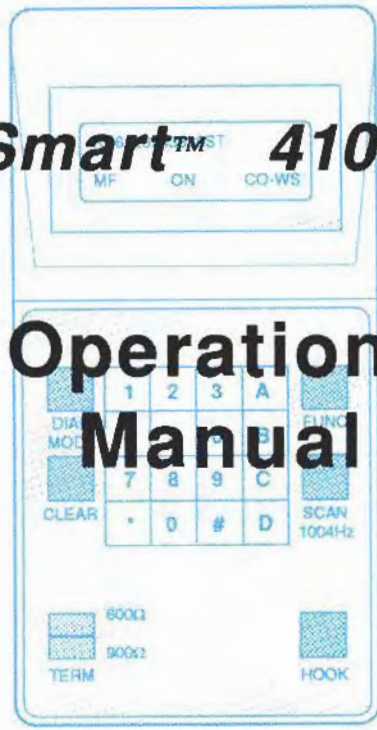
Nicollet Technologies, Inc.

DigiSmart™ 4100/4200

Operations Manual



DigiSmart 4100-RT/4200-RT

USER MANUAL

Version 2.01

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I. INTRODUCTION

The *DigiSmart* Model 4100-RT and 4200-RT are handheld, multi-mode test sets especially well-suited to diagnosing problems with DID and E-911 circuits.

Five signalling modes are available at the touch of a button:

Direct Outward Dial:
C/O Immediate Start
C/O Wink Start

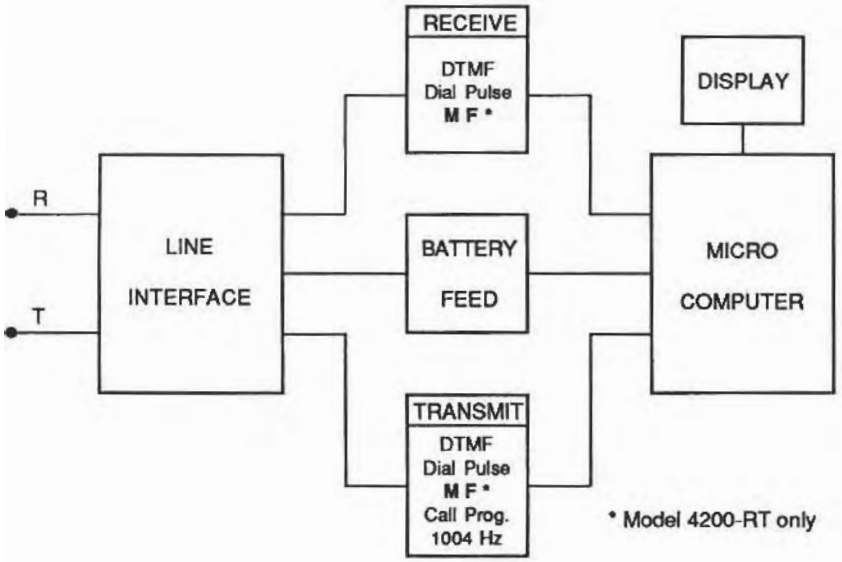
Direct Inward Dial:
PBX Immediate Start
PBX Wink Start

Plain Old Telephone Service:
Normal Analog Loop

Battery is supplied to the originating Central Office for DID applications. Both models can send and receive DTMF and Dial Pulse digits. The Model 4200-RT can also send and receive MF (Multi-Frequency) digits.

- Display up to 32 digits
- Bridge or terminate circuit
- 600 or 900 ohm impedance
- 1004 Hz tone source
- Wink timing analysis displayed
- 11 standard Call Progress tones
- Visual display of status messages
- Speaker for audible monitoring
- Bantam and modular test jacks
- Rugged, reliable construction

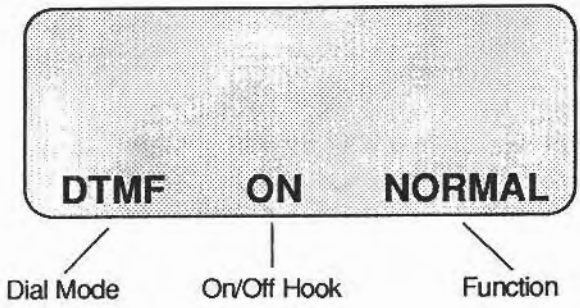
To simplify this manual, we will refer only to the Model 4200-RT, which is the most popular of the two *DigiSmart* models. With the exception of MF signalling, both units operate in the exact same manner.



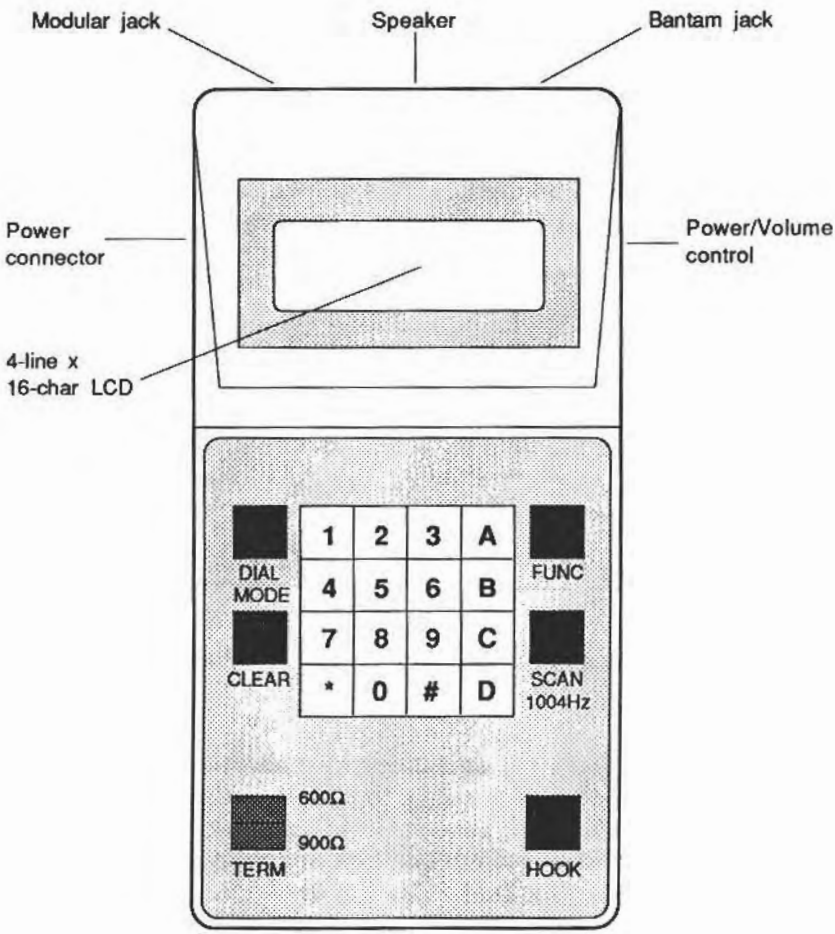
Power to the unit is supplied by a dual-output, wall-mount transformer. To use the 4200, plug the transformer into a standard, 3-prong electrical outlet (110 VAC, 60 Hz) and connect the power cord to the jack on the left side.

The Power/Volume control is on the right side of the unit. Rotate this switch until it clicks ON. Speaker volume can then be adjusted by rotating the control down or up until the desired amplitude is reached.

The model and version number will appear briefly on the top line of the display, followed by three status words on the bottom line:



At this point the unit is set to send/receive DTMF digits, is ON-hook and is ready to operate in a NORMAL loop environment. The 4200 powers up in the *monitor* mode, which allows you to bridge a telephone line and display DTMF digits. If you wish to display Dial Pulse or MF digits instead, simply use the DIAL MODE button as described on page 9.


Modular jack
Speaker
Bantam jack
Power connector
Power/Volume control
4-line x 16-char LCD
DIAL MODE
CLEAR
1 2 3 A
4 5 6 B
7 8 9 C
* 0 # D
FUNC
SCAN 1004Hz
600Ω
900Ω
TERM
HOOK

II. GENERAL OPERATION

A. Test Access

The telephone circuit may be accessed by using the cable supplied with the 4200. The bantam plug at one end of this cable fits into the jack on the top of the unit. The other end includes a pair of 5-way clips.

A modular cord can be used instead of this "bantam" test cord. An RJ-11C jack is located on the top of the unit next to the bantam jack. Both jacks provide a two-wire connection to the telephone circuit being tested.

In the *monitor* mode, the 4200 provides a high-impedance connection to any type of analog telephone circuit. Two-way traffic can be monitored and digits displayed while calls are in progress, without interfering with signalling between the central office and the customer premise.

The 4200 is in *monitor* mode when the last line of the display shows the words ON and NORMAL. This is the default mode on power-up.

In the *terminate* mode, the 4200 acts as one end of a telephone circuit to simulate the operation of switching equipment, either in the central office or on the customer premise.

CO When the 4200 simulates the Central Office end of a DID circuit, it will provide loop closure, wink recognition and digit feed. *No battery will be applied.*

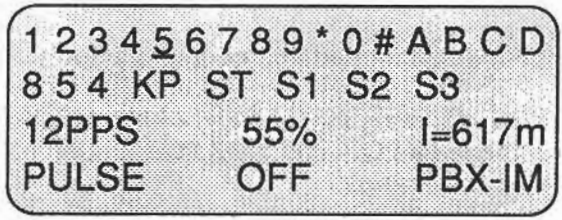
PBX When it simulates the PBX end of a DID circuit, the 4200 supplies voltage to the loop and will perform wink-back (if required), digit capture and battery reversal.

B. Display Configuration

The front panel of the 4200 includes a 4-line by 16-character Liquid Crystal Display (LCD) which will hold up to 32 digits on the first two lines. Both received and transmitted digits are displayed.

> NOTE: Special MF tones are displayed as *two* characters (see page 12), thus reducing display capacity to less than 32 digits.

The third line of the LCD is reserved for wink and digit timing parameters, along with Reverse Battery indication. The current dialing and signalling modes are displayed on the bottom line.



C. Button Functions

Below the LCD is a 4x4 keypad and six black buttons. The keypad contains the ten numeric digits **0** through **9** and the DTMF *****, **#**, **A**, **B**, **C** and **D**. Smaller type above these DTMF characters identifies the MF tones that are produced when these keys are pressed in the MF *Dial Mode*.

The functions of the six black buttons are described on the following pages.

DIAL MODE

Selects how digits will be transmitted and received by the 4200: DTMF, Dial Pulse, MF or Call Progress tones. The current Dial Mode is shown in the bottom left corner of the display.

Default mode: display reads **"DTMF"**

The unit is ready to send or receive DTMF digits 0-9, *, #, A, B, C, D

Depression 1: display reads **"PULSE"**

The unit is ready to send or receive Dial Pulse digits 0 through 9.

Depression 2: display reads **"MF"**

The unit is ready to send or receive MF digits 0-9, KP, ST, STP, ST2P, ST3P.

Depression 3: display reads **"CALL"**

The unit is ready to transmit Call Progress sequences. See page 23 for specifications.

Depression 4: **"Press CLEAR to set hook threshold or MODE to exit"**

Sets the idle-loop voltage threshold for monitoring line status and Dial Pulse digits.

When working on a circuit that does *not* use -48VDC (e.g., a 24-volt system), press the CLEAR button once to set the new threshold. Then press the DIAL MODE button until the proper mode is displayed.

FUNC tion

Selects one of five Supervision modes. The current mode is shown in the lower right corner of the display.

Default mode: display reads "**NORMAL**"

The unit is set up for operation in a Normal Loop environment (*monitor* or *terminate*).

Depression 1: display reads "**PBX-WS**"

The unit is set up for operation in a Wink Start DID environment (PBX termination) .

Depression 2: display reads "**PBX-IM**"

The unit is set up for operation on Immediate Start DID lines (PBX termination).

Depression 3: display reads "**CO-WS**"

The unit is set up for operation in a Wink Start DOD environment (CO origination).

Depression 4: display reads "**CO-IM**"

The unit is set up for operation on Immediate Start DOD lines (CO origination).

CLEAR

Clears digits from the top two lines of the display. Should be pressed prior to sending or receiving the next dialing sequence.

When simulating a PBX (PBX-IM or PBX-WS), the CLEAR button terminates the call by clearing the display and returning to idle loop battery.

SCAN/1004Hz

Moves the cursor from left to right to analyze individual digits that have been received. If held down for two seconds, activates the 1004 Hz tone source.

TERM ination

Selects either 600 or 900 ohm termination impedance. Has no effect in the bridge/monitor mode (i.e., when the unit is On-hook, Normal loop). Unlike the other five buttons, TERM is a rocker switch.

HOOK

Selects the On-Hook or Off-Hook condition. This button also controls the Reverse Battery function, which is used to answer and terminate DID calls.

KEYPAD

Dialing sequences are entered via the 4x4 keypad. The following digits are available in each Mode:

Dial Pulse: 0 through 9

DTMF: 0-9, *, #, A, B, C, D

Multi-Frequency (MF) coded as follows:

0 - 9	(numeric keys)
KP	(* key; displayed as **KP**)
ST	(# key; displayed as **ST**)
STP	(**A** key; displayed as **S1**)
ST2P	(**B** key; displayed as **S2**)
ST3P	(**C** key; displayed as **S3**)

Call Progress tones coded as follows:

1 == Dial Tone
2 == Reorder
3 == Busy
4 == Ringback
5 == Recall Dial
6 == Special Audible Ring
7 == Intercept
8 == Call Waiting
9 == Busy Verification
0 == Executive Override
* == Confirmation

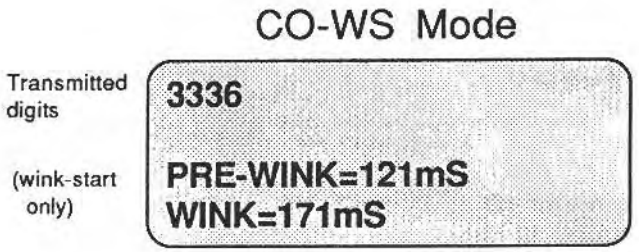
D. Timing Analysis

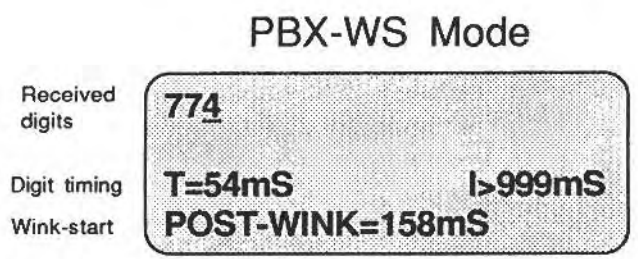
To analyze Wink timing parameters, press the SCAN button after sending or receiving a Wink. The 4200 will display the following values in milliseconds:

CO-WS "Wink" duration -- length of Reverse Battery received from the PBX

"Pre-Wink" interval -- delay between loop closure and wink from PBX

PBX-WS "Post-Wink" interval -- delay between wink and first digit received from CO

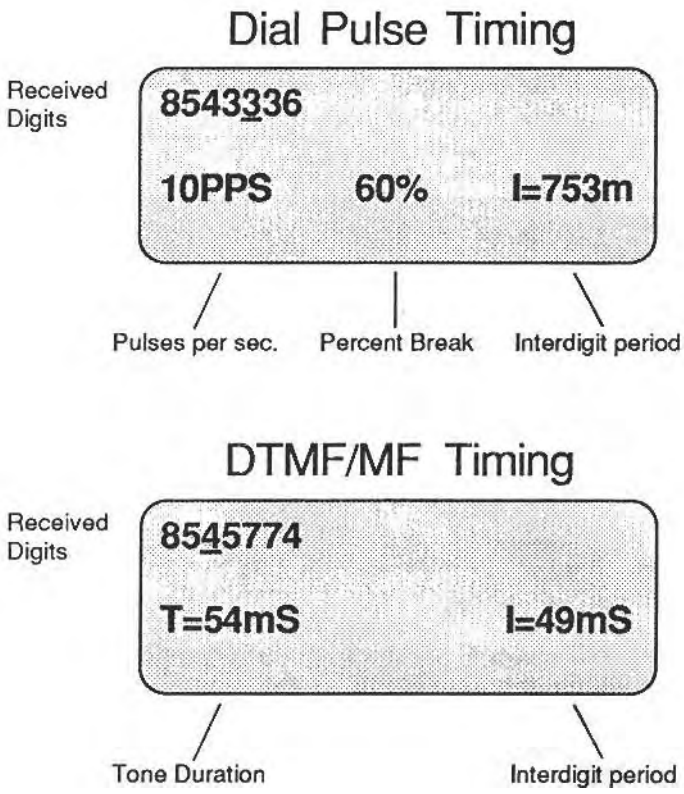




To analyze digits, operate the SCAN button to move the cursor from left to right across the digits displayed on the first and second lines. Timing analysis parameters will be shown on the third line of the display.

Tone duration (T) and Interdigit duration (I) are displayed for DTMF and MF, while the average Pulses per Second (PPS), percent Break (%) and Interdigit duration (I) are displayed for Dial Pulse digits.

The CLEAR button must be pressed to clear the display prior to receiving the next number sequence.



III. TEST PROCEDURES

A. Monitoring Digits

The 4200 defaults to the *monitor* mode when the Power/Volume switch is first turned on. In this mode the unit detects DTMF digits across a high-impedance connection.

When receiving or monitoring digits, select the proper mode by pressing the DIAL MODE button. This will eliminate errors in the detection of DTMF and MF digits. If a problem with Dial Pulse digits is encountered, it may be necessary to set the voltage threshold. This is done by pressing the DIAL MODE button until the *Hook Threshold* display appears. Then press the CLEAR button once.

B. Dialing Digits

Step 1: Turn on the unit by operating the Power/Volume switch on the right side. The default settings will appear at the bottom of the display.

Step 2: Press the DIAL MODE button until the desired signalling mode is displayed on the last line (see page 9).

Step 3: Select the desired line impedance (600 or 900 ohms) by toggling the TERM switch.

(Continue with either the *Manual Dial* or *Store & Forward* steps on the next page.)

MANUAL DIAL

Step 4: Go off-hook by pressing the HOOK button. The word "OFF" will appear in the middle of the last line of the display.

Step 5: Enter the desired digit sequence on the keypad. Digits will be displayed and then transmitted in the selected dialing mode.

Note: The dialing mode may be changed *during* a dialing sequence by operating the DIAL MODE button as part of the sequence. So you may change from DTMF to Dial Pulse to MF in any combination during a dialing sequence.

Step 6: Go On-Hook when desired by momentarily pressing the HOOK button. The word "ON" will then be displayed in the middle of the last line.

STORE & FORWARD

Step 4: Enter the desired digit sequence on the keypad *before* going Off-Hook.

Step 5: Go Off-Hook by pressing the HOOK button once.

Note: Two seconds after the unit is placed in an Off-Hook state, the digit sequence entered in Step 4 above will be transmitted at the standard dialing rates (see page 22).

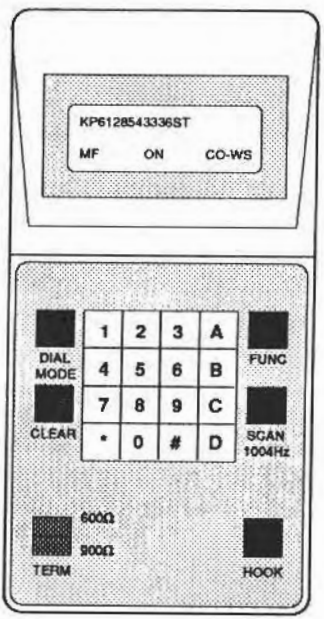
LAST NUMBER REDIAL

After entering the digits as described above under *Manual Dial* or *Store & Forward*, do the following:

Step 1: Go On-Hook by pressing the HOOK button and wait a moment for the central office register to clear.

Step 2: Go Off-Hook by pressing the HOOK button again. The digit sequence will be redialed.

The display must be cleared prior to entering a new digit sequence. Press the CLEAR button when desired.



C. PBX Simulation

Step 1: Turn the unit on.

Step 2: Select the desired line impedance by toggling the TERM switch.

Step 3: Select the dialing mode by pressing the DIAL MODE button until the desired mode is displayed.

Step 4: Select **PBX-WS** or **PBX-IM** by pressing the FUNC button until the proper display appears on the bottom line.

Step 5: When the unit detects loop closure from the CO, it will wink back *only* if PBX-WS was selected in Step 4. (See specs on page 23.)

Step 6: The unit will now display digits received from the CO.

Step 7: To accept the call, press the HOOK button. The words "REVERSE BATTERY" will appear on the third line of the display.

Step 8: Press the SCAN button to view the Post-Wink interval and digit timing parameters.

Step 9: To release the call, press CLEAR:
a) If the trunk is still *seized*, you must wait until the trunk is released and then press CLEAR again to go on hook.
b) If the CO has already released the trunk, press the HOOK button to return to the *idle loop* condition.

D. CO Simulation

Step 1: Turn the unit on.

Step 2: Select the desired line impedance by toggling the TERM switch.

Step 3: Select the dialing mode by pressing the DIAL MODE button until the desired mode is displayed.

Step 4: Select **CO-WS** or **CO-IM** by pressing the FUNC button until the desired mode is displayed.

Step 5: Enter the digit sequence on the keypad. The digits will be displayed on the first line of the LCD.

Step 6: Close the loop by pressing the HOOK button once. The word "OFF" will appear on the last line of the display.

Step 7: The PBX will sense loop closure and will return a Wink if it is configured for wink-start operation.

Step 8: The 4200 will transmit the digit sequence that was entered in Step 5. The PBX will accept the call (by reversing battery) if the digits are found to be valid.

Step 9: Press the SCAN button to view the Pre-Wink interval and Wink duration. Open the loop by pressing the HOOK button after the call is complete.

IV. WARRANTY AND REPAIR

The *DigiSmart* Model 4100-RT/4200-RT is controlled by a microprocessor and should require no field calibration.

The display window is clear plastic and may be cleaned with a soft cloth. Avoid using glass cleaner, since this may fog the plastic. If the window becomes soiled, dampen the cloth with a mild soap solution and rub gently. Then wipe clean with a cloth moistened with warm water.

Never immerse the unit in water, since this will damage the components inside. As with any piece of electronic equipment, protect your *DigiSmart* from static, freezing temperatures and excessive heat.

Should the unit fail to operate properly at any time, please contact the manufacturer for repair service. Do *not* attempt to repair the *DigiSmart* yourself.

To obtain a Returned Material Authorization (RMA) number, please call or write:

Nicollet Technologies, Inc.
7901 12th Avenue South
Bloomington, MN 55425

Tel: (952) 854-3336
Fax: (952) 854-5774

All *DigiSmart* products are warranted to be free from defects in materials and workmanship for a period of one year from date of purchase. Nicollet Technologies, Inc. will, at its option, repair or replace any unit that is found to be defective during this period, free of charge.

APPENDIX

Specifications

for the

DigiSmart 4100-RT/4200-RT

DTMF/Dual-Tone Multi-Frequency

TRANSMIT (Store & Forward and Repeat)	
Rate	10 digits/second
Level	
Low Group	-6 dBm +/-2dB
High Group	-3 dBm +/-2dB
RECEIVE	
Minimum Sensitivity	0 dBm
Maximum Sensitivity	-30 dBm
Maximum Receive Rate	14 digits/sec
Minimum Tone Duration	35 msec
Minimum Interdigit Duration	35 msec
Maximum Twist	10 dB
Analysis Resolution	1 msec
Analysis Accuracy	+/-2 msec

Dial Pulse

TRANSMIT	
Pulse Rate	10 pulses/second
Percent Break	67%
Interdigit Period	800 msec
RECEIVE	
Pulse Rate	
Minimum	8 pulses/sec
Maximum	16 pulses/sec
Analysis Resolution	1 pulse/sec
Analysis Accuracy	+/-0.5 pulses/sec
Percent Break	
Minimum	35%
Maximum	80%
Analysis Resolution	1%
Analysis Accuracy	+/-2% Break
Interdigit Period	
Minimum	160 msec
Analysis Resolution	1 msec
Analysis Accuracy	+/-2 msec

MF/Multi-Frequency (Model 4200-RT only)

TRANSMIT (Store & Forward and Repeat)	
KP Tone Duration	100 msec
Duration of all other tones	70 msec
Interdigit Period	70 msec
Tone Level (each tone)	-6 dBm +/-1 dB
RECEIVE	
Minimum Sensitivity	0 dBm
Maximum Sensitivity	-25 dBm
Minimum KP Tone Duration	60 msec
Min. Duration of all other tones	40 msec
Minimum Interdigit Duration	40 msec
Maximum Twist	6 dB
Analysis Resolution	1 msec
Analysis Accuracy	+/-2 msec

Call Progress Tones

Transmit Level (each tone)	-10 dBm nominal
Frequency Accuracy	+/-0.75%
Timing Accuracy	+/-2.5% of nominal

Key	Tone Name	Freq. 1	Freq. 2
1	Dial Tone	350 Hz	440 Hz
2	Reorder	480 Hz	620 Hz
3	Busy	480 Hz	620 Hz
4	Audible Ring	440 Hz	480 Hz
5	Recall Dial	350 Hz	440 Hz
6	Special AR	440 Hz	480 Hz
7	Intercept	440 Hz	620 Hz
8	Call Waiting	440 Hz	—
9	Busy Verification	440 Hz	—
0	Executive Override	440 Hz	—
*	Confirmation	350 Hz	440 Hz

Tone Source

Frequency	1004 Hz +/-2 Hz
Level into 900 ohms	0 dBm +/-0.2 dB
Level into 600 ohms	2 dBm +/-0.5 dB

DID Parameters

Line Resistance	1700 ohms maximum
Wink Type	Reverse battery
Off-Hook/Wink Delay	100 msec nominal
Wink Duration	200 msec nominal
Receive Inhibit Period	30 msec nominal
Normal Battery Voltage	-48 VDC nominal
Reverse Battery Voltage	48 VDC nominal
Battery Source Resistance	Balanced 220 ohms
Current	Current limited to 70 ma

Wink Timing Analysis

C/O Wink Start Mode	
Pre-Wink Interval	10 to 999 msec
Wink Duration	100 to 290 msec
PBX Wink Start Mode	
Post-Wink Interval	0 to 999 msec
Analysis Resolution	1 msec
Analysis Accuracy	+/-2 msec

Power Requirements

AC Adapter	Class B transformer, 8 ft. cord
Input Voltage	100/120 VAC, 60 Hz (std.) 220/240 VAC, 50 Hz (opt.)
Output Voltages	+15 and -60 VDC

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