S-7235 Series

PULSE/DTMF SWITCHABLE DIALER

The S-7235 Series is a CMOS DTMF/PULSE switchable dialer, which has a 32-digit redial memory. Input is made from keyboard or CPU.

■ Features

· Operating supply voltage
PULSE mode: 1.5 V to 5.5 V
DTMF mode: 2.0 V to 5.5V

· Low current consumption
PULSE mode: 500 µA max. (3V)
DTMF mode: 1 mA max. (3V)

· Low data retention current:
0.1 µA max. (3V)

· Selectable make/break ratio of 33% and 40%

· Selectable dial speed of 10 pps and 20 pps in PULSE mode

· Selectable times for Flash and Auto-pause

· Selectable interface of 8-bit keyboard and 4-bit CPU (A2 and A2F types)

· Built-in 32-digit (or 31-digit including DTMF mode) redial memory

· 3.579545-MHz quartz crystal or ceramic oscillator

· Key-in-tone output responding to a valid key-input in PULSE mode (output time: 37.2 ms, frequency: 1.8 kHz)

■ Functions

· Flash

· Auto-pause

· Wait-pause

· Redialing inhibition

· Dialing inhibition

· Mixed dialing from PULSE mode to DTMF mode

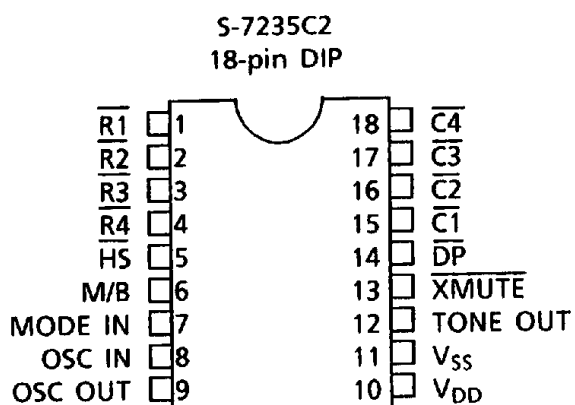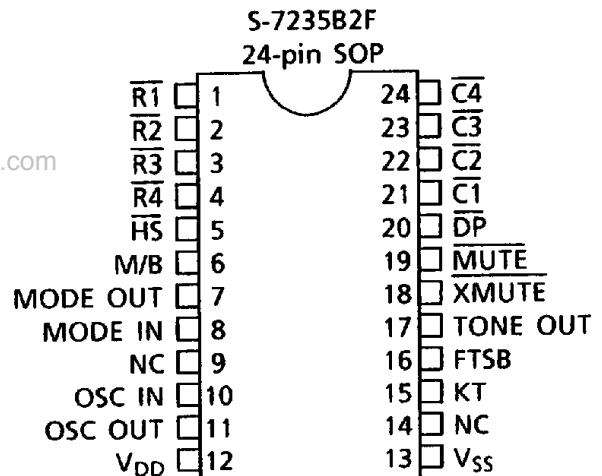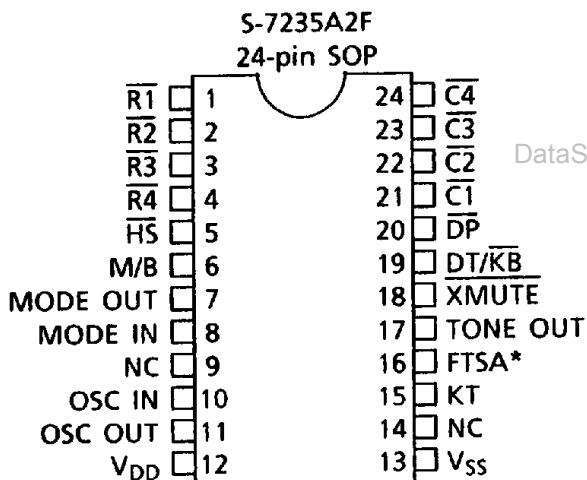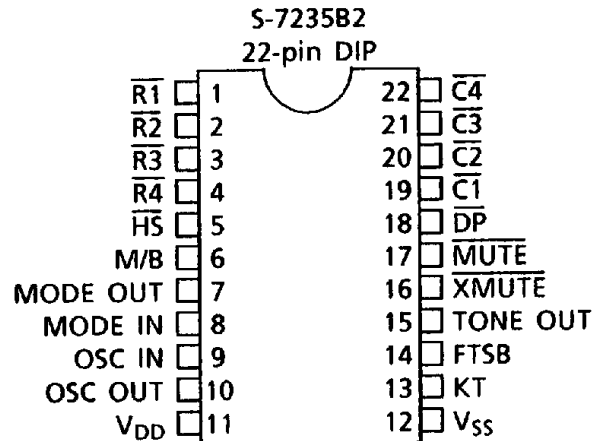· Mode selection of PULSE and DTMF modes and mode change from PULSE mode to DTMF mode

■ Timing Selection

Table 1

Item	Symbol	A2, A2F		B2, B2F		C2
		FTSA = high	FTSA = low	FTSB = high	FTSB = low	
Flash time	t_{FL}	608 ms	203 ms	933 ms	94.6 ms	933 ms
Flash-pause time	t_{FLP}	1.0 s	1.0 s	1.0 s	1.0 s	1.0 s
Auto-pause time	t_{AP}	3.6 s	3.6 s	2.0 s	2.0 s	2.0 s
DTMF signal output time (min.)	t_{MF}	70.9 ms	70.9 ms	84.5 ms	84.5 ms	84.5 ms
DTMF signal inter-pause time (min.)	t_{TIP}	81.1 ms	81.1 ms	87.9 ms	87.9 ms	87.9 ms

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■ Pin Arrangement

S-7235A2
22-pin DIP

Pin			Pin
$\overline{R1}$	1	22	$\overline{C4}$
$\overline{R2}$	2	21	$\overline{C3}$
$\overline{R3}$	3	20	$\overline{C2}$
$\overline{R4}$	4	19	$\overline{C1}$
$\overline{HS}$	5	18	$\overline{DP}$
M/B	6	17	$DT/\overline{KB}$
MODE OUT	7	16	$\overline{XMUTE}$
MODE IN	8	15	TONE OUT
OSC IN	9	14	FTSA
OSC OUT	10	13	KT
V_{DD}	11	12	V_{SS}

S-7235B2
22-pin DIP

Pin			Pin
$\overline{R1}$	1	22	$\overline{C4}$
$\overline{R2}$	2	21	$\overline{C3}$
$\overline{R3}$	3	20	$\overline{C2}$
$\overline{R4}$	4	19	$\overline{C1}$
$\overline{HS}$	5	18	$\overline{DP}$
M/B	6	17	$\overline{MUTE}$
MODE OUT	7	16	$\overline{XMUTE}$
MODE IN	8	15	TONE OUT
OSC IN	9	14	FTSB
OSC OUT	10	13	KT
V_{DD}	11	12	V_{SS}

S-7235A2F
24-pin SOP

Pin			Pin
$\overline{R1}$	1	24	$\overline{C4}$
$\overline{R2}$	2	23	$\overline{C3}$
$\overline{R3}$	3	22	$\overline{C2}$
$\overline{R4}$	4	21	$\overline{C1}$
$\overline{HS}$	5	20	$\overline{DP}$
M/B	6	19	$DT/\overline{KB}$
MODE OUT	7	18	$\overline{XMUTE}$
MODE IN	8	17	TONE OUT
NC	9	16	FTSA*
OSC IN	10	15	KT
OSC OUT	11	14	NC
V_{DD}	12	13	V_{SS}

S-7235B2F
24-pin SOP

Pin			Pin
$\overline{R1}$	1	24	$\overline{C4}$
$\overline{R2}$	2	23	$\overline{C3}$
$\overline{R3}$	3	22	$\overline{C2}$
$\overline{R4}$	4	21	$\overline{C1}$
$\overline{HS}$	5	20	$\overline{DP}$
M/B	6	19	$\overline{MUTE}$
MODE OUT	7	18	$\overline{XMUTE}$
MODE IN	8	17	TONE OUT
NC	9	16	FTSB
OSC IN	10	15	KT
OSC OUT	11	14	NC
V_{DD}	12	13	V_{SS}

S-7235C2
18-pin DIP

| Pin			Pin
$\overline{R1}$	1	18	$\overline{C4}$
$\overline{R2}$	2	17	$\overline{C3}$
$\overline{R3}$	3	16	$\overline{C2}$
$\overline{R4}$	4	15	$\overline{C1}$
$\overline{HS}$	5	14	$\overline{DP}$
M/B	6	13	$\overline{XMUTE}$
MODE IN	7	12	TONE OUT
OSC IN	8	11	V_{SS}
OSC OUT	9	10	V_{DD}

$\overline{R1}$ to $\overline{R4}$, $\overline{C1}$ to $\overline{C4}$	Key input or scan signal output
$\overline{HS}$	Hook switch on/off input
M/B	Make ratio selection input
MODE OUT	Operation mode output
MODE IN	Mode change input
OSC IN	Oscillator connection input
OSC OUT	Oscillator connection output
$\overline{DP}$	Dial pulse output
$DT/\overline{KB}$	CPU control/keyboard input
$\overline{MUTE}$	Mute output
$\overline{XMUTE}$	Transmit mute output
TONE OUT	DTMF signal output
FTSA, FTSB	Flash time selection input
KT	Key-in-tone output

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■ Block Diagram
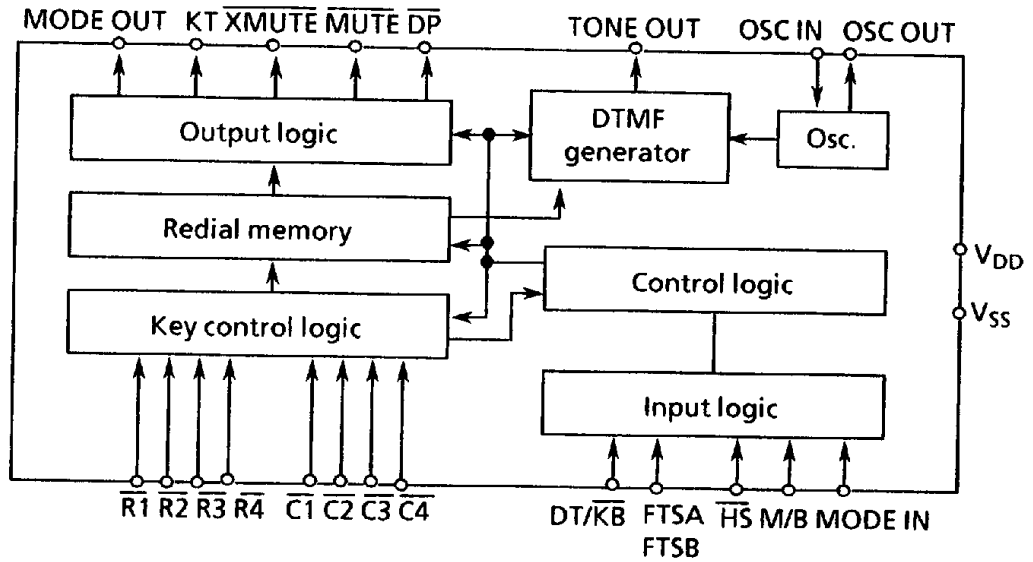
■ Keyboard Matrix
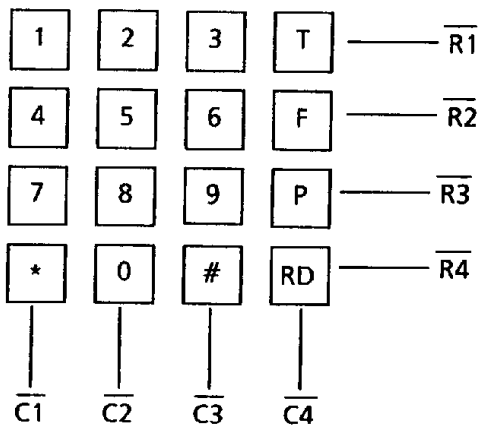
Key	Function
T :	PULSE mode: Mode change from PULSE to DTMF DTMF mode: Wait pause (Dial data ending code)
F :	Flash
P :	Auto-pause
RD :	Redial
0 to 9 :	Data
# , * :	Data (at DTMF mode only)

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■ Key Operation

↑ : Off hook ($\overline{HS}$ = low)

1. Normal dialing

1.1 PULSE mode (MODE IN = high or open)   ↑ | D_1 | to | D_n |

1.2 DTMF mode (MODE IN = low)   ↑ | D_1 | to | D_n |

1.3 DTMF mode (MODE IN = low)   ↑ | D_1 | to | D_n | T | | D'_1 | to | D'_n |

(| T | distinguishes DTMF data.)

2. Mixed dialing

2.1 Change by | T | (MODE IN = high or open)   ↑ | D_1 | to | D_n | T | | D'_1 | to | D'_n |

             PULSE mode   DTMF mode

2.2 Change by MODE IN   ↑ | D_1 | to | D_n | | D'_1 | to | D'_n |

             PULSE mode   DTMF mode

(MODE IN = high or open) | (MODE IN = low)

3. Redialing

↑ | RD |

Only data | D_1 | to | D_n | are redialed after normal dial (when the redialing mode is returned to DTMF mode) or mixed dial.

4. Redialing inhibition

↑ | D_1 | to | RD | | RD |

(| RD | is input after whole data are dialed.)

5. All redialing valid

↑ | D_1 | to | RD |

(| RD | is input after whole data are dialed.)

6. Auto-pause release

↑ | RD | to | P | (or | T |, | RD |)

(| P | is input during auto-pause time.)

7. Wait-pause release

↑ | RD | to | T | (or | P |, | RD |)

(| T | is input during wait-pause time.)

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■ Operation

1. Normal dialing

- After Off-Hook, a mode is set up depending upon the state of MODE IN. When any key of [0] to [9] in PULSE mode, or of [0] to [9] , [*], [#] in DTMF mode is input, a PULSE/DTMF signal corresponding to the key is output.

- Redial memory has 32 digits and [0] to [9] , [*], [#] , [P] , [T] , [F] are stored in the redial memory each as one digit. Digits after the 32nd erase the old digits and rewrite the redial memory from digit 1.

- After Off-Hook, when the first key-input is [0] to [9] , [F] in PULSE mode, [0] to [9] , [*], [#] , [F] in DTMF mode, the redial memory is cleared and the key-input data is stored from digit 1 of the redial memory.

- In normal dialing in PULSE mode, the dial rate (20 pps/10 pps) is decided when a key is input to digit 1. In redialing after Off-Hook in PULSE mode, the dial rate is decided at [RD] . The dial rate is effective until it is reset by executing flash.

【 Note 】 [RD] cannot be accepted in normal dialing.

2. Mode change (Mixed dialing from PULSE mode to DTMF mode)

- Mixed dialing is available from PULSE mode to DTMF mode. There are two methods as follows:
  - · MODE IN is set from PULSE mode (high or open) to DTMF mode (low) and normal dialing is executed.
  - · [T] is input when MODE IN is at PULSE mode and normal dialing is executed.

- Mode change code and data code are input to the redial memory, and then successive DTMF data is output. When returning to PULSE mode, MODE IN is set to high or open and flash is executed.

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3. Redialing

- By inputting ⌷RD⌷ initially after Off-Hook, data in the redial memory is output. Output data is as follows:
  - · PULSE data at mixed dialing ⋯ (1)
    - When ⌷F⌷ is input in PULSE data, only the data before ⌷F⌷ is redialed.
  - · DTMF data from digit 1 of the redial memory to ⌷T⌷ when ⌷T⌷ is input at normal dialing in DTMF mode ⋯ (2)
    - When ⌷F⌷ is input before ⌷T⌷ , only the data before ⌷F⌷ is redialed.
  - · When digit 1 of the redial memory is ⌷F⌷ in normal or mixed dialing, the data after ⌷F⌷ is output in the same way as (1) and (2) after flash execution.

- Regardless of the MODE IN state, redialed data is output in a mode of the redial memory.

- 〔 Complete redialing 〕 When ⌷RD⌷ is input once after normal dialing is completed, and then input it again after Off-Hook, all the data of the redial memory is output. ⋯ (3)

- 〔 Redialing inhibition 〕 Redialing is inhibited in the following cases:
  - · When the redial memory overflows: data over 33 digits in PULSE mode or 32 digits in DTMF mode is input.
  - · When ⌷RD⌷ is input twice after normal dialing is completed. After inhibiting redialing, normal dialing can be done; its data cannot be redialed.

  Redialing inhibition is reset by the first normal dialing after $\overline{HS}$ is turned from V_{DD} (On-Hook) to V_{SS} (Off-Hook).

- 〔 Normal dialing after redialing 〕
  - · In case of (1) or (2), normal dialing data after redialing is not output at the following redialing.
  - · In case of (3), normal dialing data after redialing is input after the last data of the redial memory and output at the following redialing.
  - · When normal dialing data in DTMF mode is input after redialing in DTMF mode, ⌷T⌷ is input automatically between redialed data and data after redialing. At the following redialing, only the redialed data is redialed. When complete redialing mode is set, at the following redialing the redialed data is output, wait-pause is executed, and reset, and the data after redialing is redialed.

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4. Pause

4.1 Auto-pause

- $\boxed{P}$ input before normal dialing enables auto-pause. When a $\boxed{P}$ is input, an auto-pause is executed during the auto-pause time (t_{AP}). $\boxed{P}$ can be input n times to make an auto-pause time of n × t_{AP}.

- When all data are dialed at normal dialing, and then $\boxed{P}$ is input, auto-pause is not executed at that time but is executed at the following redialing. When $\boxed{P}$ is input during dialing, $\boxed{P}$ is dialed from the redial memory and then an auto-pause is executed.

- The first $\boxed{P}$ input after Off-Hook is ignored.

- When $\boxed{P}$, $\boxed{T}$ or $\boxed{RD}$ is input during executing an auto-pause or subsequent auto-pauses after redialing, the auto-pause is reset and next data is dialed.

- [Mode change and auto-pause] When mode change instruction from PULSE mode to DTMF mode is executed by MODE IN or $\boxed{T}$ during normal dialing (including inter-digital pause time, and auto-pause execution time), auto-pause is executed after the mode change. When mode change instruction is after normal dialing, however, auto-pause is not executed. When $\boxed{P}$ is input before or after mode change, auto-pause is executed after mode change.

4.2 Wait-pause

- The following cases lead to wait-pause, which temporarily stops data dialing after mode change with MODE OUT on and off.
  - After redialing when $\boxed{P}$ is input neither before nor after mode change at mixed dialing, and $\boxed{RD}$ is input after mode change.
  - After redialing when $\boxed{P}$ is input neither before nor after mode change in DTMF mode, and $\boxed{RD}$ is input after normal dialing.

- [Reset] $\boxed{T}$, $\boxed{RD}$ or $\boxed{P}$ is input. After reset, next data is dialed.

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5. Flash

- $\boxed{\text{F}}$ input causes On-Hook state temporarily. $\boxed{\text{F}}$ is stored in the redial memory, and when $\boxed{\text{F}}$ is dialed, flash is executed. After flash, flash-pause is executed. Flash time (t_{FL}) is selected by FTSA or FTSB.

- During flash or flash-pause, normal dialing is valid. Input data is dialed after flash-pause.

- During flash or flash-pause, MODE OUT is off, which means it is set to PULSE mode. Normal dialing mode is reset by MODE IN after flash. After reset, data code is input in PULSE mode in the redial memory, and mode change code and data code are input in DTMF mode.

6. Key-in-tone
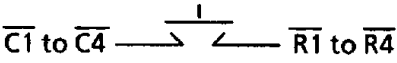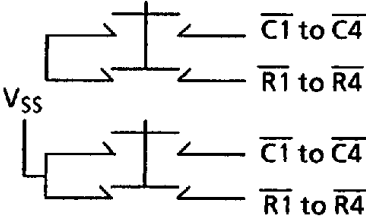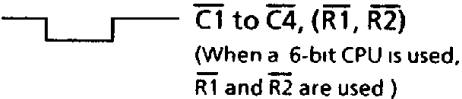
- The key-in-tone is a sound that confirms that key-input has been executed. It is output after reading valid key-input in PULSE mode.

- Key-in-tone is not output in the following cases:
  - Key-input for releasing auto-pause or wait-pause at redialing
  - $\boxed{\text{F}}$ or $\boxed{\text{T}}$ input

7. Dialing inhibition

- [Input through single-contact type keyboard] All key-input can be inhibited by turning DT/$\overline{\text{KB}}$ to high or $\overline{\text{C4}}$ to low. As long as $\overline{\text{C4}}$ is low, the oscillation circuit operates.

- [Input through CPU] All key-input is inhibited by turning $\overline{\text{R4}}$ to low.

- Data input before inhibition is output during redialing in the usual way.

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■ Pin Functions

Pin name	Functions
$\overline{R1}$ to $\overline{R4}$ $\overline{C1}$ to $\overline{C4}$	• Key inputs. Interfaces with keyboard and with CPU are available. There are three types of keyboard: single-contact, 2 of 7, and 2 of 8. Their contact resistance is $10\,k\Omega$ max. Single-contact keyboard $\overline{C1}$ to $\overline{C4}$ ———⟍⟋——— $\overline{R1}$ to $\overline{R4}$ 2 of 7 keyboard 2 of 8 keyboard V_{SS} ⟍⟋——— $\overline{C1}$ to $\overline{C4}$ / $\overline{R1}$ to $\overline{R4}$ CPU ⎍ $\overline{C1}$ to $\overline{C4}$, ($\overline{R1}$, $\overline{R2}$) (When a 6-bit CPU is used, $\overline{R1}$ and $\overline{R2}$ are used) • A chatter-free circuit at key-on/off is built in. Detection time: 16.9 ms typ. Allowable time lag between column and row inputs: 6 ms max. Valid key-input time: 50 ms min. (25 ms min. while oscillating circuit is running) Pause time between key-input: 25 ms min. • Preceding key-input is valid, and simultaneous key-inputs are invalid. • When $\overline{HS}$ is high, columns and rows become high impedance. When $\overline{HS}$ is low in keyboard input, columns become high and rows become low. Key-input is read by connecting columns and rows to each other in a matrix or to V_{SS} corresponding to input key. When $\overline{HS}$ is low in CPU input, columns and rows are pulled up with $100\,k\Omega$, data is input by $\overline{C1}$ to $\overline{C4}$ and $\overline{R1}$, $\overline{R2}$ (when 6-bit input) with code corresponding to key-code. All columns and rows become high between key input digits. • When two keys of same column (excluding $\overline{C4}$) or same row in DTMF mode of keyboard-input are input simultaneously, single tone is output. High frequency group is output when same column, and low group when same row.

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Pin name	Functions

$\overline{HS}$	• Hook switch signal input in CMOS input
	
	      $\overline{HS} = V_{DD}$: On-Hook mode
	
	      $\overline{HS} = V_{SS}$: Off-Hook mode
	
	• In On-Hook mode, inputs are inhibited and the internal circuit is initialized: key inputs, KT, TONE OUT, MODE IN, MODE OUT, $\overline{DP}$, $\overline{XMUTE}$, and $\overline{MUTE}$ become high impedance.
	
	• In Off-Hook mode, an internal voltage regulator for control of output level of DTMF signal operates and key inputs are in standby mode. Once a key is input, the oscillating circuits start to operate.
	
	• For internal initialization in power ON, $\overline{HS}$ must remain high for 1 ms or longer (5 ms is recommended) when V_{DD} is 1 V or more.

M/B	• Dial pulse make/break ratio selection signal input in CMOS input
	
	      M/B = V_{DD} : 40%
	
	      M/B = V_{SS} : 33.3%

MODE OUT	• Mode output in Nch opendrain output • Turns off during On-Hook, in PULSE mode, during Flash or flash-pause; turns on in DTMF mode. • Blinks during wait-pause in redialing. Blinking frequency : 2.3 Hz typ.

MODE IN	• PULSE (10 pps/20 pps) /DTMF mode selection input in CMOS input
	
	      MODE IN = V_{DD} : PULSE mode 20 pps
	
	      MODE IN = open : PULSE mode 10 pps
	
	          (Allowable leakage resistance betweeen MODE IN and power supply: 2 MΩ or more)
	
	      MODE IN = V_{SS} : DTMF mode
	
	• When $\overline{HS}$ is V_{DD}, MODE IN becomes high impedance.
	
	• To prevent malfunction due to noise from telephone line circuit, connect a capacitor of 1000 pF between MODE IN and V_{SS}.

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Pin name	Functions
OSC IN OSC OUT	• A 3.579545MHz quartz crystal or ceramic resonator is connected between OSC IN and OSC OUT. • In case of ceramic resonator, 30 pF of external capacitor is required between OSC IN and V_{DD}, and between OSC OUT and V_{DD}.

V_{DD}	• Positive power supply. PULSE mode (quartz crystal) 1.5 V to 5.5 V
	  (ceramic) 2.0 V to 5.5 V
	                       DTMF mode 2.0 V to 5.5 V

V_{SS}	• Negative power supply. Connected to GND.

KT	• Key-in-tone output in CMOS output. The signal is output for valid key-input in PULSE mode.
	     Output duration : 37.2 ms typ.
	     Output frequency : 1.8 kHz (Duty ratio: 50%)
	• It is in high impedance when the signal is not output.

$\overline{XMUTE}$	• Transmit mute output in Nch opendrain output. • It outputs low (on) in PULSE/DTMF dialing (including t_{PDP}, t_{TPP}, t_{IDP}, and t_{TIP}), and flash; it outputs high impedance (off) in other operations.
$\overline{MUTE}$	• Mute output in Nch opendrain output. • It outputs low (on) in PULSE dialing (including t_{PDP} and t_{IDP}), and flash; it outputs high impedance (off) in other operations.
$\overline{DP}$	• Dial pulse output in Nch opendrain output. • It outputs low (on) at break in PULSE dialing and flash; it outputs high impedance (off) in other operations. PULSE signals are output after t_{PDP} when $\overline{XMUTE}$ and $\overline{MUTE}$ were low; $\overline{XMUTE}$ and $\overline{MUTE}$ become high impedance after t_{MOP1} or t_{MOP2} has passed, following the last PULSE signal transmission.

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Pin name	Functions
TONE OUT	• DTMF signal output in Pch opendrain output. • It is in high impedance when the signal is not output. • The minimum DTMF tone duration in both redialing and normal dialing is t_{MF}. If a key-depression in normal dialing is longer than t_{MF}, a DTMF signal is output until the key is released.
FTSA/FTSB	• Selection of flash time in CMOS input.
DT/$\overline{KB}$	• Selection of interface (CPU or keyboard) in CMOS input.

DT/$\overline{KB}$ = low	Interfaces with 8-bit keyboard							
DT/$\overline{KB}$ = high	Interfaces with CPU (usually 4-bit)							
	$\overline{C1}$	$\overline{C2}$	$\overline{C3}$	$\overline{C4}$	$\overline{R1}$	$\overline{R2}$	$\overline{R3}$	$\overline{R4}$	Remarks
	0	1	0	1	1	1	1	1	[1]
	1	0	0	1	1	1	1	1	[2]
	0	0	0	1	1	1	1	1	[3]
	1	1	0	1	1	1	1	1	[T]
	0	1	1	0	1	1	1	1	[4]
	1	0	1	0	1	1	1	1	[5]
	0	0	1	0	1	1	1	1	[6]
	1	1	1	0	1	1	1	1	[F]
	0	1	0	0	1	1	1	1	[7]
	1	0	0	0	1	1	1	1	[8]
	0	0	0	0	1	1	1	1	[9]
	1	1	0	0	1	1	1	1	[P]
	0	1	1	1	1	1	1	1	[*]
	1	0	1	1	1	1	1	1	[0]
	0	0	1	1	1	1	1	1	[#]
	1	1	1	1	0	1	1	1	[RD]
	1	1	0	1	1	0	1	1	Single-tone : low 697 Hz
	1	1	1	0	1	0	1	1	Single-tone : low 770 Hz
	1	1	0	0	1	0	1	1	Single-tone : low 852 Hz
	1	1	1	1	1	0	1	1	Single-tone : low 941 Hz
	0	1	1	1	1	0	1	1	Single-tone : high 1209 Hz
	1	0	1	1	1	0	1	1	Single-tone : high 1336 Hz
	0	0	1	1	1	0	1	1	Single-tone : high 1477 Hz

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■ DTMF Signal Frequencies

(f_{OSC} = 3.579545 MHz)

Key-in		Std. freq.	Output freq.	Error
Low	$\overline{R1}$	697 Hz	694.79 Hz	– 0.32%
	$\overline{R2}$	770 Hz	771.45 Hz	+ 0.19%
	$\overline{R3}$	852 Hz	853.90 Hz	+ 0.22%
	$\overline{R4}$	941 Hz	940.01 Hz	– 0.11%
High	$\overline{C1}$	1209 Hz	1209.31 Hz	+ 0.03%
	$\overline{C2}$	1336 Hz	1331.68 Hz	– 0.32%
	$\overline{C3}$	1477 Hz	1471.85 Hz	– 0.35%

■ Application Circuit (in case of S-7235A2)
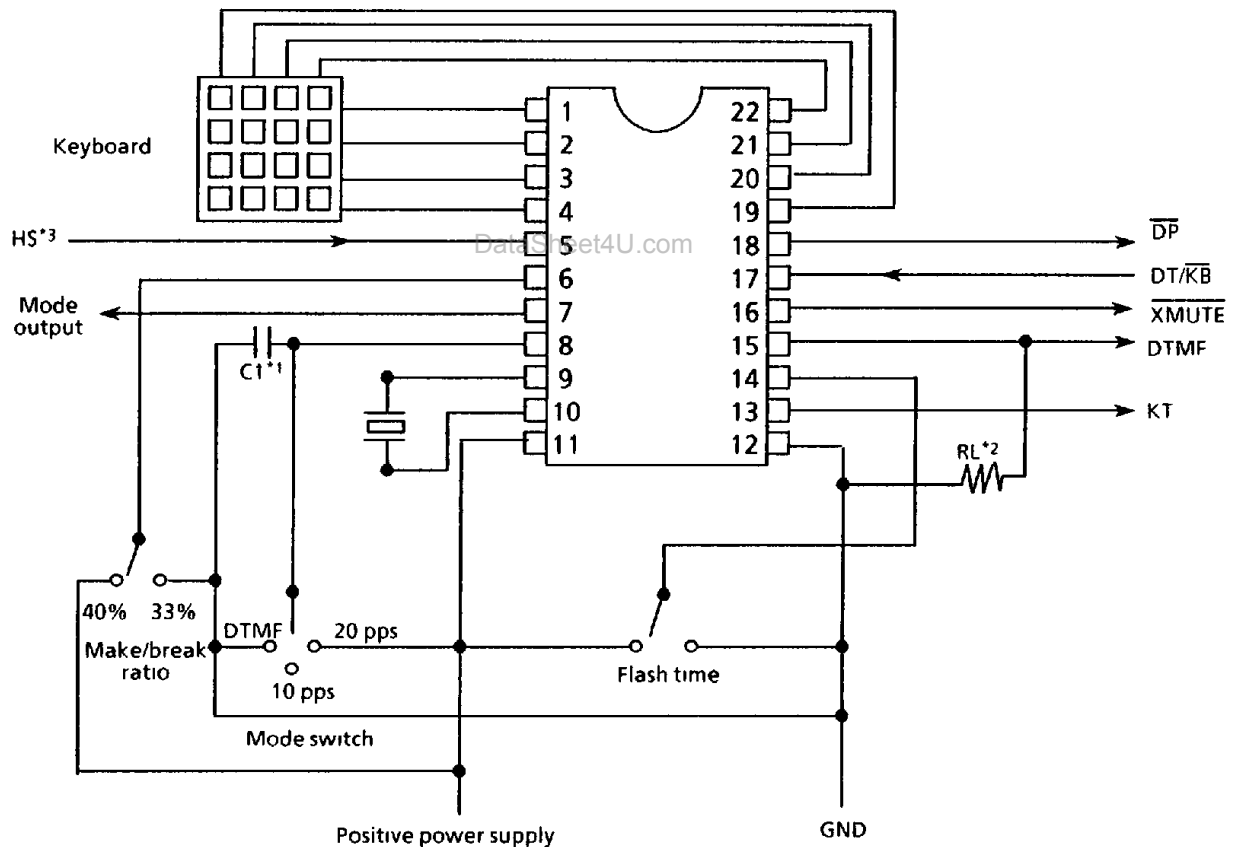
*1   C1 = 1000 pF

*2   5 kΩ ≤ RL ≤ 50 kΩ (10 kΩ is recommended)

*3 $\overline{HS}$ is set to become high (On-Hook) at power on $\overline{HS}$ remains high
for 1 to several ms when V_{DD} is 1 V or more.

Note: When interfacing with keyboard, to improve noise characteristics, 100 pF to 600 pF
of capacitor should be connected between key-input pins and GND. Also, to
improve noise characteristics in mode change input, oscillating circuit parts and C1
capacitor should be connected as closely as they are on the S-7235 Series

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■ Dimensions (Unit : mm)

1. 22-pin DIP
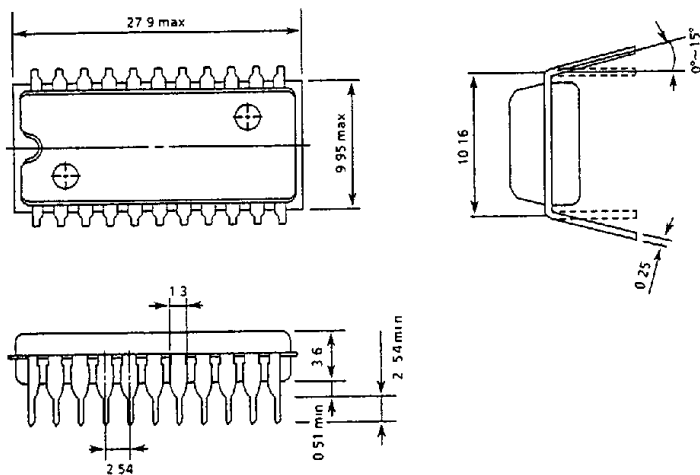
2. 24-pin SOP
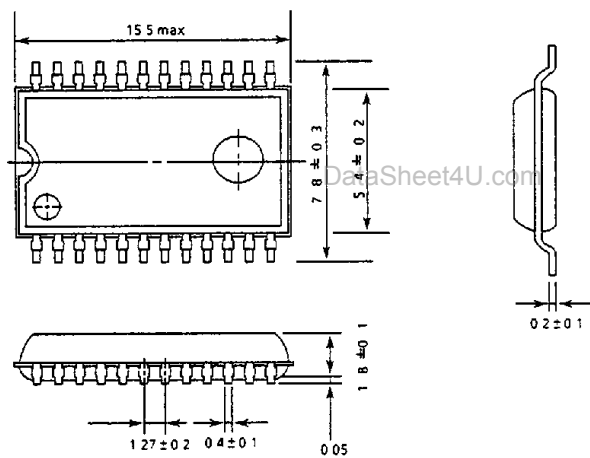
3. 18-pin DIP
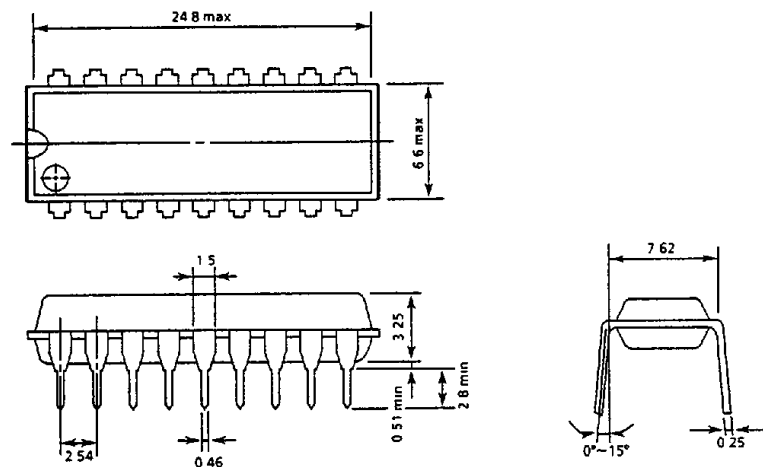
Material: Plastics
Not designed for radiation resistant

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■ Ordering Information

Product name	Package
S-7235A2	22-pin DIP
S-7235B2	22-pin DIP
S-7235C2	18-pin DIP
S-7235A2F-A	24-pin SOP
S-7235B2F-A	24-pin SOP

■ Absolute Maximum Ratings

$(V_{SS} = 0\ V,\ Ta = 25°C)$

Item	Symbol	Conditions	Ratings
Power supply voltage	V_{DD}		$-0.3\ V$ to $+6.0\ V$
Input voltage	V_{IN}	Input pins	$-0.3\ V$ to $V_{DD} + 0.3\ V$
Output voltage	V_{OUT1}	$\overline{XMUTE}$, $\overline{MUTE}$, $\overline{DP}$, MODE OUT	$-0.3\ V$ to $+12\ V$
	V_{OUT2}	TONE OUT, KT	$-0.3\ V$ to $V_{DD} + 0.3\ V$
Operating temperature	T_{opr}		$-30°C$ to $+70°C$
Storage temperature	T_{stg}		$-40°C$ to $+125°C$

■ Operating Conditions

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating voltage	V_{DD1}	Quartz crystal used, PULSE mode*1	1.5	—	5.5	V
	V_{DD2}	Quartz crystal used, DTMF mode*1	2.0	—	5.5	V
	V_{DD3}	Ceramic used*2	2.0	—	5.5	V
Load resistance	RL	Between TONE OUT and V_{SS}	5	—	50	kΩ
Oscillating freq.	f_{OSC}		—	3.579545	—	MHz

*1　Quartz crystal CI ≦ 100Ω, | △f | ≦ 200 ppm　Ta = −30°C to +70°C

*2　Ceramic　　Murata Mfg Co., Ltd. CST 3.58 MGU 300AB (C_G and C_D are built in)

Matsushita Electronic Components Co., Ltd. EFO − FC3584A (C_G and C_D are built in)

Fujitsu Ltd. FAR-C4SA-03580000-K01 (C_G and C_D are built in)

S-7235 Series

■ Electrical Characteristics

1. DC characteristics

(Unless otherwise specified : V_{DD} = 3 V, V_{SS} = 0 V, Ta = 25°C)

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit
Operating current consumption	I_{DD1}	PULSE mode $\overline{HS}$ = V_{SS} Output open	V_{DD} = 3.0 V	—	—	0.5	mA
	I_{DD2}		V_{DD} = 5.5 V	—	—	2.0	mA
	I_{DD3}	DTMF mode $\overline{HS}$ = V_{SS} Output open	V_{DD} = 3.0 V	—	—	1.0	mA
	I_{DD4}		V_{DD} = 5.5 V	—	—	4.0	mA
Standby current	I_{SD1}	$\overline{HS}$ = V_{DD}	V_{DD} = 3.0 V	—	—	0.1	μA
	I_{SD2}		V_{DD} = 5.5 V	—	—	10	μA
Data retention voltage	V_{DR}			1.0	—	5.5	V
Input voltage	V_{IH}	V_{DD} = 1.5 V to 5.5 V		$0.8 \times V_{DD}$	—	V_{DD}	V
	V_{IL}			0	—	$0.2 \times V_{DD}$	V
Input current	I_{IH1}	$\overline{C1}$ to $\overline{C4}$ $\overline{R1}$ to $\overline{R4}$	Key I/O = low V_{IH} = 0.5 V	75	—	—	μA
	I_{IL1}		Key I/O = high V_{IL} = V_{SS}	−75	−30	−12	μA
	I_{IH2}	MODE IN	Low level: V_{IH} = V_{DD}	10	30	90	μA
	I_{IL2}		High level: V_{IL} = 0 V	−90	−30	−10	μA
Input leakage current	I_{ILK}	$\overline{HS}$, M/B, FTSA, FTSB, DT/$\overline{KB}$ V_{IN} = V_{DD} or 0 V, V_{DD} = 5.5 V		−2.0	0.0	2.0	μA
		$\overline{C1}$ to $\overline{C4}$, $\overline{R1}$ to $\overline{R4}$, MODE IN, $\overline{HS}$ = V_{DD} V_{IN} = V_{DD} or 0 V, V_{DD} = 5.5 V		−2.0	0.0	2.0	μA
Output current	I_{OH1}	KT	V_{OH} = 2.5 V	—	—	−0.5	mA
	I_{OL1}		V_{OL} = 2.5 V	0.5	—	—	mA
	I_{OL2}	$\overline{DP}$, $\overline{XMUTE}$, $\overline{MUTE}$, MODE OUT V_{OL} = 0.5 V		1.4	4.0	—	mA
Output off-leakage current	I_{OLK1}	KT, $\overline{DP}$, $\overline{XMUTE}$, $\overline{MUTE}$, MODE OUT V_{OUT} = V_{DD} or 0 V, V_{DD} = 5.5 V		−2.0	0.0	2.0	μA

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(Unless otherwise specified : V_{DD} = 3 V, V_{SS} = 0 V, Ta = 25°C)

	Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
D T M F	Off-leakage current	I_{OLK2}	V_{OUT} = V_{DD} or 0 V, V_{DD} = 5.5 V	– 2.0	0.0	2.0	µA
	Row tone output	V_{TR}	V_{DD} = 5.5 V	– 14.3	—	– 10.5	dBm*
	Column – Row tone pre-emphasis	C/R		2.0	2.5	3.0	dB
	Harmonic distortion	% DIS	R_L = 10 kΩ	—	2	10	%
Oscillation startup time		t_{OSC}		—	2	—	ms

* 0 dBm = 0.755 Vrms

2. AC characteristics

	Item	Symbol	Conditions		Min.	Typ.	Max.	Unit
P U L S E m o d e	Make-break ratio	M/B	M/B = V_{DD} (40%)		—	40.0	—	%
			M/B = V_{SS} (33%)		—	33.3	—	%
	Dial rate	DR	MODE IN = open (10 pps)		—	9.86	—	pps
			MODE IN = V_{DD} (20 pps)		—	19.73	—	pps
	Pre-digital pause	t_{PDP}	10 pps	33%	—	33.79	—	ms
				40%	—	40.55	—	ms
			20 pps	33%	—	16.90	—	ms
				40%	—	20.28	—	ms
	Make time	t_M	10 pps	33%	—	33.79	—	ms
				40%	—	40.55	—	ms
			20 pps	33%	—	16.90	—	ms
				40%	—	20.28	—	ms
	Break time	t_B	10 pps	33%	—	67.58	—	ms
				40%	—	60.83	—	ms
			20 pps	33%	—	33.79	—	ms
				40%	—	30.41	—	ms
	Inter-digital pause time	t_{IDP}	10 pps	33%	—	658.9	—	ms
				40%	—	838.0	—	ms
			20 pps	33%	—	469.7	—	ms
				40%	—	473.1	—	ms
	XMUTE, MUTE overlap time	t_{MOP1}	10 pps	33%	—	621.8	—	ms
				40%	—	794.1	—	ms
			20 pps	33%	—	449.4	—	ms
				40%	—	449.4	—	ms
		t_{MOP2}			—	449.4	—	ms

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	Item		Symbol	Conditions			Min.	Typ.	Max.	Unit
D T M F m o d e	Tone output pre-digital pause		t_{TPP}				—	3.38	—	ms
	Tone duration		t_{MF}	A2, A2F type			—	70.9	—	ms
				B2, B2F, C2 type			—	84.5	—	ms
	Tone inter-pause time		t_{TIP}	A2, A2F type			—	81.1	—	ms
				B2, B2F, C2 type			—	87.9	—	ms
	Tone output off delay time		t_{MFD}				—	24.0	—	ms
	XMUTE overlap time		t_{MOT1}	t_{TIP} = 81.1 ms			—	74.3	—	ms
				t_{TIP} = 87.9 ms			—	81.1	—	ms
			t_{MOT2}				—	3.38	—	ms
				T is accessed			—	6.76	—	ms
	Tone output period		t_T	t_{MF} + t_{TIP}	A2, A2F type		—	152.0	—	ms
					B2, B2F, C2 type		—	172.4	—	ms
Auto-pause	Timer pause		t_{AP}	A2, A2F type			—	3.6	—	s
				B2, B2F, C2 type			—	2.0	—	s
F l a s h	Flash time		t_{FL}	A2, A2F type	FTSA = high		—	608.0	—	ms
					FTSA = low		—	203.0	—	ms
				B2, B2F type	FTSB = high		—	933.0	—	ms
					FTSB = low		—	94.6	—	ms
				C2 type	FTSB = high		—	933.0	—	ms
	Flash-pause time		t_{FLP}				—	1.0	—	s
K e y i n	Valid key input		t_{KIN}	While oscillating			25.0	—	—	ms
							50.0	—	—	ms
	Pause-time btwn valid keys		t_{KIP}				25.0	—	—	ms
	Chattering free time		t_{CH}	Key-on and key-off			—	16.9	—	ms
	Key scan frequency		f_{KS}	$\overline{C1}$ to $\overline{C4}$, $\overline{R1}$ to $\overline{R4}$			—	296	—	Hz
K e y I n t o n e	Key-in-tone output time		t_{KT}				—	37.2	—	ms
	Key-in-tone frequency		f_{KT}				—	1776	—	Hz
	Key-in-tone output delay time		t_{MKT}				—	6.76	—	ms
	Key-in-tone output startup time		t_{KTS}				—	36.0	—	ms
XMUTE MUTE	XMUTE, MUTE output startup time		t_{KMS}				—	30.0	—	ms
MODE IN	MODE IN scan frequency		f_{MIN}				—	148.0	—	Hz
MODE OUT	MODE OUT blink		t_{MFL}				—	432.0	—	ms
	MODE OUT output startup time		t_{MO1}				—	24.0	—	ms
			t_{MO2}				—	1.9	—	ms

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■ **Timing Charts** (Dotted lines mean high-impedance)

1. Normal dialing
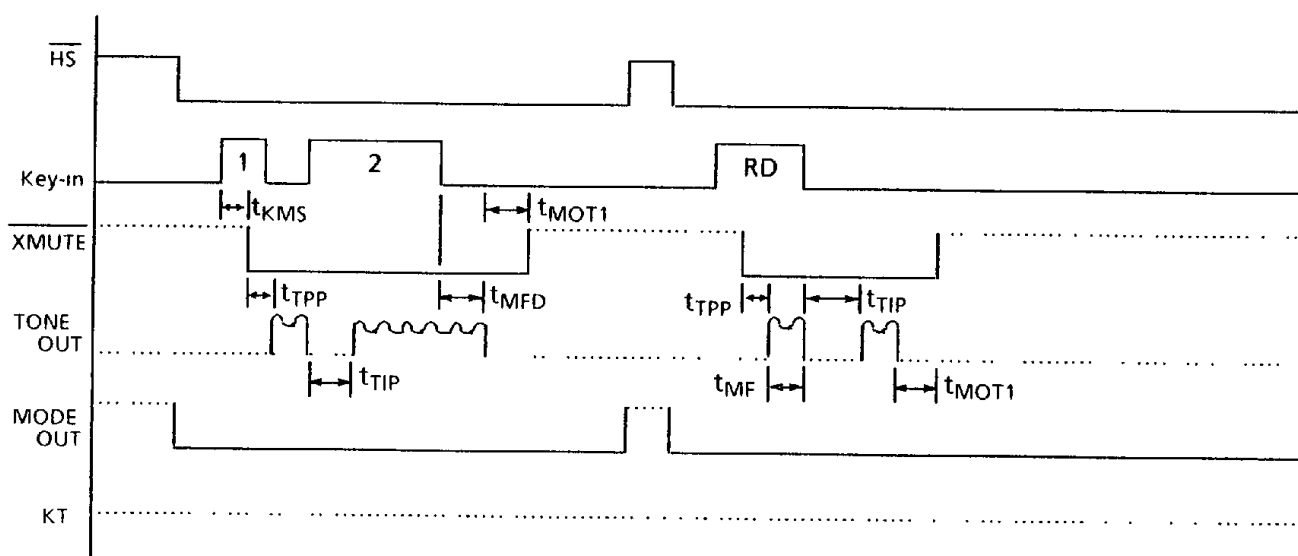
　　1.1　PULSE mode in redialing

　　　　(MODE IN = high or open,　MODE OUT = TONE OUT = off)
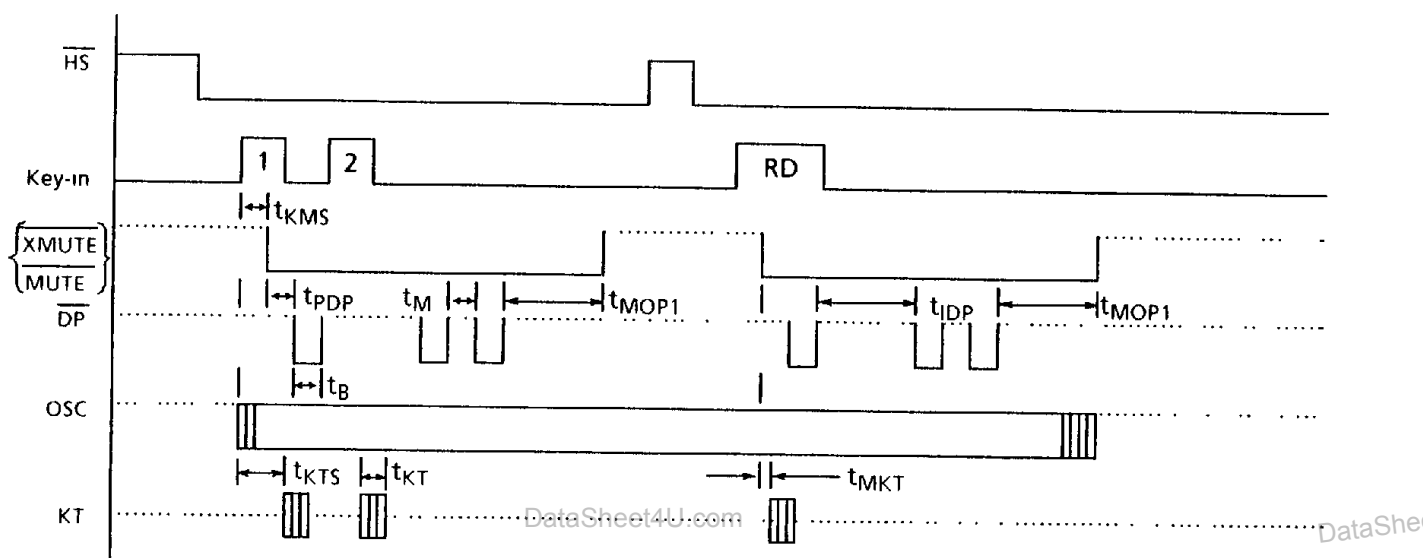
　　1.2　DTMF mode in redialing

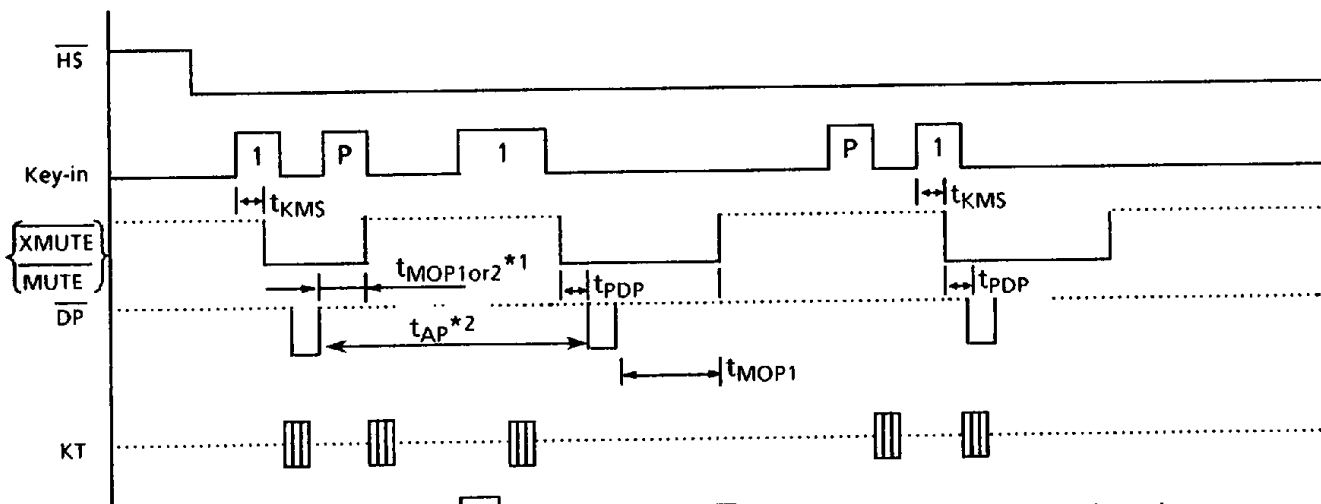　　　　(MODE IN = low,　$\overline{\text{MUTE}}$ = $\overline{\text{DP}}$ = off)

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2. Auto-pause

2.1 PULSE mode in normal dialing

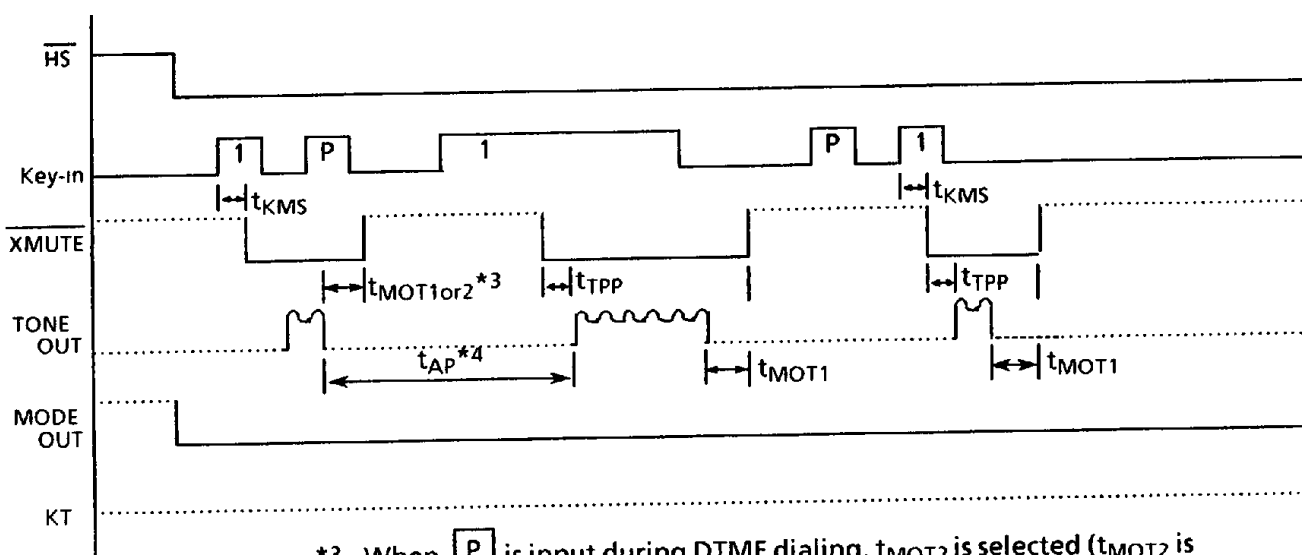(MODE IN = high or open, MODE OUT = TONE OUT = off)

*1 When $\boxed{P}$ is input during $\overline{DP}$ dialing, t_{MOP2} is selected. Otherwise t_{MOP1}.

*2 When $\boxed{P}$ is input between t_{MOP1}s, a period from $\overline{DP}$ output to the next $\overline{DP}$ output is $t_{MOP1} + t_{AP}$.

2.2 DTMF mode in normal dialing

(MODE IN = low, $\overline{MUTE} = \overline{DP} =$ off)

*3 When $\boxed{P}$ is input during DTMF dialing, t_{MOT2} is selected (t_{MOT2} is 3.38ms.). Otherwise t_{MOT1}.

*4 When $\boxed{P}$ is input between t_{MOT1}s, a period from DTMF signal output to the next DTMF signal output is $t_{MOT1} + t_{AP}$.
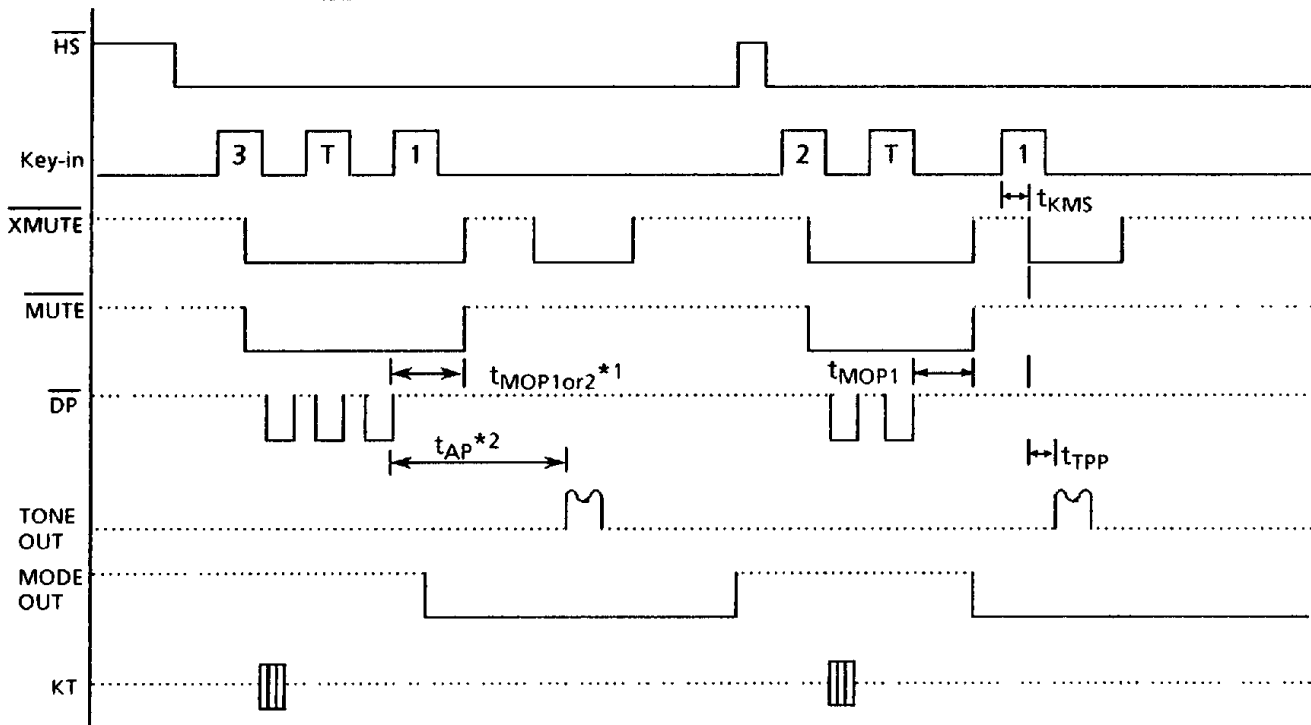
3. Mixed dialing

3.1 Mode change by |T| (MODE IN = high or open)
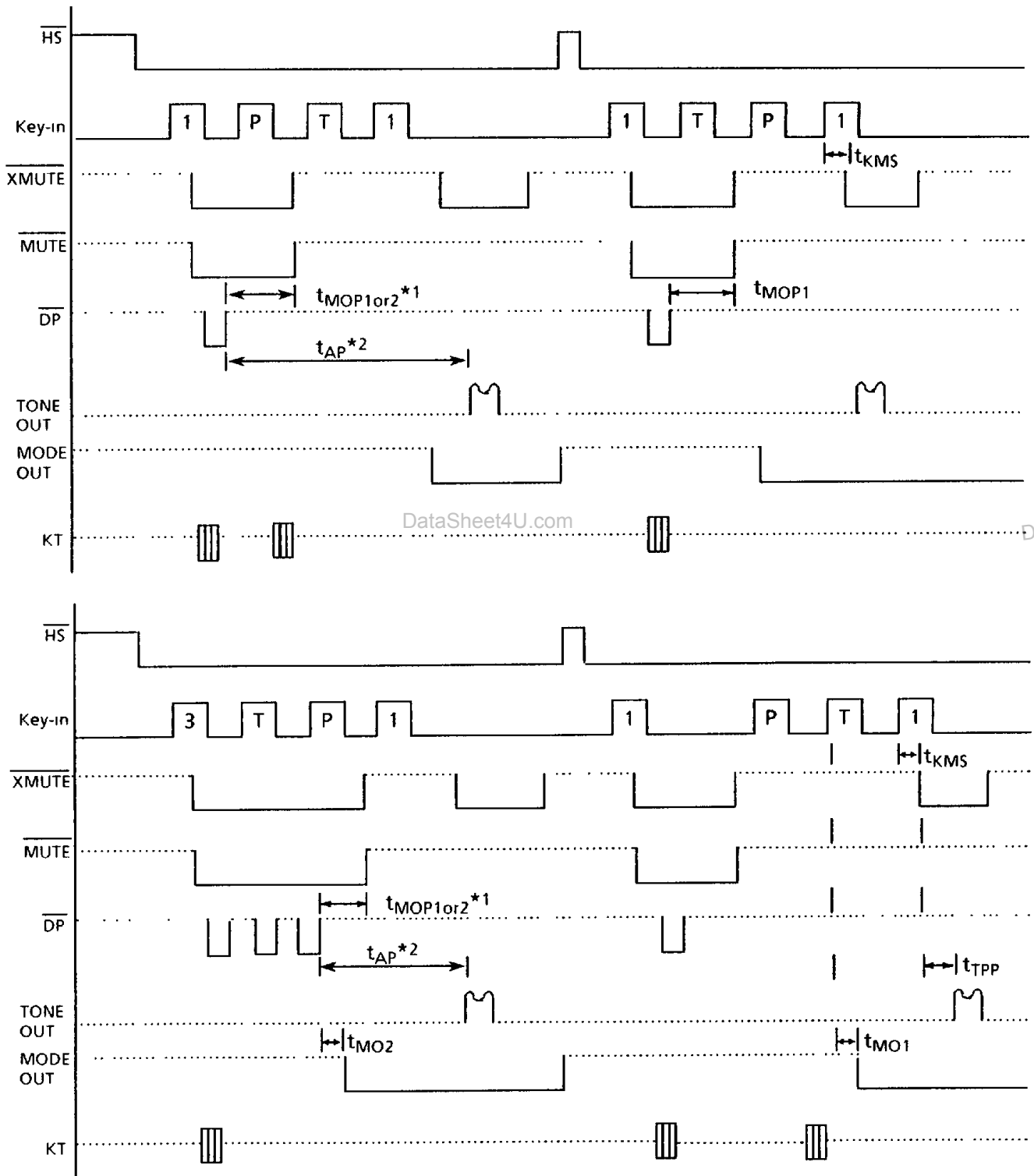
*1 When |P| is input during $\overline{DP}$ dialing, t_{MOP2} is selected. Otherwise t_{MOP1}.
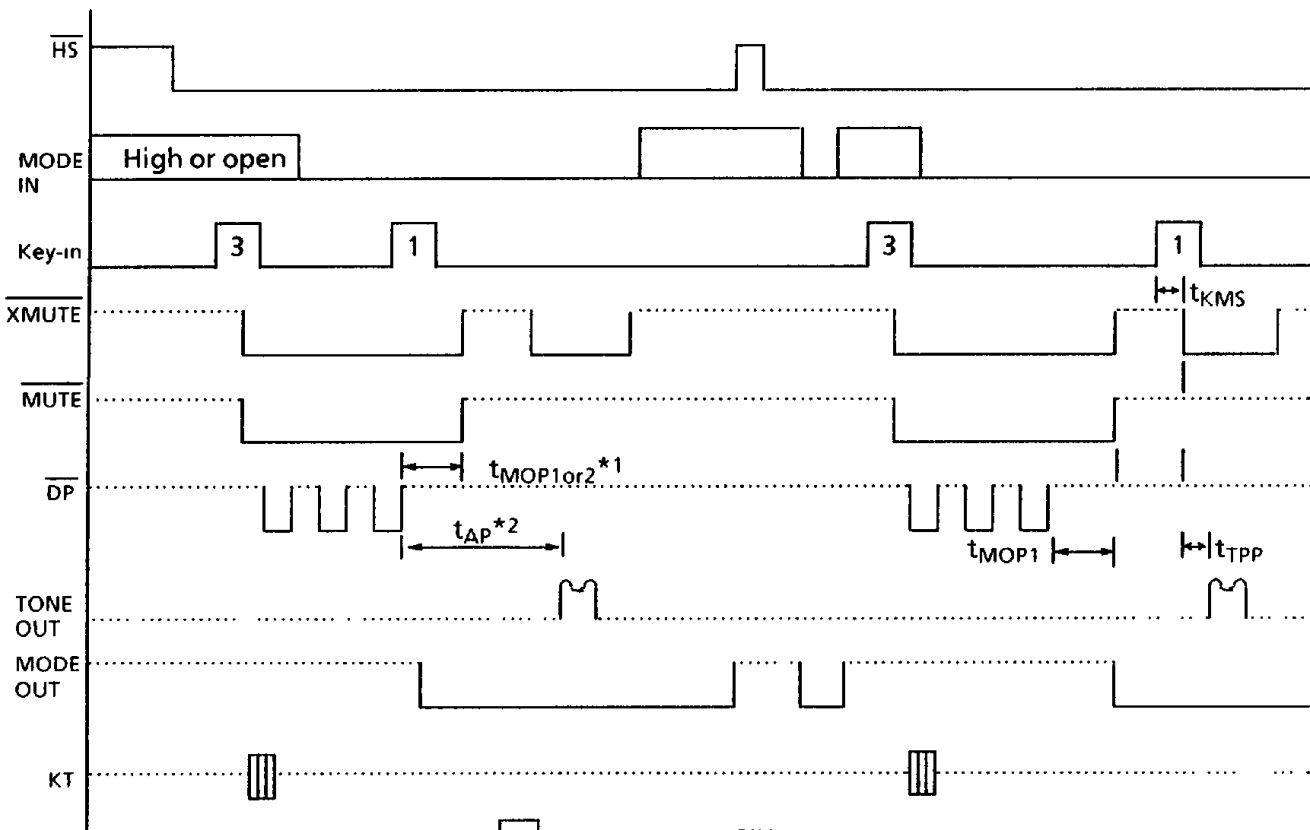
*2 When |P| is input between t_{MOP1}s, a period from $\overline{DP}$ output to TONE OUT output is $t_{MOP1} + t_{AP}$.
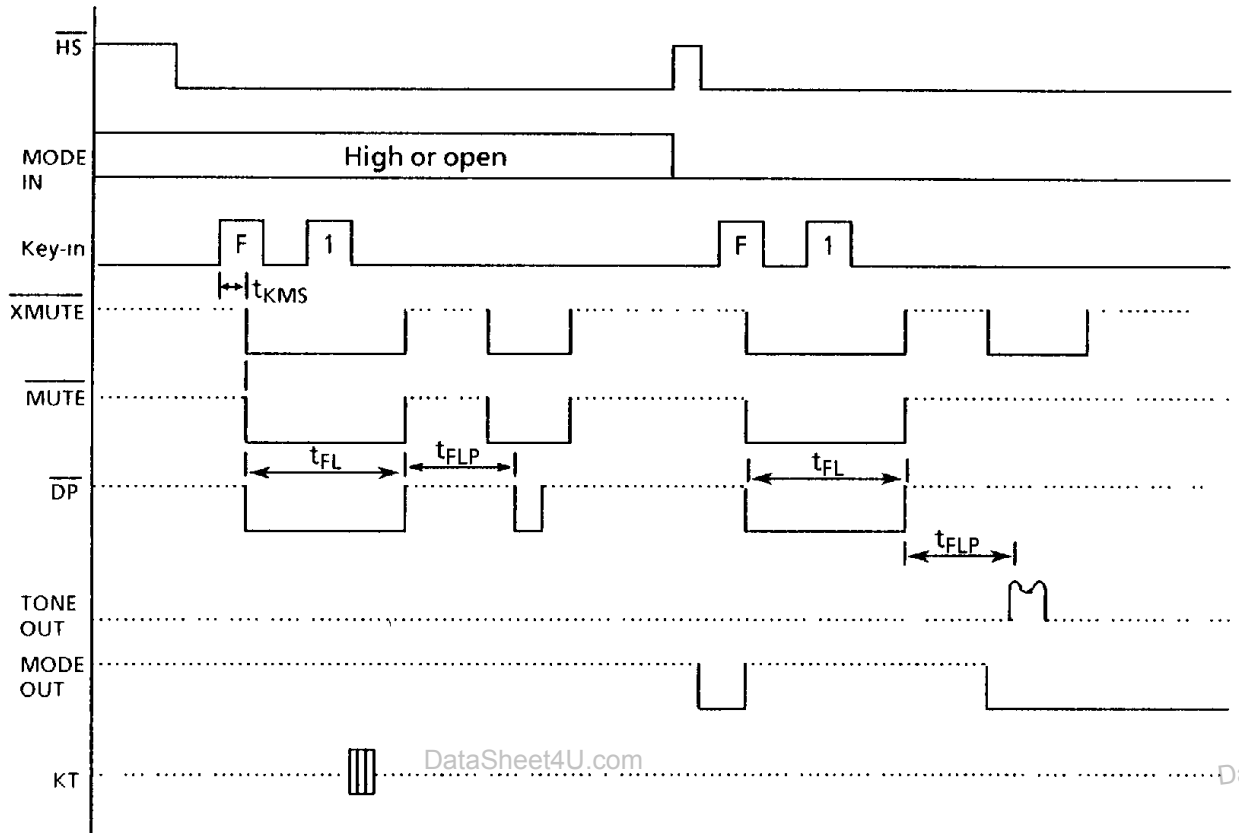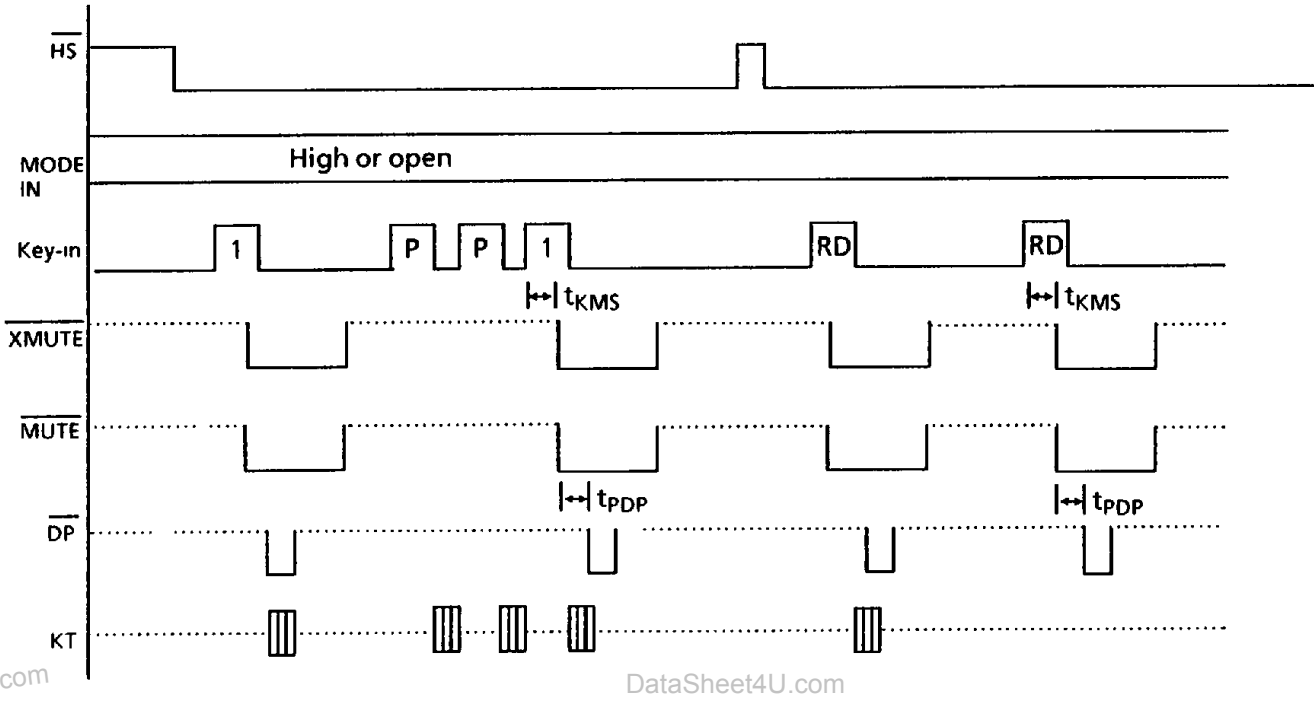
S-7235 Series

(Mode change by T continued)

3.2 Mode change by MODE IN

*1 When 1 is input during DP dialing, t_MOP2 is selected. Otherwise t_MOP1.

*2 When 1 is input between t_MOP1s, a period from DP output to TONE OUT output is t_MOP1 + t_AP.

4. Flash

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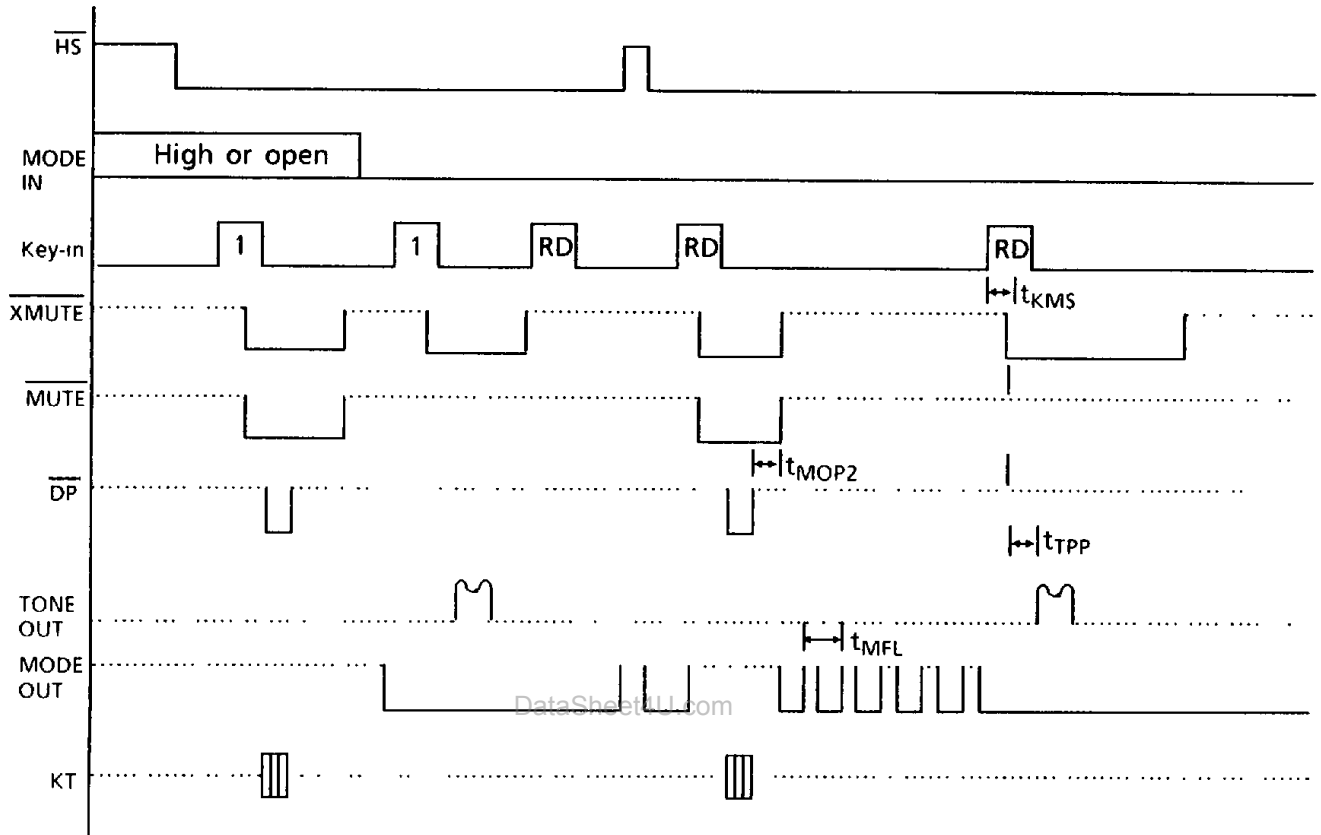
5. Auto-pause release

5.1 PULSE mode

5.2 DTMF mode
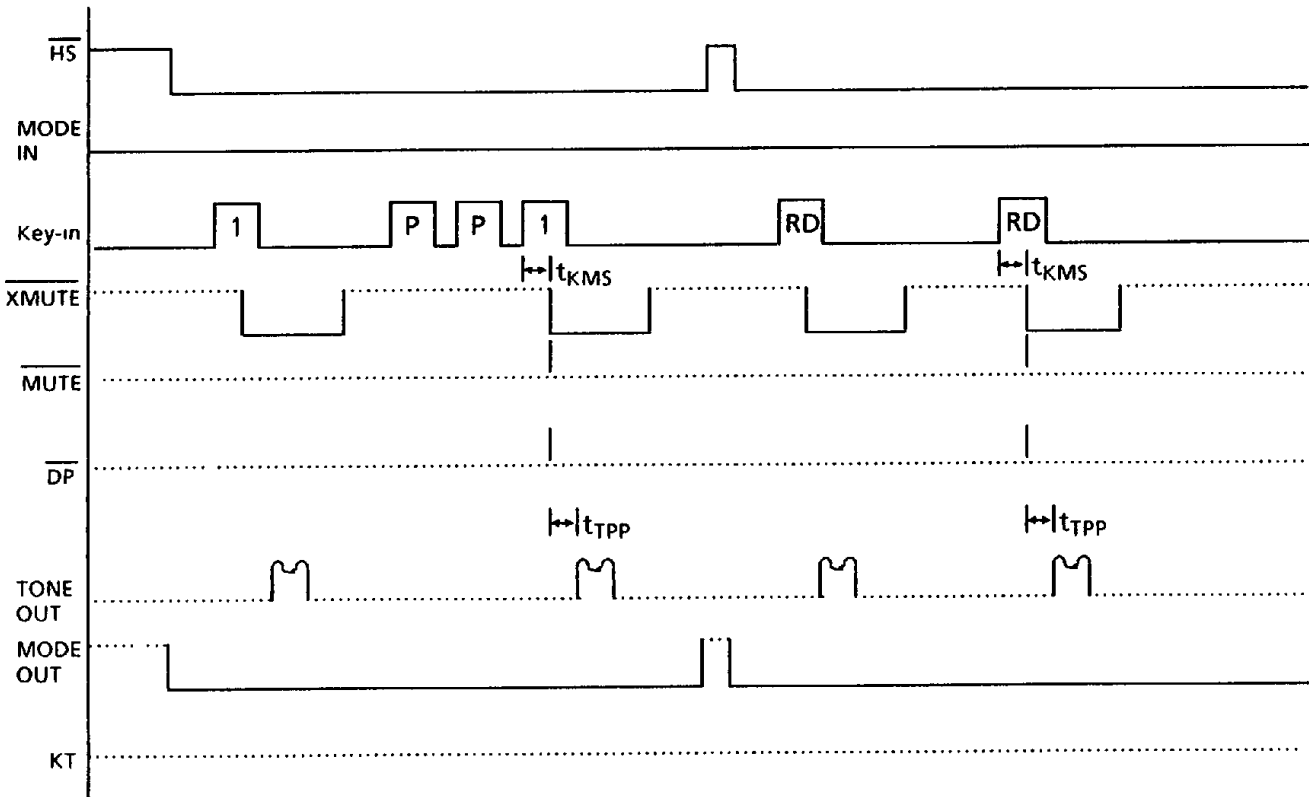
6. Wait-pause release

6.1 Mixed redialing

6.2 DTMF redialing

* t_{MOT2} (when $\boxed{T}$ is dialed) is 6.76 ms.