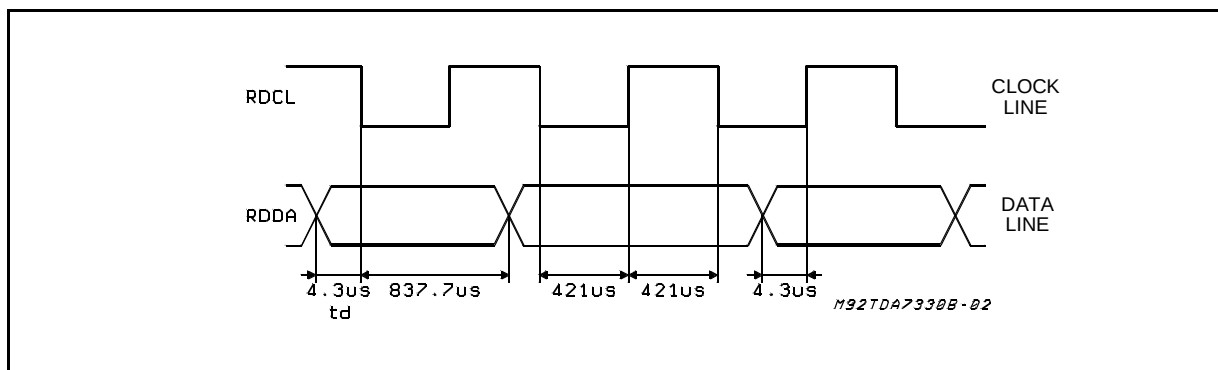
|          |                     |                      |   |     |   |   |
|----------|---------------------|----------------------|---|-----|---|---|
| $V_{OH}$ | Output voltage high | $I_L = 0.5\text{mA}$ | 4 | 4.6 |   | V |
| $V_{OL}$ | Output voltage low  | $I_L = 0.5\text{mA}$ |   | 0.4 | 1 | V |

## OSCILLATOR

|           |                                         |                                       |   |     |   |      |
|-----------|-----------------------------------------|---------------------------------------|---|-----|---|------|
| $V_{CLL}$ | Input level OSCIN pin                   | OSEL = open circuit                   |   |     | 1 | V    |
| $V_{CLH}$ | Input level OSCIN pin                   | OSEL = open circuit                   | 4 |     |   | V    |
|           | Amplitude OSCOUT                        | OSEL = open circuit                   |   | 4.5 |   | V    |
| $V_{PP}$  | Amplitude OSCIN<br>(for external drive) | OSEL = GND,<br>$f = 4.332\text{MHz}$  |   | 100 |   | mVpp |
|           |                                         | OSEL = GND,<br>$f = 8.664\text{MHz}$  |   | 120 |   | mVpp |
|           |                                         | OSEL = GND,<br>$f = 17.328\text{MHz}$ |   | 150 |   | mVpp |

(1) The 3rd harmonic (57kHz) must be less than -40dB with respect to the input signal plus gain.

Figure 1. RDS timing diagram



### OUTPUT TIMING

The RDS (1187.5Hz) output clock on RDCL line is synchronized to the incoming data.

According to the internal PLL lock condition data change can result on the falling or on the rising clock edge. (see Fig. 1)

Whichever clock edge is used by the decoder (rising or falling edge) the data will remain valid for 416.7 µsec after the clock transition.

### OSCILLATOR CONTROLS (FSEL, OSEL)

Three different crystal frequencies can be used. The adaption of the internal clock divider to the external crystal is achieved via the input pin FSEL. See the followings table for reference:

| Crystal   | FSEL (pin configuration)        |
|-----------|---------------------------------|
| 4.332MHz  | connected to GND or open        |
| 8.664MHz  | connected to Vs                 |
| 17.328MHz | external resistor of 100K to Vs |

A special mode is introduced to reduce EMI. With pin OSEL connected to GND the internal oscillator is switched off and an external sinusoidal frequency could be applied on OSCIN. The peak to peak voltage of this signal can be reduced down to 60mV.

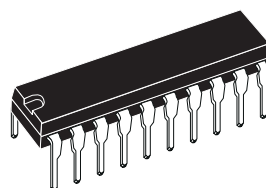
In this mode the frequency selection via FSEL is still active.

Suggested values of C1 and C2 are shown in the following table:

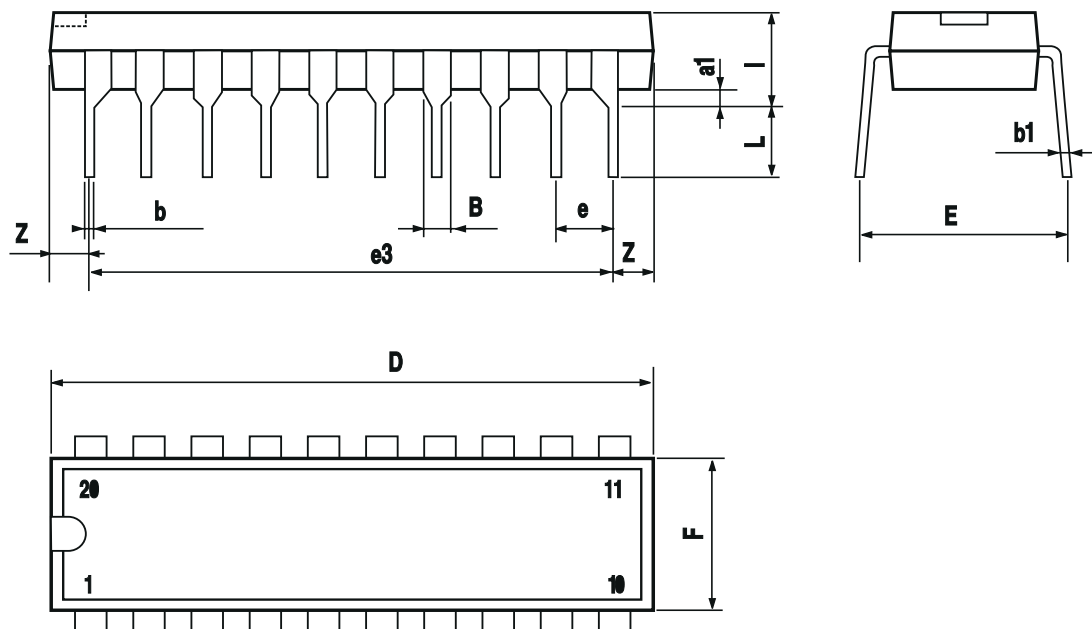
| Crystal   | C1   | C2   |
|-----------|------|------|
| 4.332MHz  | 27pF | 47pF |
| 8.664MHz  | 27pF | -    |
| 17.328MHz | 27pF | -    |

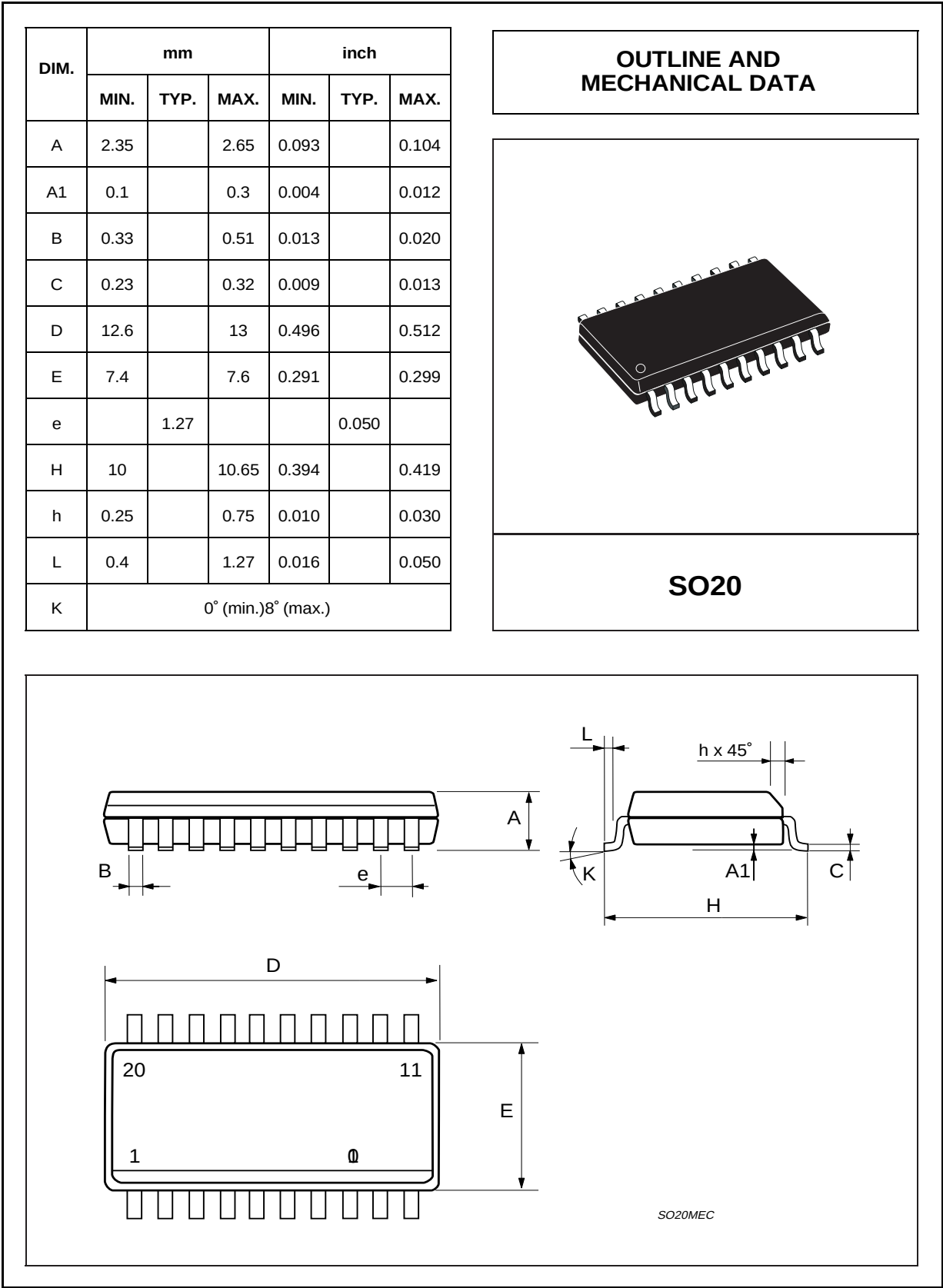
| DIM. | mm    |       |      | inch  |       |       |
|------|-------|-------|------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.254 |       |      | 0.010 |       |       |
| B    | 1.39  |       | 1.65 | 0.055 |       | 0.065 |
| b    |       | 0.45  |      |       | 0.018 |       |
| b1   |       | 0.25  |      |       | 0.010 |       |
| D    |       |       | 25.4 |       |       | 1.000 |
| E    |       | 8.5   |      |       | 0.335 |       |
| e    |       | 2.54  |      |       | 0.100 |       |
| e3   |       | 22.86 |      |       | 0.900 |       |
| F    |       |       | 7.1  |       |       | 0.280 |
| l    |       |       | 3.93 |       |       | 0.155 |
| L    |       | 3.3   |      |       | 0.130 |       |
| Z    |       |       | 1.34 |       |       | 0.053 |

### OUTLINE AND MECHANICAL DATA



**DIP20**





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