**Austria Mikro Systeme International** ®

# 20 NUMBER ONE TOUCH DIALLER WITH SERIAL BUS FOR DISPLAY DRIVER

## Key Features

- ❑ Low operating voltage (2.5V to 5.5V)
- ❑ Low current consumption (typ. 200 µA in LD mode)
- ❑ Oscillator using ceramic resonator (681 kHz)
- ❑ MF level independent of supply voltage
- ❑ Direct ´wake-up´ from keyboard
- ❑ Automatic Call Progress by direct memory key
- ❑ Data protection with 8 digit FIFO
- ❑ Sliding cursor protocol with comparison
- ❑ Diode options for different PTT requirements
- ❑ Automatic pause generation after access code
- ❑ Temporary MF select via keyboard
- ❑ 36 digit LNR (Last Number Redial)
- ❑ 20 memories addressable with direct keys and the **2nd** key or indirect with a **MEM** key
- ❑ Notepad
- ❑ Serial interface to display driver AS2590
- ❑ Consistent, simple and useable procedures
- ❑ Input for dial tone recognizer

## General Description

The AS2574B is an integrated CMOS device for feature telephones. It is a very versatile LD/MF dialler with serial interface to a display driver. The device is designed to be used in a wide variety of applications together with the companion display driver, AS2590.

The on chip RAM can contain up to 20 memories (each with maximum 18 digits), a 36 digit Last Number Redial (LNR) and an 18 digit notepad. Access to the 20 memories is either with direct keys, abbreviated dial code or a combination of both. The AS2574B provides a unique feature, Automatic Call Progress (ACP), on all memory keys, i.e. the circuit automatically seizes the line and waits for the dial tone and dials the number just by pressing any of the memory keys (including LNR).
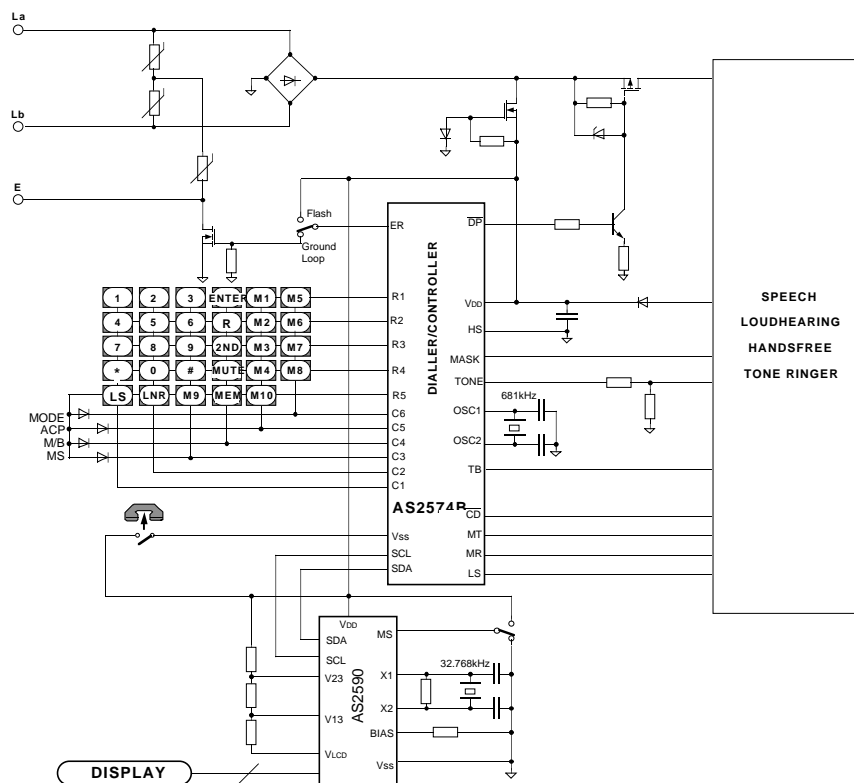
The circuit features 2 different access code procedures to allow easy use under a PABX. A dial tone input enables the use of a dial tone recognizer.

## Application

High feature telephone sets.

## Package

Available in 28 pin DIP and PLCC.

*Direct wake-up is an AMS patented solution providing line seizing with a telephone, that is entirely powered from the telephone line, by pressing a key in a key matrix connected to a dialler/controller that is constantly connected to the line by means of a line voltage limiter and yet maintaining a high dc isolation resistance in idle state (on-hook).*

*The wake-up feature allows the user to go off-hook by pressing a direct memory key or a loudspeaker key, so-called on-hook dialling or call progress monitoring, and thereby seize the line.*
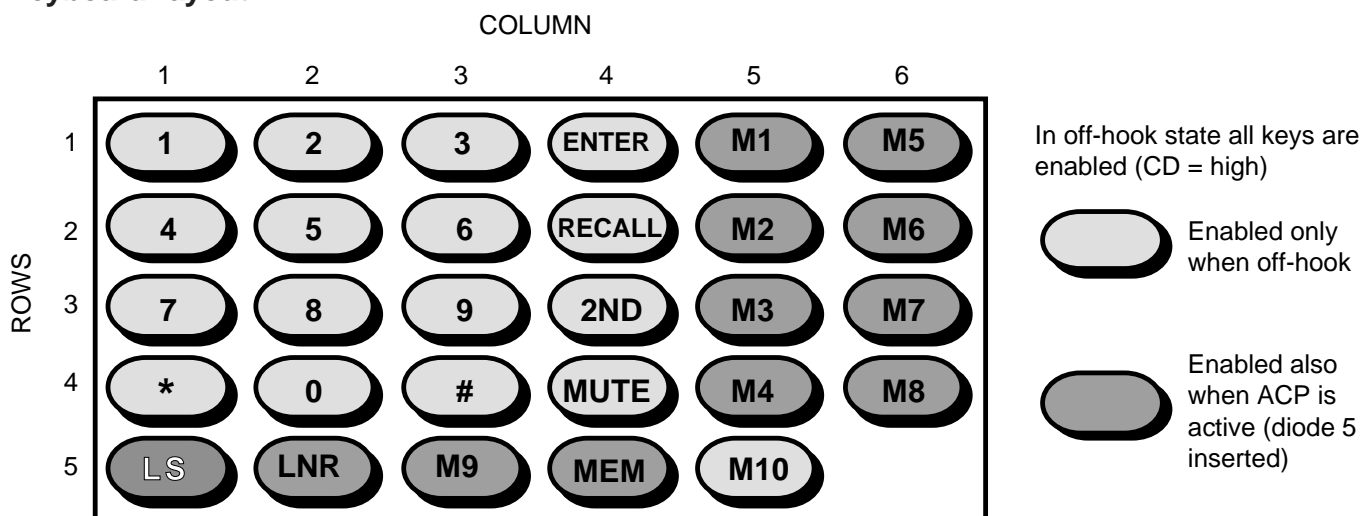
## Pin Description

| Pin # | Pin Node | Description |
|---|---|---|
| 1<br>2 | OSC2<br>OSC1 | Oscillator pins for ceramic resonator (681 kHz) |
| 3<br>4 | SCL<br>SDA | The SCL output is used to clock all data into the display driver<br>The SDA output is used to transfer data into the display driver |
| 5 - 10 | C1 - 6 | Keyboard columns |
| 11 - 15 | R1 - 5 | Keyboard rows |
| 16 | LS | Output for controlling loudhearing and handsfree facilities, active high<br>(see hook state diagramme) |
| 17 | MASK | Mask output, active high during pulsing (make and break period, see timing diagrammes). |
| 18 | $\overline{CD}$ | Chip disable input, active low.<br><br>When $\overline{CD}$ is low, the circiut is disabled.<br>If this pin is pulled to $V_{SS}$ during Off-hook (indicating a disconnect) for more than 2 sec., the circuit is reset*. If the pin is pulled to $V_{SS}$ for less than 2 sec., the line break is ignored.<br>* If in ACP or monitor state, reset also means return to idle state. |
| 19<br>20 | MR<br>MT | Mute output, active high during signalling (see timing diagrammes).<br>Transmit mute output, active high when MR is high and when the **Mute** key has been activated (see timing diagrammes). |
| 21 | ER | Earth recall input/output, active high during ER but when forced to $V_{DD}$, the flash is enabled. |
| 22 | DT | Dial tone input.<br><br>This input is scanned when invoking ACP or a pause is read in a digit string:<br><br>{DT table below}<br><br>* Reset means that dialling is stopped and the circuit returns to standby.<br>  If the circuit was in ACP state, the reset will also return the circuit to idle state. |
| 23 | $\overline{DP}$ | Hook switch control, dial pulse and flash output; low during Idle and break periods and high during off-hook (see timing diagrammes). |

DT table (within Pin 22 Description):

| DT pin | Function |
|---|---|
| Open | Pause duration 4.1 sec |
| Low | If a high is not detected within 8 sec., the circuit is reset * |
| High | If the pin is high for > 1.15 sec., the pause is terminated and the dialling continued. Noise immunity > 8 ms |

Continues…

Pin Description Continued

| Pin # | Pin Node | Description |
|-------|----------|-------------|
| 24 | HS | Hook switch input; active high with internal pull-down resistor. Debounce 25 ms. |
| 25 | Vss | Negative terminal of power supply. |
| 26 | TB | Tone burst output: |
| 27 | TONE | MF tone output. |
| 28 | Vdd | Positive terminal of power supply |

Pin 26 (TB) table:

| LS high | 80 ms burst, 8 sec pause | |
|---------|--------------------------|---|
| MT high | 80 ms burst, 2 sec pause | Only in speech mode |
| MT+LS high | 80 ms burst, 2 sec pause | |

Pin 27 (TONE):

An on chip reference voltage provides tone levels independent of the supply voltage.
A dc path from TONE output is needed to accommodate an external voltage divider for setting the appropriate tone level.

Frequencies:

| Frequency (Hz) | Key Matrix (Hz) | Error (%) |
|----------------|-----------------|-----------|
| 697 | row 1 | |
| 770 | row 2 | |
| 852 | row 3 | |
| 941 | row 4 | |
| 1209 | col. 1 | $\leq \pm 0.7\%$ |
| 1336 | col. 2 | |
| 1477 | col. 3 | |
| 1633 | see p. 7 | |

## Keyboard Layout

COLUMN



The keyboard is arranged in a 5 x 6 contact matrix with single pole single throw contacts (SPST).
Keyboard resistance: Ron < 5 kΩ; Roff > 5 MΩ.

## Power On Reset

The on chip analogue power on reset circuit monitors the supply voltage ($V_{DD}$). As long as $V_{DD}$ remains below the internal reference voltage, $V_{REF}$ (typically 1.2V), the oscillator is inhibited. When $V_{DD}$ rises above $V_{REF}$, a reset signal is generated to assure correct start-up, and the oscillator is enabled.

The correct start-up/reset condition of the circuit is guaranteed regardless of the absolute and chronological rise time of $V_{DD}$, CD and HS inputs.

## Line Supervision

In off-hook condition the device performs supervision of the line current disconnects in the following manner:
Line disconnects (CD low) of less than 2 sec. are ignored and the device continues operation.
Line disconnects of more than 2 sec. cause stop of dialling and the circuit is switched to standby mode if HS is high, otherwise the circuit will return to idle mode.

## Valid Keys

A valid key is detected from the keyboard by connecting the appropriate row to the column. This can be done using an n x m keyboard matrix with single contacts. Positive and negative edges of each contact are de-bounced. The debounce time is 15 ms.

In idle state (on-hook) only the **LS** key is always valid independent of the CD pin. When diode 5 is connected, also the **LNR**, **MEM**,  and **M1 - 9** keys are valid entries invoking ACP (automatic call progress).

## Mute Key

Depressing the **Mute** key activates and deactivates (toggle switch) the MT output, when internal mute is inactive, i.e. when no data is being read from the RAM or FIFO.

A change of the hook state will release the mute.

## Mode Selection

The default mode (LD or MF) can be selected by the diode option mode (diode 6).

When default LD mode is selected, a temporary change to MF mode can be invoked by pressing the  * key.

When the circuit is in temporary MF mode, each of the following procedures revert it to default LD mode:

- pressing **R** key (all subsequently entered digits are buffered in FIFO),

- by next On-hook.

## Last Number Redial

LNR is a facility that allows resignalling of the last manually dialled number without keying in all the digits again. The LNR is repeatable.

A manually entered number is automatically stored in the LNR RAM. The capacity of the RAM is 36 digits. If a number greater than 36 digits is entered, the LNR facility will be inhibited (until new entries < 37 digits) and further entries will be buffered in FIFO. If more than 18 digits are entered, the display will show the digit 19 and onwards.

Postdialled digits, i.e. digits manually entered after LNR has been invoked, are not stored in RAM but buffered in FIFO.

The current contents of the LNR RAM are overwritten by new entries.

## Memory Dial

An on chip RAM enables the dialler to store up to 20 numbers, each containing a maximum 18 digits/data.

The first 10 memories are accessible with 10 Direct dial keys (**M1** to **M10**) and another 10 memories (11 - 20) are accessible by pressing the **2nd**  key before one of the Direct dial keys or by pressing the **MEM** key and a digit 0 - 9 (abbreviated dialling).

Basic store procedure:

1  Press **Enter** key

2 Key in digits, including access code, pauses and recall as appropriate (number is stored in LNR RAM)

3 Select location by keeping **Enter** key depressed while entering the desired location (**M1**…**M10**, **2nd M1**…**M10**, or **MEM 0**…**9**)

4  Release **Enter** key to finish

5 Continue with 1, 2, 3 and 4 for storing further numbers.

Only the first 18 digits/data will be stored when copying more than 18 digits/data in a memory.

## Recall Function

A recall activation will invoke a flash (timed loop break) or an earth recall (ER) depending on the ER pin. When the ER pin is forced to $V_{DD}$, a flash is executed; and when ER is open (> 50 kΩ), an earth recall is executed.

If **R** is the first entry in a digit string, it will be stored in LNR RAM.

If the **R** key is depressed after a digit string has been dialled out, the recall will not be stored, and subsequently entered digits will be buffered in the FIFO.

A recall will automatically generate a pause when a recall is read from a memory and the recall has been stored as an access code.

A manual invoked earth recall will pull ER high for minimum 500 ms, but the ER pin is maintained high as long as the key is depressed.

During auto dial an earth recall is executed with a duration of 500 ms.

## Access Codes

Different access codes (totally up to 18 digit/data including spaces) can be stored in one string. Spaces between the different access codes are entered by pressing the **2nd  #** during programming. Each access code can contain up to 4 digits.

If one or more access codes are stored, the first entered digit(s) in a digit string read from the RAM will be compared with the access code(s) and if equal, a pause is generated.

Example on programming access codes:

***ENTER, 9 , 2nd #, 50***
Keep ***ENTER*** depressed while pressing ***0***
Release both

The first access code in this example is 9 and the second 50.

## Pause Generation

Pause introduces a delay in signalling digits strings to accommodate second and subsequent dial tones.

Automatic pauses are generated:

- during dialling out from memories when the first digit(s) in the digit string equal the stored access code(s) (pause depends on DT input).

- when going Off-hook by pressing **LNR**, **MEM**, or **M1** - **9** (ACP).

Any pause can be terminated (shortened) prior to time out by pressing the **LNR** key or a high level on the DT input.

During ACP a pause time out, i.e. DT kept low for > 8 sec., will return the device to idle state.

Pauses are storable as digits within a string of any of the memories by pressing **2nd #** during programming. Multiple pause entries can be stored up to the maximum length of the digit string (18 digits/data). A pause is not accepted in location 1 of a digit string.

If more pauses have been stored in succession, they can all be terminated by one depression of the **LNR** key or a high level on the DT pin for ≥ 1.15 sec.

## Sliding Cursor Procedure

To accommodate redialling (LNR) behind a PABX without using automatic pause generation (storing access codes), a sliding cursor protocol is implemented. If new entries match the previous LNR RAM contents, pressing the **LNR** key will dial out the remaining digits.

If there is an error in matching, the LNR will be inhibited until next On-hook, and the LNR RAM will contain the new number.

## Serial Interface

The AS2574B supports a serial bus. The protocol defines device that sends data onto the bus as a transmitter, and the receiving device as the receiver. The AS2574B is controlling the transfer and hence the master. The display driver, AS2590, being controlled is the slave.

## Clock and Data Conventions

Data states on the SDA line can change only during SCL low. SDA state changes during SCL high are reserved for indicating start and stop conditions (see figure 1).

## Start Condition

All commands are preceded by the start condition, which is a high to low transition of SDA when SCL is high.

## Stop Condition

All communications are terminated by a stop condition, which is low to high transition of SDA when SCL is high.
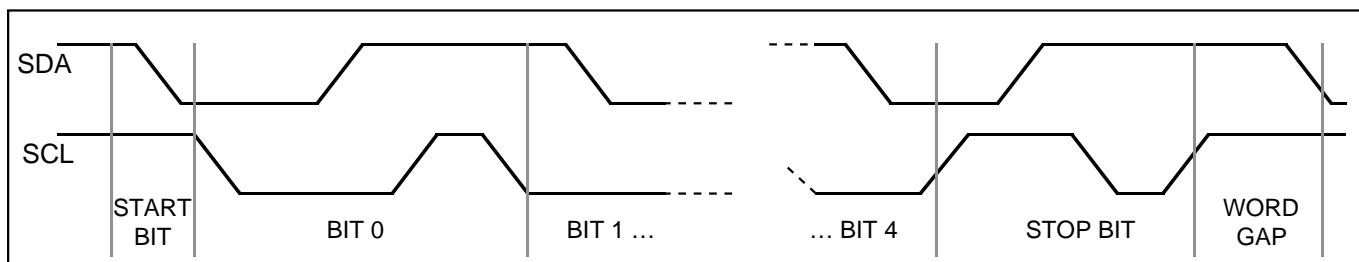


Figure 1: Data Transmission

| No | Symbol/command | MSB | B3 | B2 | B1 | LSB | HEX |
|----|----------------|-----|----|----|----|----|-----|
| 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1C |
| 2 | 1 | 0 | 0 | 0 | 0 | 0 | 00 |
| 3 | 2 | 0 | 0 | 1 | 0 | 0 | 04 |
| 4 | 3 | 0 | 0 | 0 | 1 | 0 | 02 |
| 5 | 4 | 1 | 0 | 0 | 0 | 0 | 10 |
| 6 | 5 | 1 | 0 | 1 | 0 | 0 | 14 |
| 7 | 6 | 1 | 0 | 0 | 1 | 0 | 12 |
| 8 | 7 | 0 | 1 | 0 | 0 | 0 | 08 |
| 9 | 8 | 0 | 1 | 1 | 0 | 0 | 0C |
| 10 | 9 | 0 | 1 | 0 | 1 | 0 | 0A |
| 11 | a | 0 | 0 | 1 | 1 | 0 | 06 |
| 12 | b | 1 | 0 | 1 | 1 | 0 | 16 |
| 13 | c | 0 | 1 | 1 | 1 | 0 | 0E |
| 14 | d | 1 | 1 | 1 | 1 | 0 | 1E |
| 15 | * | 1 | 1 | 0 | 0 | 0 | 18 |
| 16 | # | 1 | 1 | 0 | 1 | 0 | 1A |
| 17 | Pause | 1 | 1 | 0 | 1 | 1 | 1B |
| 18 | Temporary MF select | 1 | 1 | 0 | 0 | 1 | 19 |
| 19 | Recall | 0 | 0 | 0 | 0 | 1 | 01 |
| 20 | LS on | 0 | 0 | 1 | 0 | 1 | 05 |
| 21 | LS off | 0 | 0 | 0 | 1 | 1 | 03 |
| 22 | MT on | 1 | 0 | 0 | 0 | 1 | 11 |
| 23 | MT off | 0 | 1 | 0 | 0 | 1 | 09 |
| 24 | 2nd on | 0 | 0 | 1 | 1 | 1 | 07 |
| 25 | 2nd off | 1 | 1 | 1 | 1 | 1 | 1F |
| 26 | Set Clock | 0 | 1 | 0 | 1 | 1 | 0B |
| 27 | Start | 0 | 1 | 1 | 0 | 1 | 0D |
| 28 | Start copy | 0 | 1 | 1 | 1 | 1 | 0F |
| 29 | Start FIFO | 1 | 0 | 0 | 1 | 1 | 13 |
| 30 | Start timer | 1 | 0 | 1 | 0 | 1 | 15 |
| 31 | Blank all | 1 | 1 | 1 | 0 | 1 | 1D |
| 32 | Test mode | 1 | 0 | 1 | 1 | 1 | 17 |

## Key Combinations

| Key/Key Combination | Function | Remarks |
|---|---|---|
| ENTER | Programming | |
| R | Flash or ground loop | Code no 19 |
| MEM | Abbreviated dialling | |
| MUTE | Privacy mute | Code no 22/23 |
| LS | Monitor/Handsfree | Code no 20/21 |
| LNR | Last Number Redial | During execution of a pause the LNR key is used to terminate the pause. |
| M1 - 10 | Direct memory keys | |
| 2nd | Second functions | Code no 24 |
| 2nd, 1 | a | Code no 11 |
| 2nd, 2 | b | Code no 12 |
| 2nd, 3 | c | Code no 13 |
| 2nd, 4 | d | Code no 14 |
| 2nd, * | Enter FIFO | Code no 29 |
| 2nd, # | Pause | Code no 17 |
| 2nd, M1 - 10 | Memories 11 - 20 | |
| MEM, 0 - 9 | Memories 11 - 20 | |
| ENTER, Address* | Displaying content of Memo | |
| ENTER/Address* | Programming | Code no 28 when both keys are released |
| ENTER/# | Setting clock | Code no 26 |
| 2nd, 5 - 9 | 5 - 9 | Code no 6 - 10 |
| 2nd, 0 | 0 | Code no 1 |
| 2nd, R | RECALL | Code no 19 |
| 2nd, MUTE | Privacy MUTE | Code no 22/23 |
| ENTER/LNR | Clearing LNR | Code no 27 |
| ENTER, ENTER | Displaying Access code | Code no 27 |

*) *Address* means **M1 - 10** keys or **2nd**, **M1 - 10** or **MEM**, **0 - 9** key combinations.

## Diode Options

| Option | Column | Function | | No diode | diode | |
|--------|--------|----------|--|----------|-------|--|
| NoP | 1 | Number of Pulses<br>Digit 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>0 | | Standard<br>1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10 | NZ<br>9<br>8<br>7<br>6<br>5<br>4<br>3<br>2<br>1<br>10 | |
| FT | 2 | Flash Time | | 101.2 ms | 600 ms | |
| MS | 3 | Memory Size | | 10 | 20 | |
| M/B | 4 | Make/Break Ratio | | 33/66 ms | 40/60 ms | |
| ACP | 5 | Automatic Call Progress | | no | yes | |
| MODE | 6 | Default Signalling Mode | | MF | LD | |
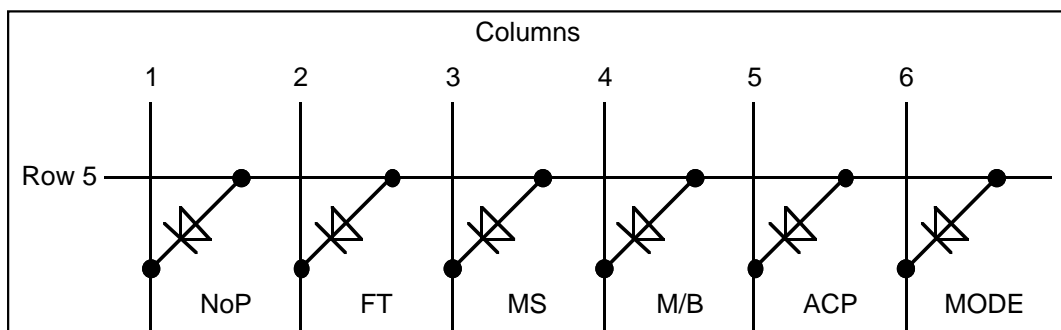


The diode options are scanned by POR and low to high transition on HS.

## System Considerations

The device is intended to be used in telephone instruments, that are permanently on-line, i.e. also when on-hook the circuit is connected to the telephone line, but in standby mode (idle) and hence only drawing a small leakage current from the line.

This implementation offers new features like electronic hook switch and call progress monitoring (on-hook dialling).

Call progress monitoring (CPM) means pressing the **LS** key will switch the telephone on from standby (direct ´wake-up´ from keyboard) and will present the dialling tones via a loudspeaker without lifting the handset.

Furthermore, it is also possible to invoke the CPM by pressing the **LNR**, **MEM** or **M1** - **9** when the ACP (Automatic Call Progress) is activated (diode 5).

## Procedure Principles

The procedures for utilizing the features of the device are optimized out of consideration for the human factor in order to:
- meet the user´s expectations
- be easy to learn and relearn
- not invoke any automatic functions which the user doesn't expect
- protect the user from committing critical errors, e.g. dialling wrong numbers, deleting stored numbers, etc.
- be consistent, simple and usable.

## Symbols

| | |
|---|---|
| Idle | Standby state, no keys activated |
| Off-hook | Lifting handset (HS = High) or pressing LS key |
| On-hook | Replacing handset (HS = Low) or repressing LS key |

## Manual Dial

```
            ┌─────────┐
            │  Idle   │
            └────┬────┘
                 │
            ┌────▼────┐
            │ Off-hook│
            └────┬────┘
                 │
            ┌────▼────┐
            │ Key in  │
            │ digits  │
            └────┬────┘
                 │
         ┌───────▼───────┐      ┌──────────────────┐
         │ Entries stored│─────▶│                  │
         │ in LNR RAM    │      └──────────────────┘
         └───────┬───────┘
                 │
         ┌───────▼───────┐
         │ Entries are   │
         │ dialled out   │
         └───────┬───────┘
                 │
         ┌───────▼───────┐
         │ Speech mode   │
         └───────┬───────┘
                 │
            ┌────▼────┐
            │ On-hook │
            └────┬────┘
                 │
            ┌────▼────┐
            │  Idle   │
            └─────────┘
```
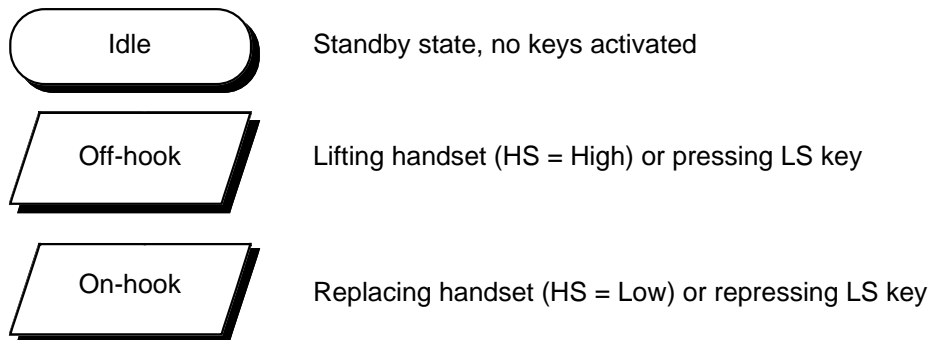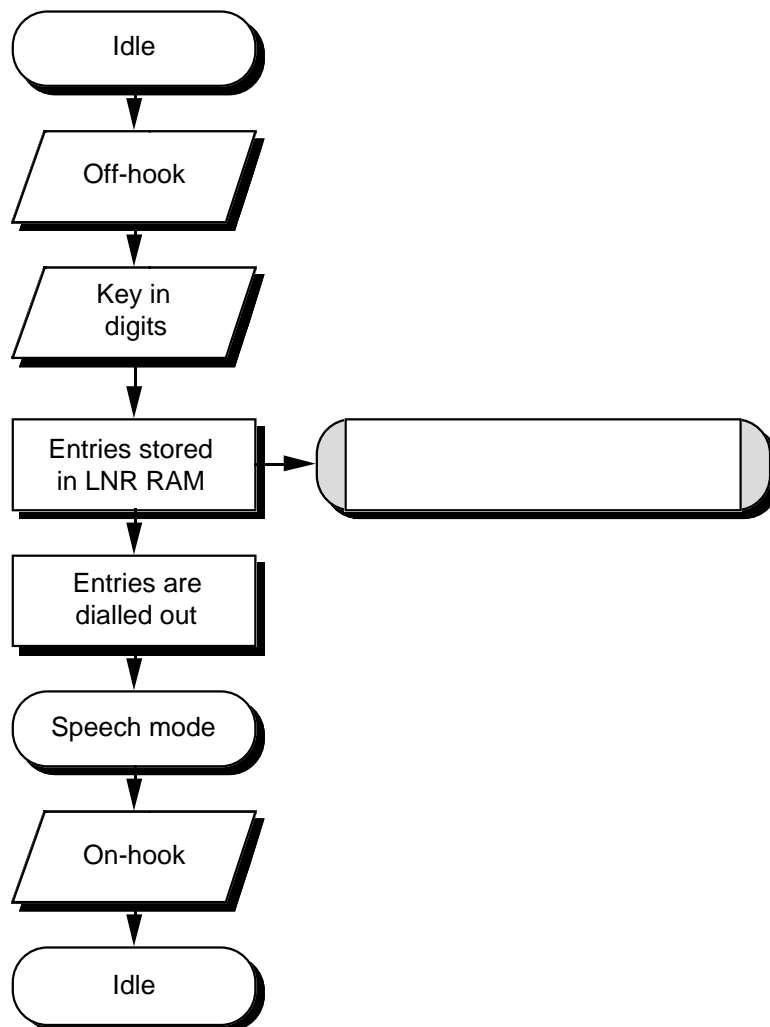
The last manually dialled number is automatically stored in the LNR RAM.
In LD mode  *  invokes temporary MF mode and  #  are ignored.
In MF mode  *  and  #  are automatically stored in LNR RAM.

## Programming/Notepad

```
                                    ┌──────────────┐
                                    │ Speech mode  │
                                    └──────┬───────┘
                                           │
     During programming                ┌───▼────┐
     the dial out is inhibited.        │ Enter  │
                                       └───┬────┘
                                           │              correction
          ┌──────────────┐        ┌────────▼──────┐
          │ Key in       │        │ Key in        │
          │ an address   │        │ number        │
          └──────┬───────┘        └───────┬───────┘
                 │        no               │
                 │      change    ┌────────▼────────┐      ┌──────────────┐
         ┌───────▼──────────┐     │ Digits are entered │──▶│              │
         │ Content of selected│   │ in LNR RAM      │      │              │
         │ memory is displayed│   └────────┬────────┘      └──────────────┘
         └───────┬──────────┘              │
                 │                    ┌─────▼────┐
          ┌──────▼──────┐             │  Enter   │
          │   Enter     │             └─────┬────┘
          └──────┬──────┘                   │
                 │                    ┌──────▼──────┐
                 │                    │ keep Enter  │
                 │                    │ depressed   │
                 │                    └──────┬──────┘
```

Direct dial (M1 - 10)  |  2nd  |  MEM  |  Digit 0 (access codes)

Direct dial (M11 - 20)  |  Digit 0-9 (M11 - 20)

release Enter → Code no 28

Access code(s) are displayed

stored — The content of the LNR RAM is stored in the selected memory.

```
                              ┌──────────────┐
                              │ Speech mode  │
                              └──────────────┘
```

10 Direct dial keys, a **MEM** and a **2nd** key are available for addressing up to 20 numbers.
Each number can contain up to 18 digits, including recall and pauses.
Programming a new number will automatically clear the previous.
**2nd**, **#** has to be pressed between the different access codes.

**Direct Dial/Abbreviated Dial/Last Number Redial**
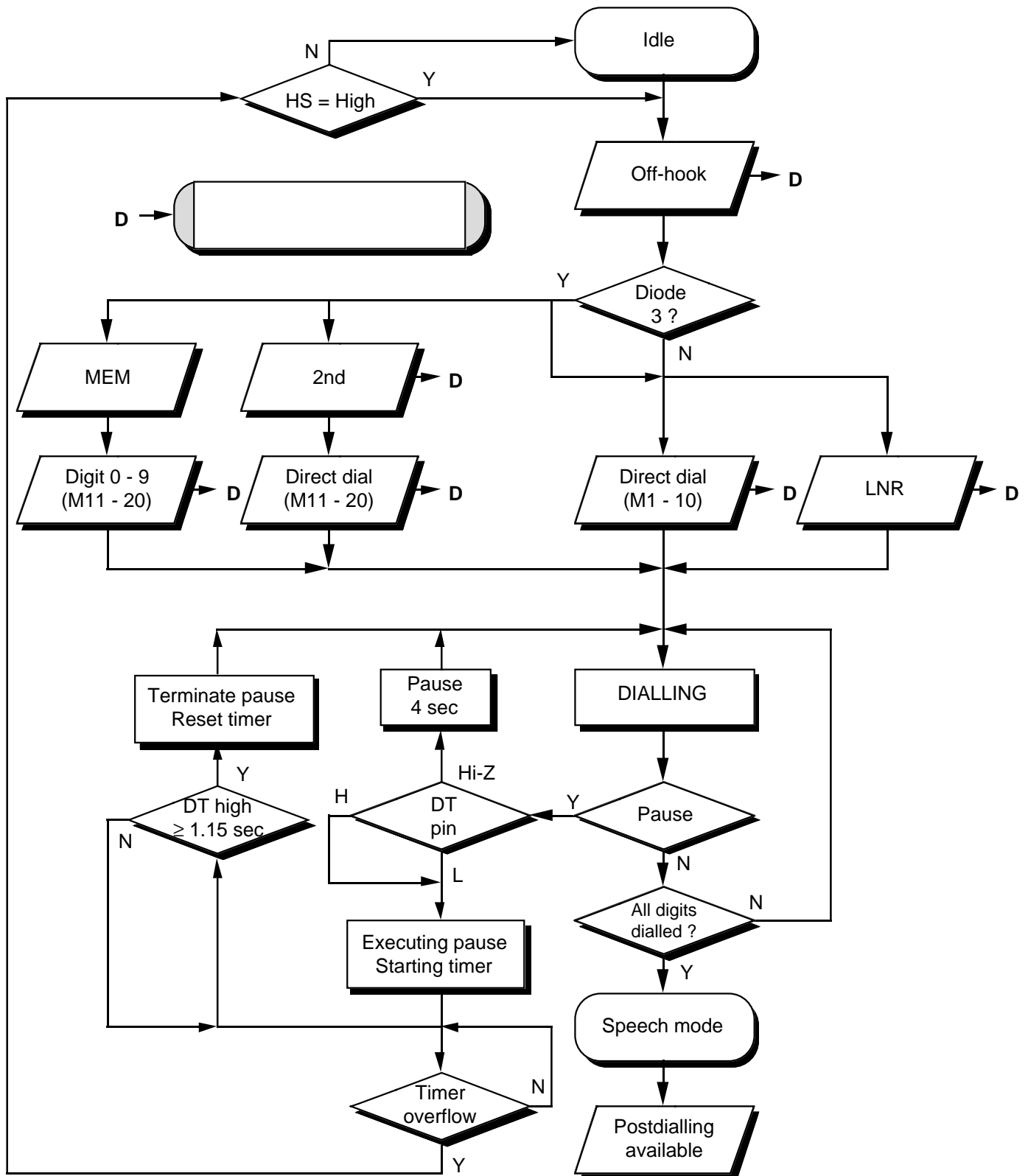
**Automatic Call Progress (ACP)**

**Privacy Mute**

MT output will go low.

```
                                                                    (code 23)

                                        ┌─────────────┐
                                        │ Speech mode │
                                        └─────────────┘
                                               │
┌──────────┐   ┌──────────────┐        ┌─────────────┐
│ Dialling │   │  Change of   │        │  Mute key   │ ──────▶  ⌀  (code 22)
└──────────┘   │  hook state  │        └─────────────┘
               └──────────────┘               │
                                        ┌─────────────┐
                                        │ Speech mode │
                                        │  MT high    │
                                        └─────────────┘
                                               │
                                        ┌─────────────┐
                                        │  Mute key   │ ──────▶  (code 23)
                                        └─────────────┘
                                               │              MT output will go low.
                                        ┌─────────────┐
                                        │ Speech mode │
                                        └─────────────┘
```
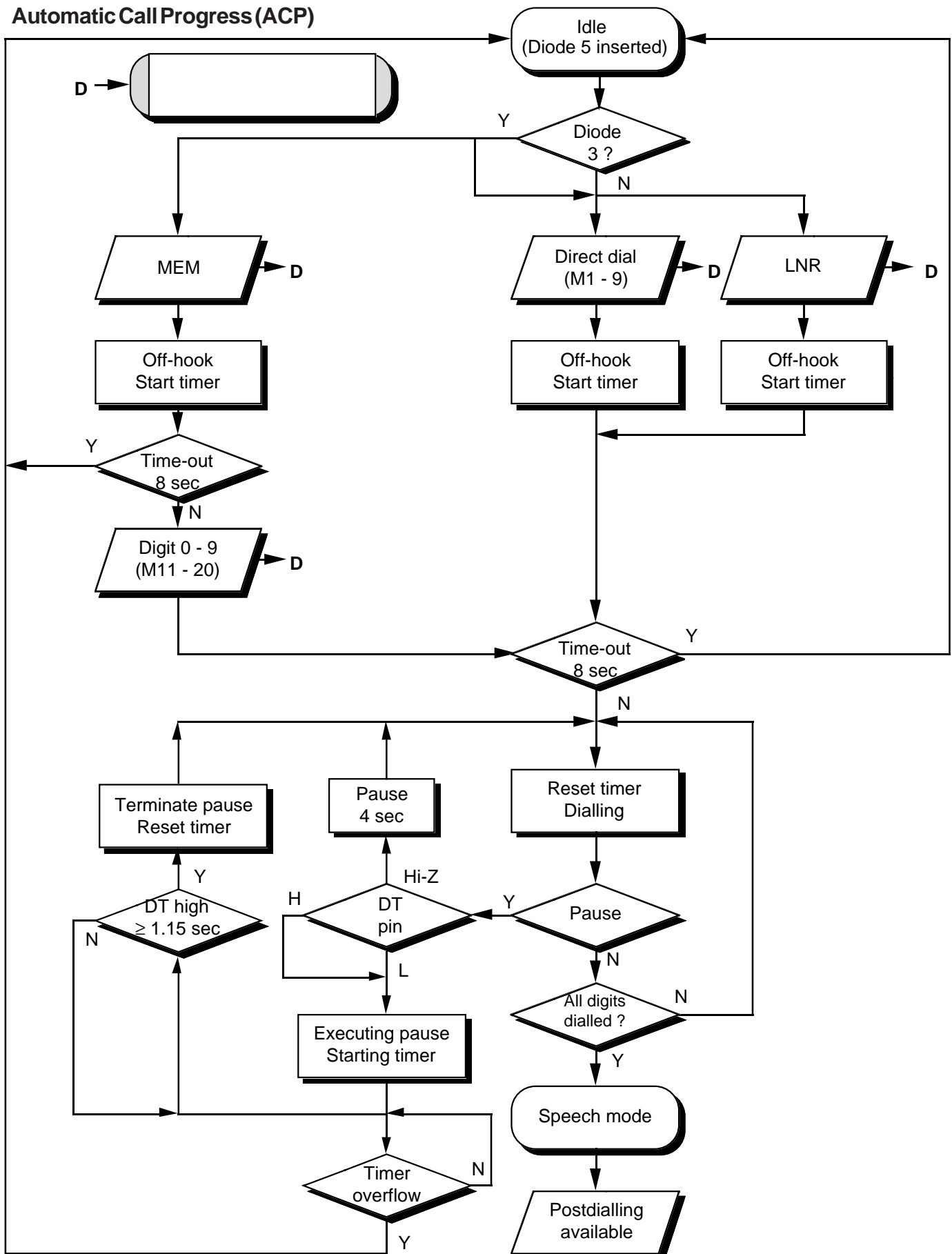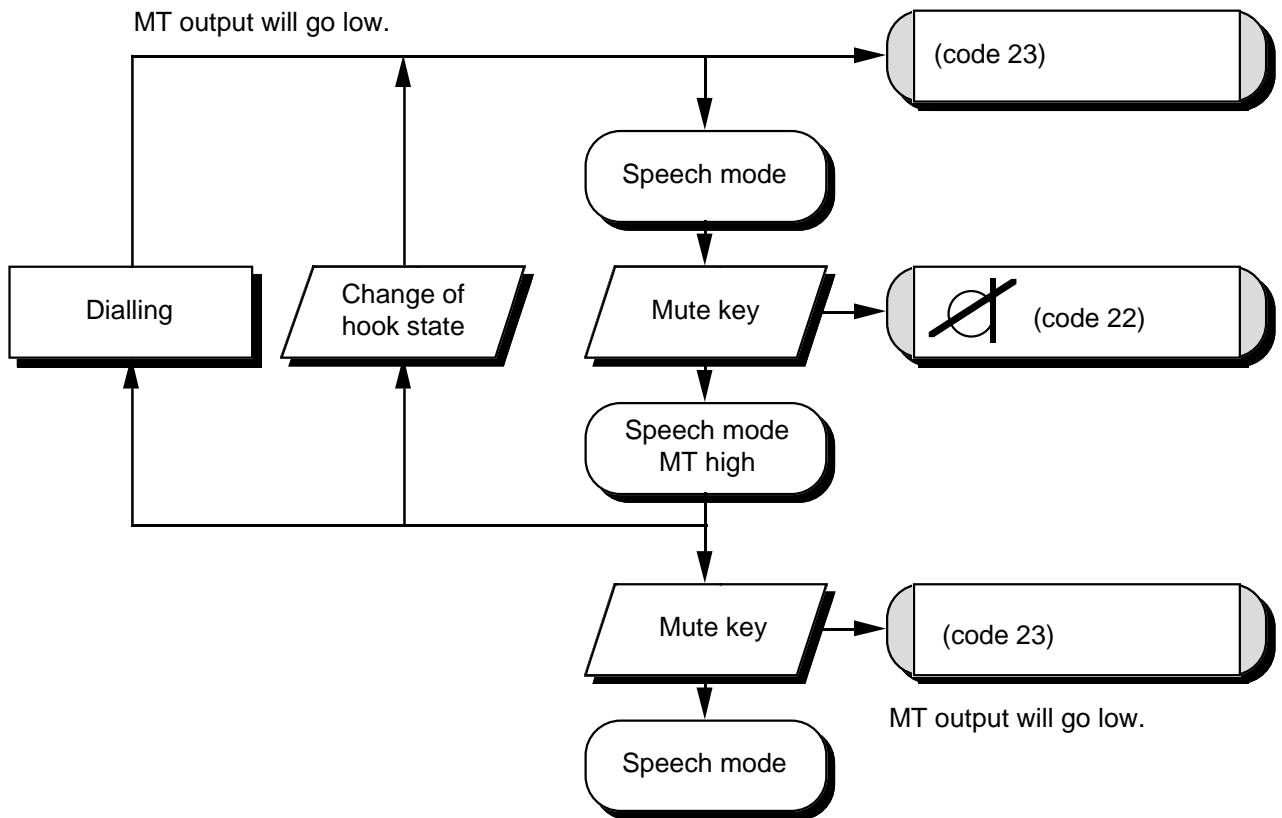
## Temporary MF Select



All further entries are NOT stored in LNR
RAM but buffered in FIFO.
The LNR RAM will contain the number
entered before pressing the * key and
the mode change code.
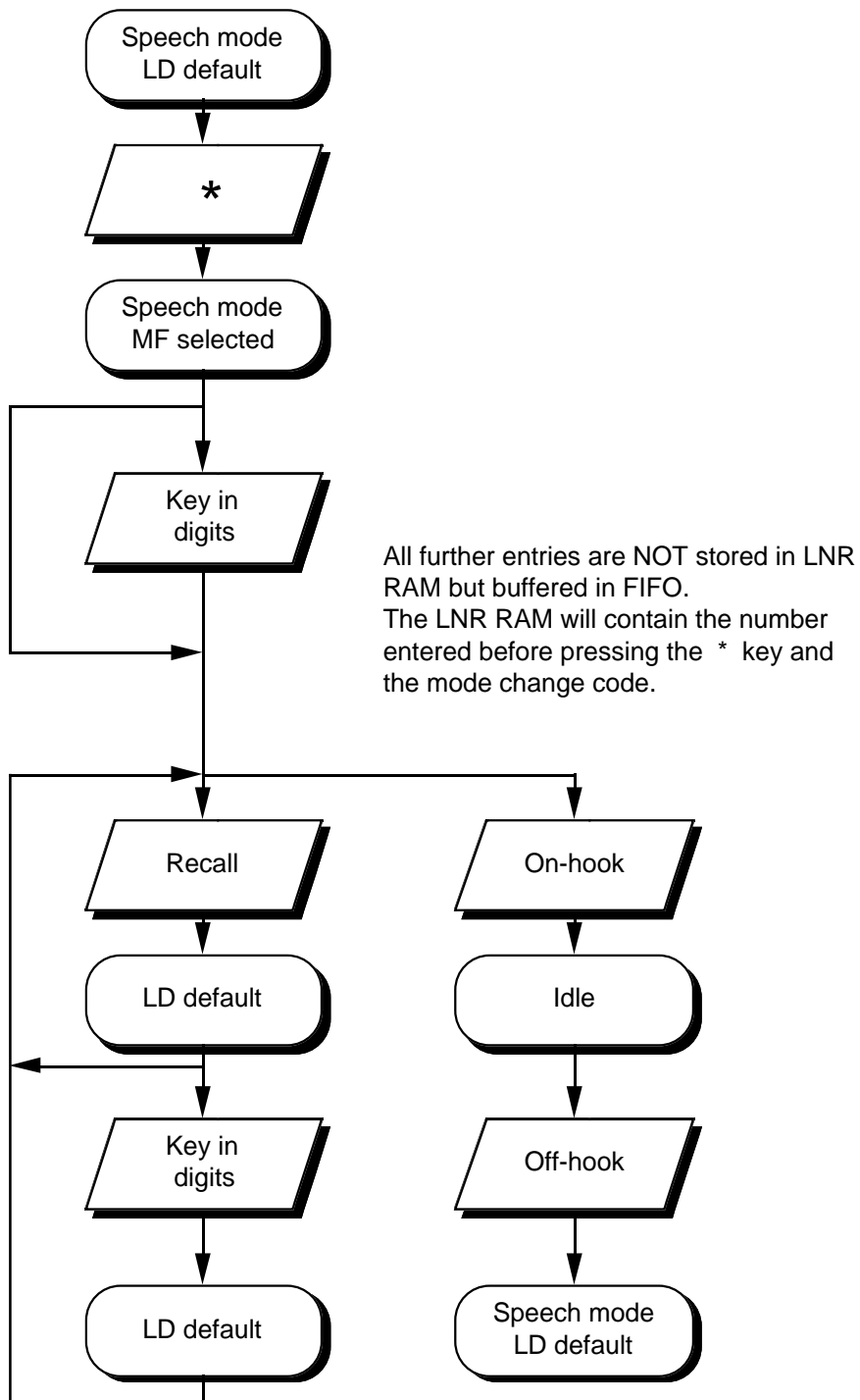
**Setting Clock** (in display driver)

```
                            ┌──────────────┐
                            │ Speech mode  │
                            └──────┬───────┘
                                   │
                                   ▼
                            ╱──────────────╱
                           ╱   Enter      ╱
                          ╱──────────────╱
                                   │
        ┌──────────────────────────┤
        │                          ▼
        │                   ╱──────────────╱
        │                  ╱  keep Enter  ╱
        │                 ╱   depressed  ╱
        │                ╱──────────────╱
        │                          │
        │                          ▼
        │                   ╱──────────────╱         ┌──────────────────┐
        │                  ╱   Press      ╱  ───────▶ │            __:__ │
        │                 ╱     #        ╱            └──────────────────┘
        │                ╱──────────────╱
        │                          │
        │                          ▼
        │                   ╱──────────────╱
        │          ┌──────╱   release    ╱
        │          │     ╱    Enter     ╱
        │          │    ╱──────────────╱
        │          │              │
        │          │              ▼
        │          │       ╱──────────────╱         ┌──────────────────┐
        │      ◀───┼──────╱  Key in hours ╱  ──────▶ │            18:__ │
        │          │     ╱   (2 digits)  ╱           └──────────────────┘
        │          │    ╱──────────────╱
        │          ▼              │
        │   ╱──────────────╱      ▼
        │  ╱   Enter      ╱  ╱──────────────╱         ┌──────────────────┐
        │ ╱──────────────╱  ╱  Key in min.  ╱  ─────▶ │            18:31 │
        │                  ╱   (2 digits)  ╱          └──────────────────┘
        │                 ╱──────────────╱
        │                          │
        │                          ▼
        │                   ┌──────────────┐
        └───────────────────│ Speech mode  │
                            │   or idle    │
                            └──────────────┘
```
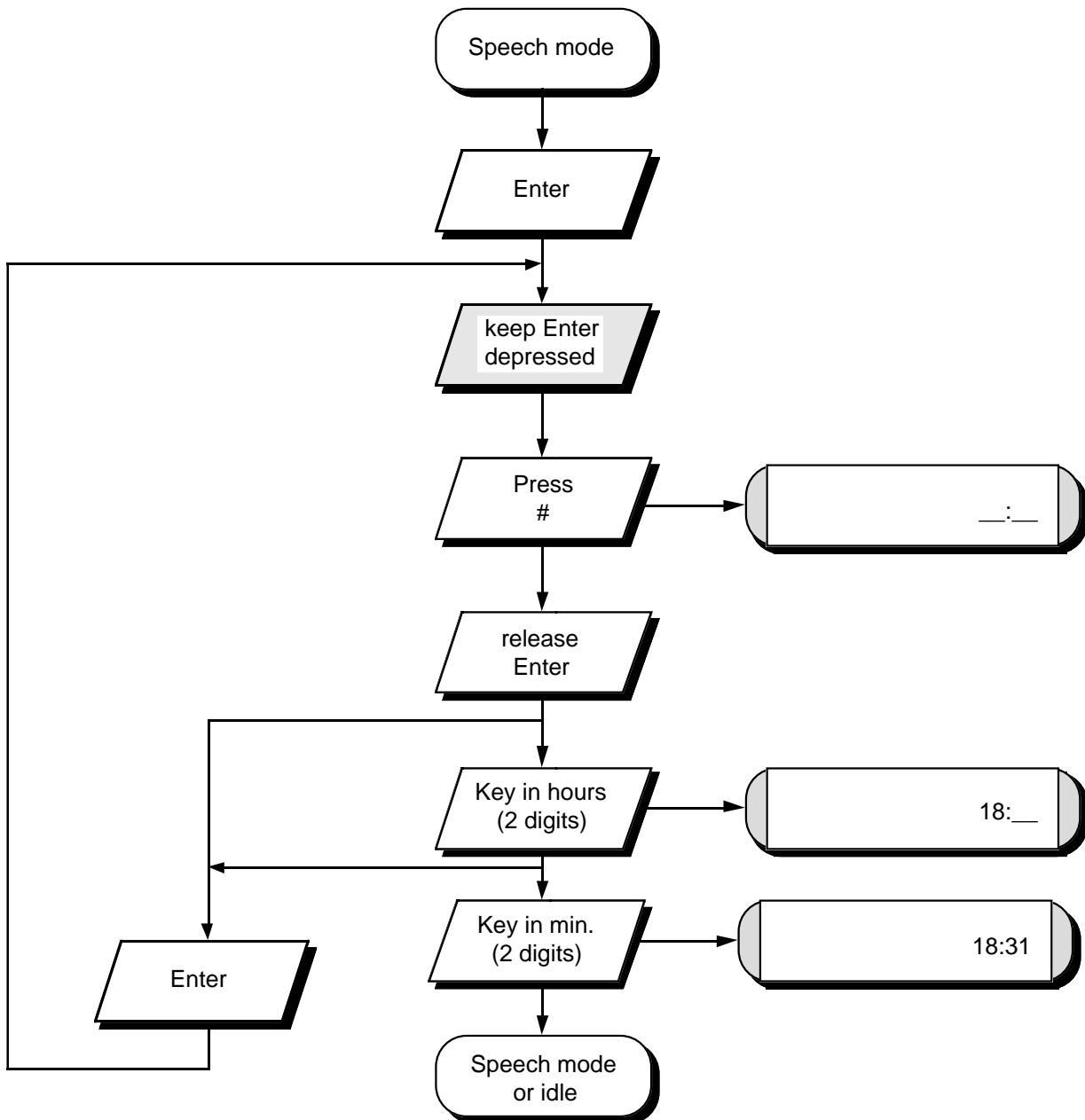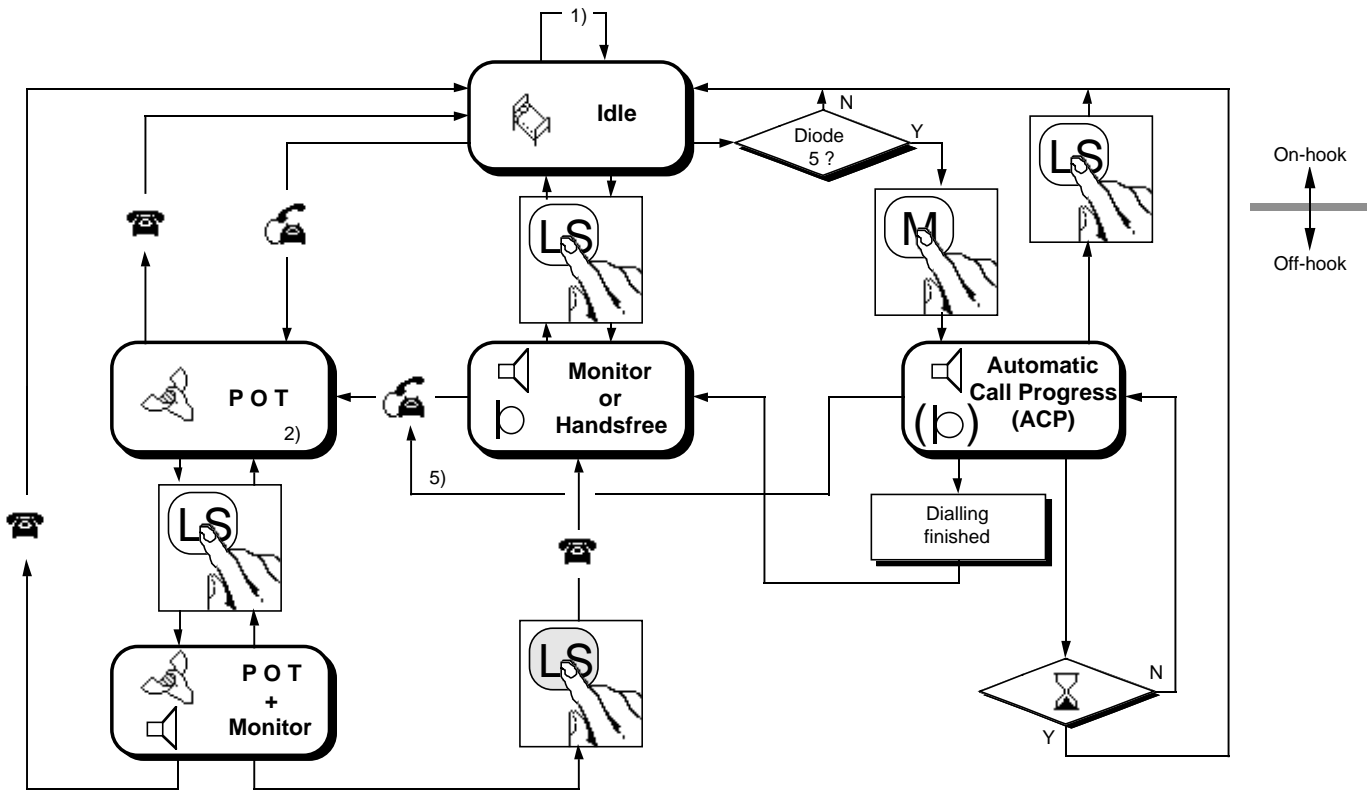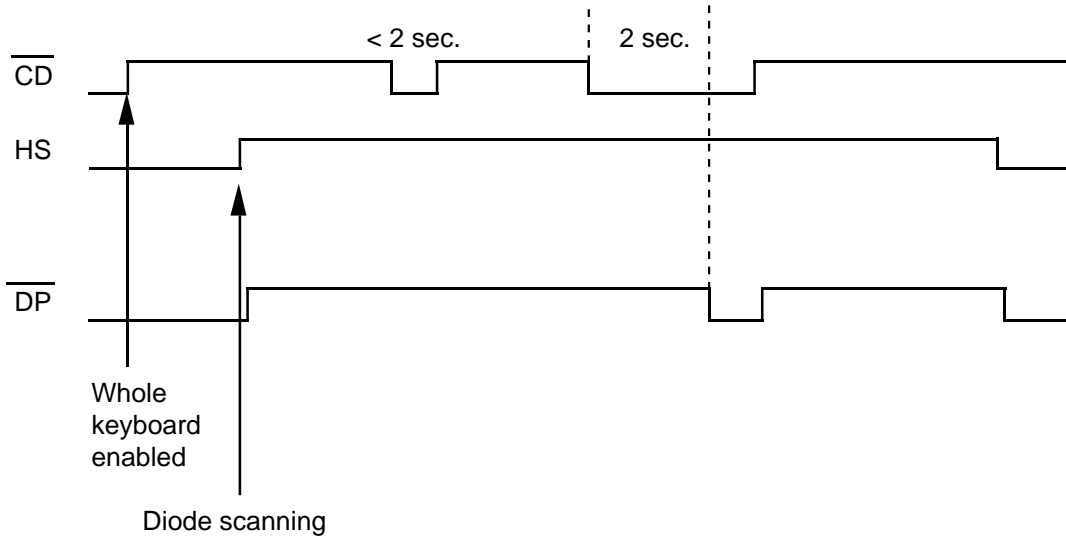
## Hook States



1) Pressing any unvalid key doesn´t have any effect in Idle state.
2) POT means Plain Ordinary Telephone.
3) Lift handset means HS going high.
4) Replace handset means HS going low.
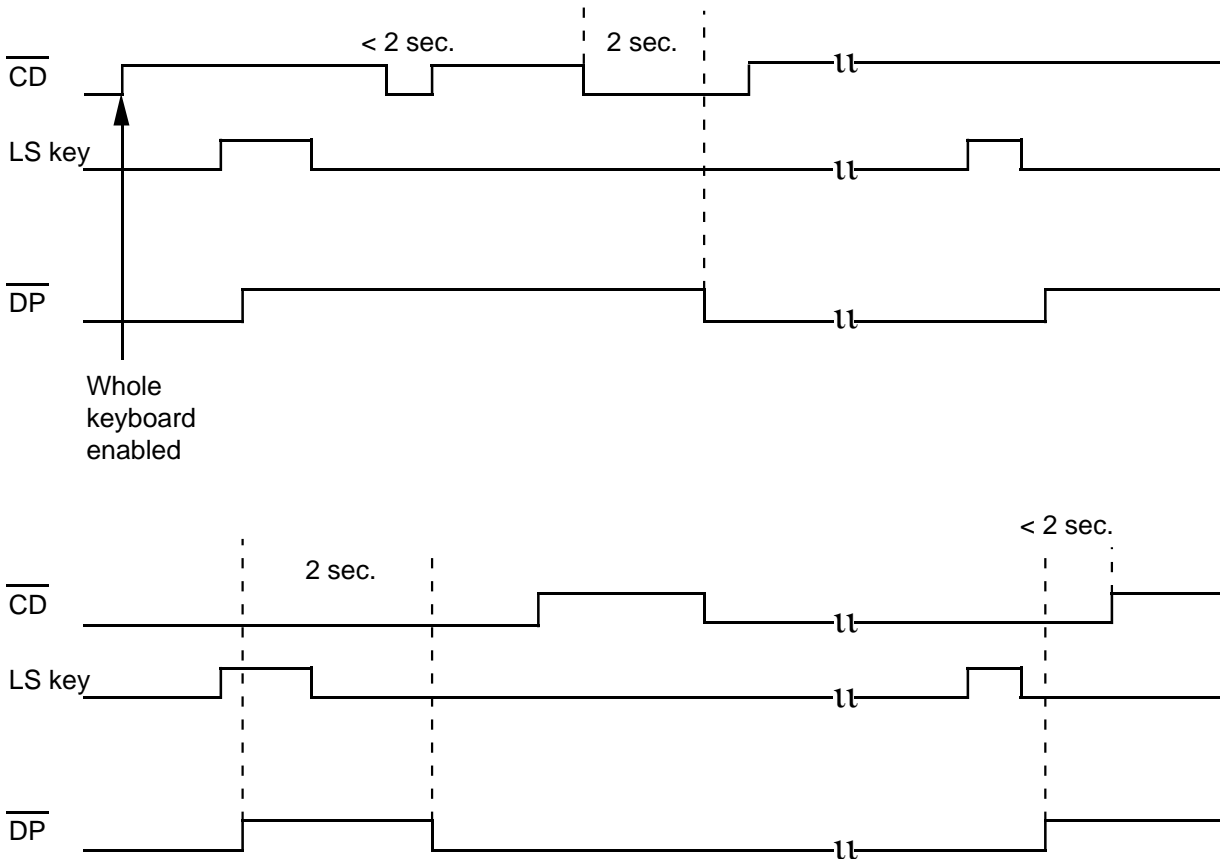5) Lifting the handset during ACP will change the hook state to POT, however, the dialling will continue uneffected.

## Timing Diagrammes

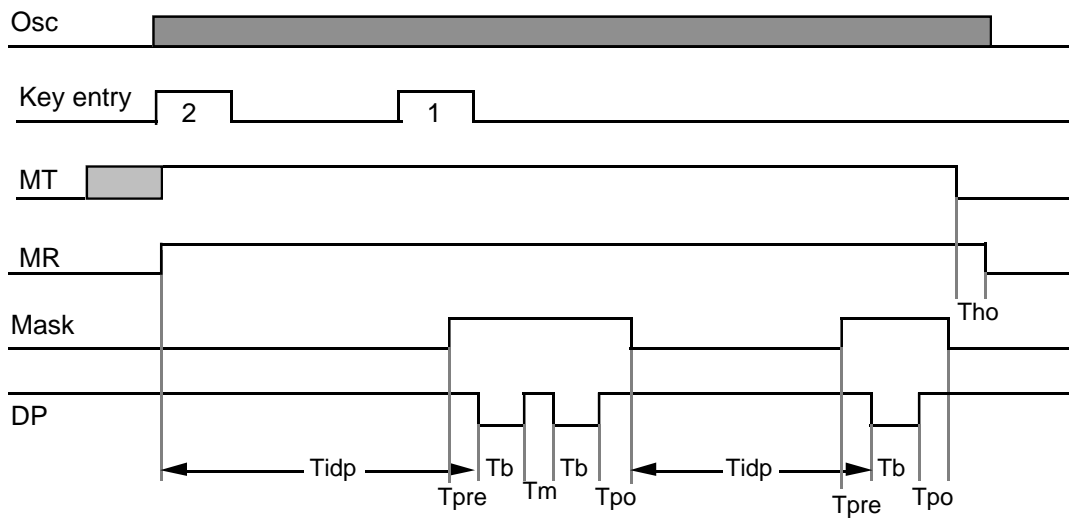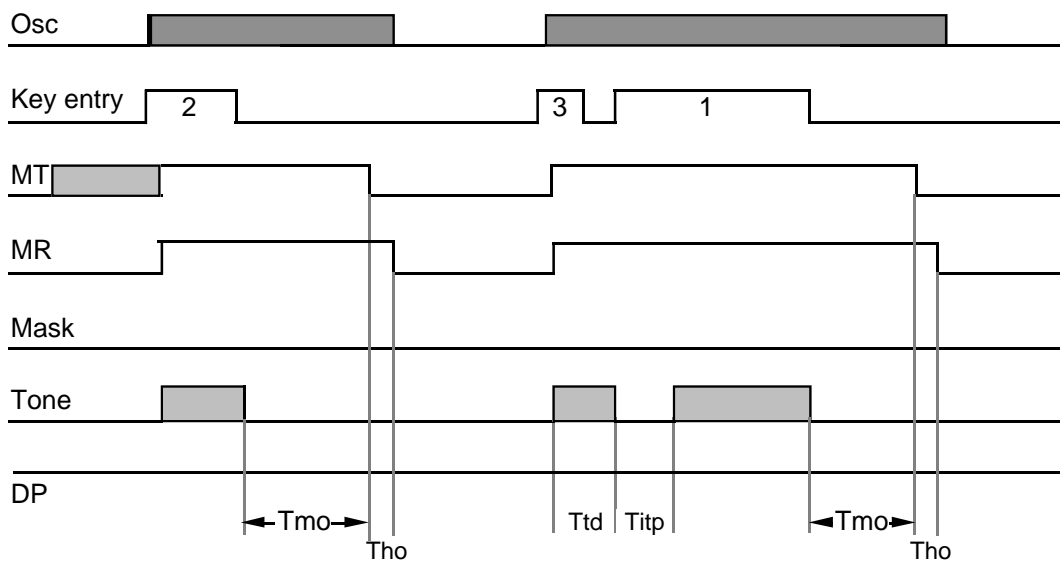The timing diagrammes do not show the correct scaling only the sequence.

**P.O.T.**



Whole
keyboard
enabled

Diode scanning

**Monitor State**



Whole
keyboard
enabled

**LD Dialling**

Osc

Key entry   2       1

MT

MR

Mask                                                  Tho

DP

$T_{idp}$    $T_b$   $T_b$    $T_{idp}$    $T_b$

$T_{pre}$   $T_m$   $T_{po}$     $T_{pre}$   $T_{po}$

▭ = depending on **Mute** key
(high when **Mute** key has been activated, otherwise low)

**MF Dialling**

Osc

Key entry   2      3    1

MT

MR

Mask

Tone

DP

◄–$T_{mo}$–►     $T_{td}$ | $T_{itp}$    ◄–$T_{mo}$►

Tho                 Tho

▭ = depending **Mute** key
(high when **Mute** key has been activated, otherwise low)

**Flash**

Osc

Key entry — **R**

MT

MR

Mask — Tho

DP

GL — Tpre | Tfd | Tpo

Pause
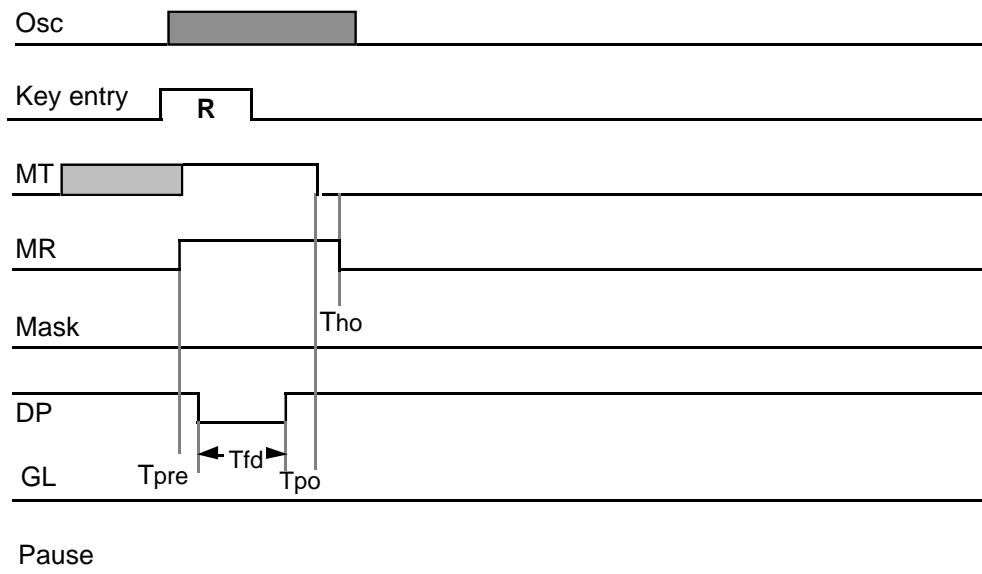
⬛ = depending on **Mute** key
(high when **Mute** key has been activated, otherwise low)

**Ground Loop (GL)**
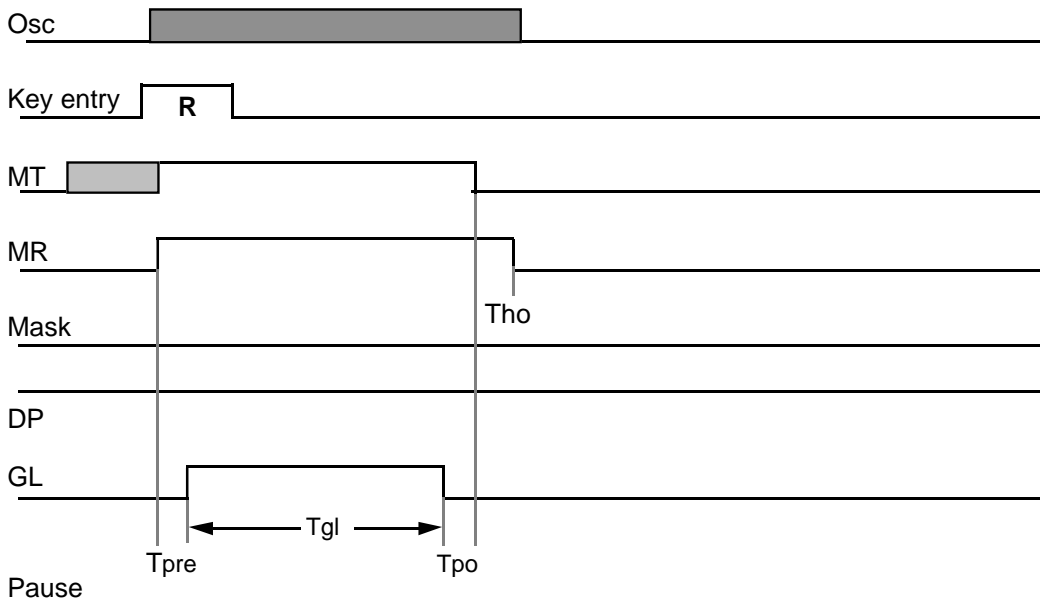
Osc

Key entry — **R**

MT

MR

Mask — Tho

DP

GL

Tpre | Tgl | Tpo

Pause

⬛ = depending on **Mute** key
(high when **Mute** key has been activated, otherwise low)

**Automatic Dialling LD** (content of LNR is GL, 2, 1 and GL is stored as access code)
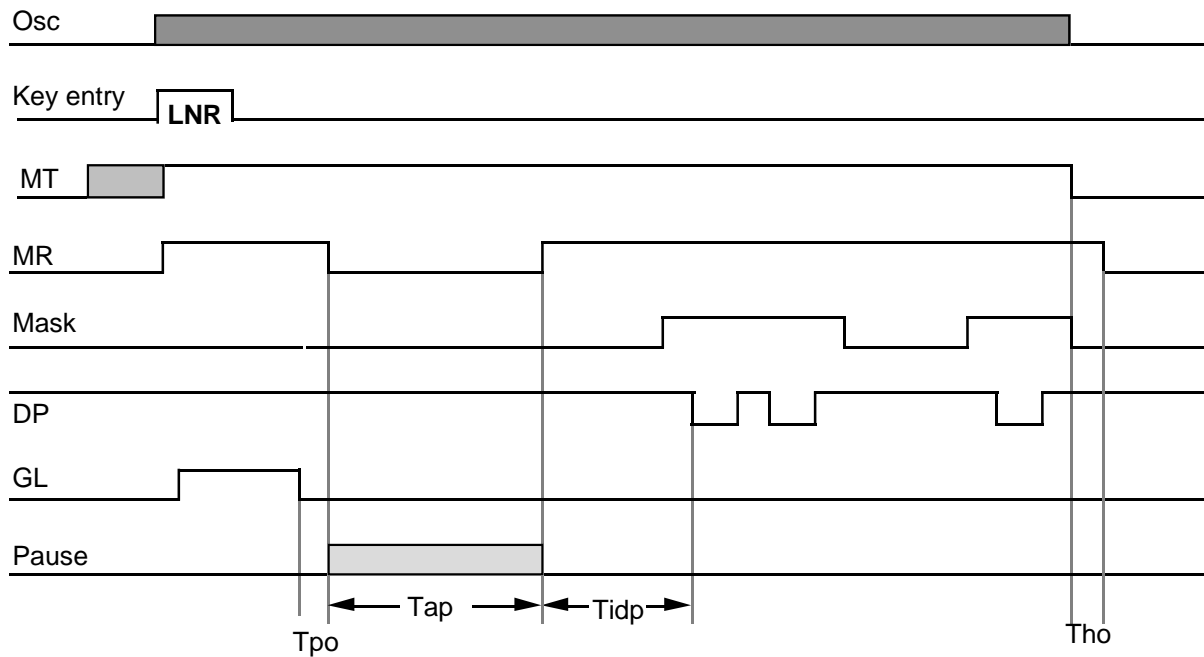
Osc

Key entry   **LNR**

MT

MR

Mask

DP

GL

Pause

Tap     Tidp

Tpo            Tho

= depending on **Mute** key
(high when **Mute** key has been activated, otherwise low)

**Automatic Dialling MF** (content of LNR is Flash, 1, 2, 3, and Flash is stored as access code)

Osc

Key entry   **LNR**

MT

MR

Mask

DP

GL

Tone

Pause

Tap

Tpo        Tmo
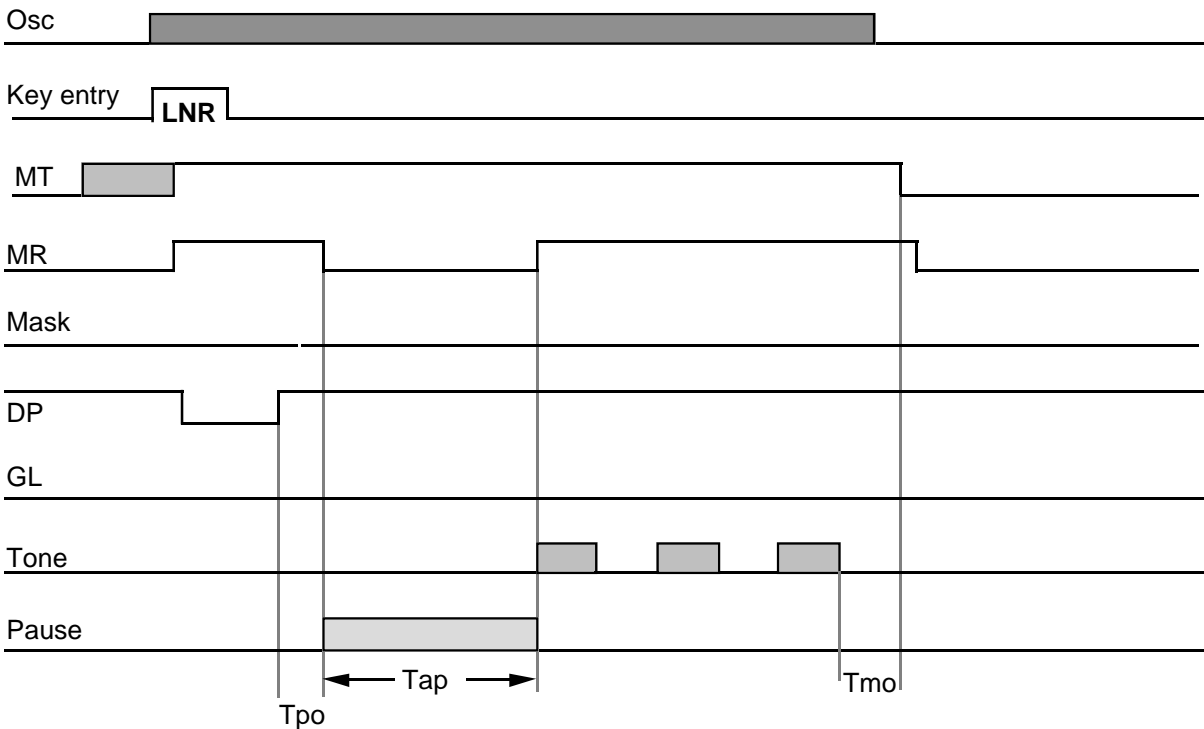
= depending on **Mute** key
(high when **Mute** key has been activated, otherwise low)

## Electrical Data

### Absolute Maximum Ratings

Positive Supply Voltage ..............................................................................-0.3V $\leq$ $V_{LS}$ $\leq$ 7V

Input Voltage .......................................................................-0.3V $\leq$ $V_{IN}$ $\leq$ $V_{DD}$ + 0.3V

Input Current ...................................................................................................$\pm$ 25 mA

Storage Temperature ..........................................................................-65°C to +125°C

Electrostatic Discharge (HBM) ...................................................................$\pm$1000V

### Recommended Operating Range

| Parameter | Symbol | Min | Typ | Max | Unit | Condition |
|---|---|---|---|---|---|---|
| Operating Temperatur | Top | - 25 | | 70 | °C | |
| Operating Voltage | $V_{DD}$ | 2.5 | 3.0 | 5.5 | V | |
| Retention Voltage | $V_{DD}$ | 1.8 | | 5.5 | V | |
| Oscillator Frequency | Fosc | | 681 | | kHz | |

### DC Characteristics

Default conditions: Recommended Operating Range; $V_{DD}$ = 3.0V.

| Parameter | Symbol | Min | Typ | Max | Unit | Condition |
|---|---|---|---|---|---|---|
| Supply Current | $I_{DD}$ | | | | | Outputs unloaded |
| Operating except MF | | | 200 | 250 | µA | |
| Operating MF | | | 0.75 | 1 | mA | |
| Data Retention | | | 1 | 2 | µA | $V_{DD}$=1.8V; note1 |
| | | | 2 | 4 | µA | Note 1 |
| Input Voltage | | | | | | |
| Low | Vil | $V_{SS}$ | | 0.3x$V_{DD}$ | V | |
| High | Vih | 0.7x$V_{DD}$ | | $V_{DD}$ | V | |
| Input Current | | | | | | |
| Low | Iil | | | 1 | µA | |
| High | Iih | | | 1 | µA | |
| Output Current | | | | | | |
| Sink | Iol | 1.5 | | | mA | Vol = 0.4V |
| Source | Ioh | 1 | | | mA | Voh = $V_{DD}$ - 0.4V |
| Pull-down Resistor | | | | | | |
| HS Input | Rhs | 1 | | | M$\Omega$ | |
| CD Input | Rcd | 1 | | | M$\Omega$ | |
| Scanning Current DT | | | | | | During Pause |
| Sink | Isl | 20 | | 150 | µA | |
| Source | Ish | 20 | | 150 | µA | |

Note 1: Circuit in Idle state (HS = Low and no key activated).

## Signalling Characteristics

Defaults conditions: Recommended Operating Range

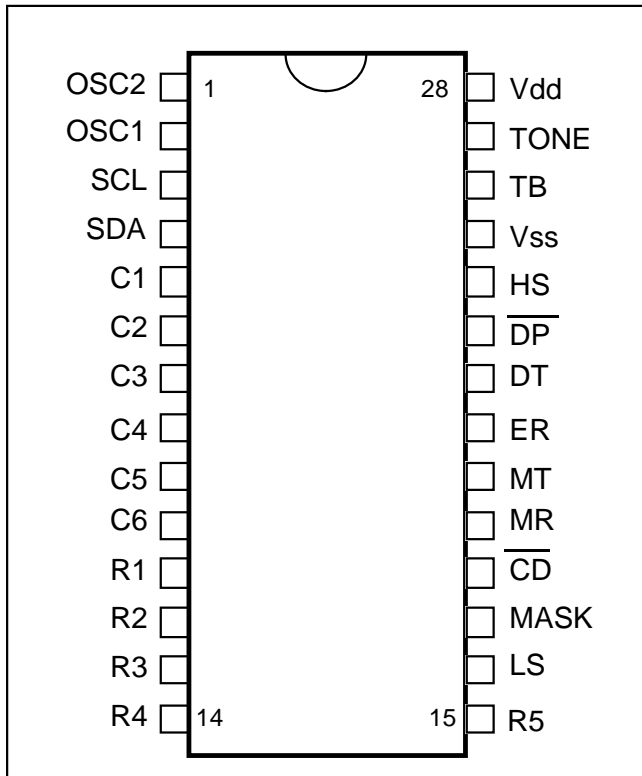| Parameter | Symbol | Min | Typ | Max | Unit | Condition |
|---|---|---|---|---|---|---|
| Clock Startup Time | Ts | | | 5 | ms | |
| Key Debounce Time | Td | 14 | | 18 | ms | |
| HS Debounce Time | Ths | 21 | | 26 | ms | |
| CD Reset Delay Time | Tr | | 2 | | sec | |
| DTMF | | | | | | |
|   Tone Level, High Group | Vol | - 12.4 | - 10.9 | - 9.4 | dBm | RL = 15 kΩ |
|   Preemphasis | | 2 | 2.5 | 2.8 | dBm | RL = 15 kΩ |
|   Distortion | | | | - 26 | dBr | RL = 15 kΩ, note 3 |
|   Tone Duration | Ttd | 80 | 82.3 | 85 | ms | Note 1 |
|   Inter Tone Pause | Titp | 80 | 82.3 | 85 | ms | Note 1 |
|   Tone Rise/Fall Time | Ttr | | | 5 | ms | Note 2 |
| LD | | | | | | |
|   Dial Rate | | | 10 | | pps | ± 5% |
|   Make/Break Period | Tm/Tb | | 33/66 | | ms | ± 5% |
|   (diode option) | | | 40/60 | | ms | ± 5% |
|   Inter Digit Pause | Tidp | 753 | | 785 | ms | |
|   Pre Digit Pause | Tpre | 55 | | 57 | ms | |
|   Post Digit Pause | Tpo | 55 | | 57 | ms | |
| Flash | | | | | | |
|   Duration | Tfd | 100 | 101.2 | 103 | ms | No diode 2 |
| | | 600 | | 620 | ms | With diode 2 |
| Earth Recall | Tg | | | | | |
|   Duration | | 500 | | 510 | ms | |
| Automatic Access Pause | Tap | | | | | |
|   Short | | 4 | 4.1 | 4.2 | sec | DT = Hi-Z |
|   Long | | 7.9 | 8 | 8.1 | sec | DT = Low |
|   Termination | | 1.15 | 1.2 | 1.25 | sec | DT = High |
| Mute Overhang | Tmo | 182 | 200 | 223 | ms | |
| MR/MT Hold Over | Tho | 18 | | 27 | ms | |
| Tone Burst | | | | | | |
|   Frequency | Fb | 700 | | 800 | Hz | |
|   Output Level | Vtb | -13 | -11 | -9 | dBm | |
|   Tone Duration | Ttb | 80 | | 85 | ms | |
|   Inter Tone Pause (LS) | Titb1 | 7 | 8 | 9 | sec | |
|   Inter Tone Pause (Mute) | Titp2 | 1.8 | 2 | 2.2 | sec | |
| Time-out | Tto | 7.7 | 8 | 8.2 | sec | |

Note 1:  The values are valid during automatic dialling and are minimum values during manual dialling, i.e. the tones will continue as long as the key is depressed.

Note 2:  The rise time is the time from valid key detection (key has been debounced) till the tone amplitude has reached 90 % of its final value.
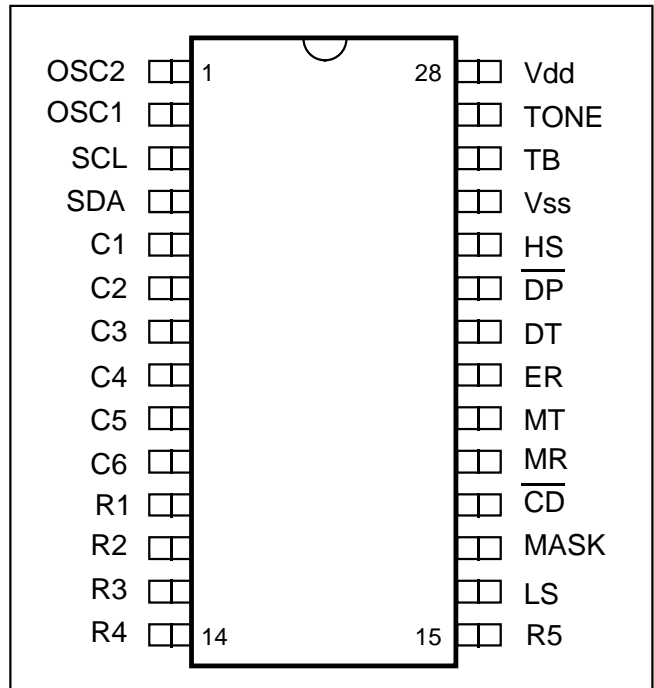
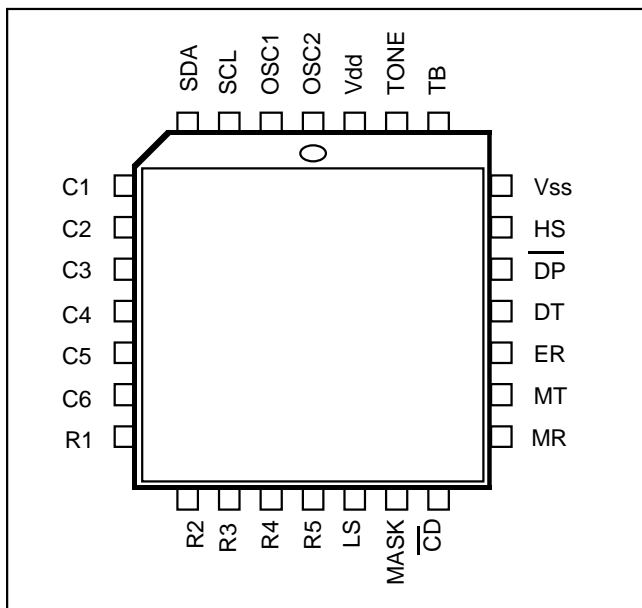Note 3:  Relative to high group.

## Pin Configuration

**28 Pin DIP**

| | | | |
|---|---|---|---|
| OSC2 | 1 | 28 | Vdd |
| OSC1 | | | TONE |
| SCL | | | TB |
| SDA | | | Vss |
| C1 | | | HS |
| C2 | | | $\overline{DP}$ |
| C3 | | | DT |
| C4 | | | ER |
| C5 | | | MT |
| C6 | | | MR |
| R1 | | | $\overline{CD}$ |
| R2 | | | MASK |
| R3 | | | LS |
| R4 | 14 | 15 | R5 |

**28 Pin SOIC**

| | | | |
|---|---|---|---|
| OSC2 | 1 | 28 | Vdd |
| OSC1 | | | TONE |
| SCL | | | TB |
| SDA | | | Vss |
| C1 | | | HS |
| C2 | | | $\overline{DP}$ |
| C3 | | | DT |
| C4 | | | ER |
| C5 | | | MT |
| C6 | | | MR |
| R1 | | | $\overline{CD}$ |
| R2 | | | MASK |
| R3 | | | LS |
| R4 | 14 | 15 | R5 |

**28 Pin PLCC**

Top pins: SDA  SCL  OSC1  OSC2  Vdd  TONE  TB

| | |
|---|---|
| C1 | Vss |
| C2 | HS |
| C3 | $\overline{DP}$ |
| C4 | DT |
| C5 | ER |
| C6 | MT |
| R1 | MR |

Bottom pins: R2  R3  R4  R5  LS  MASK  $\overline{CD}$

## Ordering Information

| Part number | Package |
|---|---|
| AS2574B P | 28 pin DIL |
| AS2574B N | 28 pin PLCC |