TC-2000A Universal Pager Tester

Operating Manual

R40127

This document applies to firmware version 1.50

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General Information

This chapter covers instrument Specifications, Key Features and Safety Consideration.

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I

Warranty

TESCOM Warrants that this product will be free from defects in materials and workmanship for a period of one(1) year from the date of shipment. During the warranty period, TESCOM Company will, at its option, either repair or replace products that prove to be defective.

For warranty service or repair, Customer must notify TESCOM of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by TESCOM. Customer shall prepay shipping charge to TESCOM designated service center and TESCOM shall pay shipping charge to return the product to customer. Customer is responsible for all shipping charges including freight, taxes, and any other charge if the product is returned for service to TESCOM, if customer is located outside of Korea.

This warranty shall not apply to any failure or damage caused by improper use or unauthorized service. In these cases, TESCOM may refuse to furnish service under the warranty.

Safety Considerations

Review the following safety precautions to avoid injury and prevent damage to this product or any product connected to it.

Injury Precautions

Use Proper Power Cord
To avoid fire hazard, use only the power cord specified for this product.

Avoid Electric Overload
To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is specified beyond the range.

Ground the Product
This product is grounded through the grounding conductor of the power cord. In case no ground is available at the power outlet, it is recommended to provide a separate grounding path to the instrument by connecting wire between the instrument ground terminal and an earth ground to avoid electric shock or instrument damage. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Do Not Operate Without Covers
To avoid electric shock or product damage, do not operate this product with protective covers removed.

Do Not Operate in Wet/Damp Conditions
To avoid injury or fire hazard, do not operate this product in wet or damp conditions.

Product Damage Precautions

Use Proper Power Source
Do not operate this product from a power source that applies more than the voltage specified.

Provided Proper Ventilation
To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures
If you there is damage to this product, have it inspected by qualified service personnel.

Safety Symbols and Terms

These terms may appear in this manual,

WARNING : Warning statements identify conditions or practices that could result in injury or loss of life.
CAUTION : Caution statement identify conditions or practices that could result in damage to this product or other property.

These terms may appear on the product,

DANGER : Indicates an injury hazard immediately accessible as you read the marking.
WARNING: Indicates an injury hazard not immediately accessible as you read the marking.
CAUTION : Indicates a hazard to property including the product.

Symbols on the Product : The following symbols may appear on the product.

DANGER
High Voltage

ATTENTION
Refer to Manual

Indicates earth (ground) terminal

TESCOM Sales and Service Office

If you have difficulty with the product, call or write to our Technical Support specialists.

Product Support

TESCOM Company Limited
927 Unitechvil, 1141-2 Baekseok-dong, Ilsan-gu, Goyang-si, Gyeonggi-do, Korea [ZIP 411-360]

TEL : 82-31-905-0513 FAX : 82-31-902-0514
Email : tescom-sales@tescom.org
Internet : http://www.tescom-lab.com

Product Description and Key Features

Description

Tescom's TC-2000A Universal Pager Tester combines all of the test functions required for complete pager testing within a single unit. Designed for R & D, manufacturing, QA and pager maintenance applications, the instrument is lightweight, portable and may be operated from all standard AC supplies. This future ready, multi-function, 2G(second generation) pager test platform supports ReFLEX25, ReFLEX 50, FLEX, POCSAG protocols.

In addition to complete pager testing applications, TC-2000A can be used as general-purpose RF source and narrow band receiver for testing transceivers up to 1 GHz. A menu-driven, user-friendly, instrument, the TC-2000A is capable of generating IQ modulated RF signals as well a analyzing narrow band signals for testing receivers and transmitters.

Applications

Pager Manufacturing: One and 2-way pager production.

IQC, OQC: Pager qualification in QA.

Product Development : One and 2-way pagers

Network Operators: OEM pager inter-operability test and network sniffing.

Pager Service: General tool for test and repair.

General purpose RF tool for service: Signal source and analyzer for most receiver and transmitter test.

Key Features

Full duplex transceiver testing up to 1GHz
Supports ReFLEX 25/50, FLEX, ERMES, and POCSAG protocols.
IQ modulated RF signal output for receiver testing.
Frequency, power, simple spectrum and modulation analysis
Large LCD screen, menu driven, scenario based testing
Future ready, PC down-load Flash ROM for easy upgrading
High speed RS-232C interface for remote operation and automation
1.5volt, 150mA utility DC supply for powering pager
Store and recall up to 9 test settings.

Specifications

RF Signal Generator for Rx Test

Main RF Output

Frequency

Frequency Range: 130 to 960MHz
Resolution: 5 KHz or 6.25KHz. Tunable to 10Hz resolution with reduced spurious specification.
Display: 9-digit
Stability: Same as reference oscillator accuracy.

Output Level

Range: -120.0 to –20.0dBm in 0.1dB steps
Resolution: 0.1dB
Display: 4-digit
Accuracy: ±1dB
Impedance: 50ohm

Auxiliary IF Output

Frequency Range: 100KHz to 50MHz
Resolution: 5KHz or 6.25KHz. Tunable to 10Hz resolution with reduced spurious specification
Output Level: Fixed, –15dBm, nominal
Output Impedance: 50ohm

Spectral Purity (RF and IF Output)

Residual FM: Less than 30Hz RMS @ 300~3000Hz
Harmonics: -30dBc typical
Non-harmonic Spurious: LO(1GHz) less than 40dBc typical. Others; less than 35dBc typical

Modulation

FSK/ FM (RECT)

Encoder Mode: ReFLEX25, ReFLEX50, FLEX, ERMES, POCSAG
Test Pattern(Service Mode): 512/2, 1200/2, 1600/2, 2400/2, 3200/2, 3200/4, 6250/4, and 6400/4.
Base Band Filter: 3.9KHz 10^{th} order Bessel filter
Deviation: 0.1 ~7.0KHz in 0.1KHz steps
Ripple: < 250Hz P-P at 1KHz ~5KHz deviation

FM (SIN)

Modulation Frequency: 20 ~ 4000Hz
Deviation: 0.1 to 7 KHz in 0.1KHz steps
Accuracy: ±2% + Displayed Value excluding noise..

AM (SIN)

Modulation Frequency: 20 ~ 4000Hz
AM Depth: 0 to 99%
Accuracy: 2% + 5% x Setting

Auxiliary Modulation Output (Front Panel BNC)

Encoder, FSK or Sine Waveform
Output Voltage: Bipolar 0 to ±4V, or unipolar 0 to 4V into open circuit
Source Impedance: 600ohm

Signal Monitor for Tx Test

Input Characteristic

Frequency Range: 455KHz to 960MHz
Maximum Input Level: +10dBm

Automatic Level Control

Automatically optimizes input attenuation for most of constant level signal.

Signal Processing

Sampling Rate: 96KS/sec, 12Bit
Data Acquisition Rate: 2000 Samples (~20msec)/sec
Display Refresh Rate: ~ 1Hz

Power Measurement

Operating Range: -70 to +10dBm
Resolution: 0.1dB
Input Signal BW: ±15KHz of the center frequency
Accuracy: ±1.5dB max, 0.5dB typical

Frequency Offset Measurement

Operating Range: -60 to +10dBm
Resolution: 10Hz
Accuracy: ± 50Hz

IQ Signal Display

Operating Range: -60 to +10dBm
X-Y plot of IQ components for visual modulator adjustment and verification

Spectrum Analyzer

Center Frequency Resolution: 5KHz or 6.25KHz
Resolution BW: ~200Hz, fixed
Frequency Span: 1KHz to 95KHz adjustable in 1KHz steps

Minimum Detectable level:

Center of Display: <-90dBm LO leakage limited

Off Center: <-110dBm off center, Noise Floor limited

Signal dependent spurious: - 40dBc typical

Frequency Roll-off within Display Range : <-1dB at ±15KHz, <-6dB at ±47.5KHz of center

FM Demodulation

Operating Range: -60 to +10dBm

Demodulation Bandwidth: >20KHz

Demodulation Filter: LPF 1K/3K/15 KHz, selectable

FM Deviation Range: 0 to 15KHz

Reading: Offset (Mean), VAR (Variance, RMS), DEV (peak)

Accuracy: Offset: <50Hz; VAR: <100Hz (Noise and Ripple); DEV: <300Hz (Noise and Ripple)

AM Demodulation

Operating Range: -60 to +10dBm

Demodulation Bandwidth: DC to 15KHz

Demodulation Filter: LPF 1K/3K/15KHz, selectable

AM Depth: 0 ~ 99%

Accuracy: 2%+ 5% of AM Reading

FM Histogram

Operating Range: -60 to +10dBm

Span: 1KHz ~40KHz

Frequency Histogram (Linear Scale)

Display Discrete Frequencies above a level set by cursor.

Accuracy: same as FM Demodulation

Pager Protocol Test

RF frequency and level may be changed during test message transmission

ReFLEX 25

Version: 2.72

Message Type: Short, Numeric, Alphanumeric, BIN, Secure, and Commands

FCH Data Rate: 1600/2, 3200/2, 3200/4, and 6400/4

RCH Data Rate: 800/4, 1600/4, 6400/4, and 9600/4

Data Polarity: Normal and inverse

RCH Analysis: Demodulation, Power, Spectrum, Slot time offset, ACK signal analysis, and message

Test Method: Scenario based test

Message Length: 1000 ASCII characters max.

Built-in Messages: 5 Numeric, 5 Binary, and Alphanumeric (same as FLEX)

Other Features: Roaming and Time, message fragmentation, Maintain the Sync.

ReFLEX 50

Version: 4.5
Message type: Short, Numeric, Alphanumeric, HEX/ BIN
FCH Data Rate: 1600/2, 3200/2, 3200/4 and 6400/4
RCH Data Rate: 9600/4
Data Polarity: Normal and inverse
RCH Analysis: Demodulation, Power, Spectrum, Slot time offset, ACK signal analysis, and Message
Test Method: Scenario based test
Message Length: 1000 ASCII characters max.
Built-in Messages: 5 Numeric, 5 HEX/BIN, and Alphanumeric (same as FLEX)
Other Features: Roaming and Time, Message fragmentation, Maintain the Sync.

FLEX

Version: G1.9
Vector Type: Numeric, Alphanumeric, Secure message, Short instruction or message, HEX/BIN
Roaming: SSID, NID
Re-Sync Mode: ON/OFF
Data Rate: 1600/2, 3200/2, 3200/4 and 6400/4
Data Polarity: Normal and inverse
Maximum Message Length: 1000 ASCII characters
Built-in Messages: 5 Numeric, 5 HEX/BIN, Alphanumeric (7-bit only, KSC-5601, GB 2312, CNS)
Other Features: Time, Header on/off, Message fragmentation

ERMES

Version: Enhanced Radio Message System (ETS 300) VER.01.01, 02.01
Message Type: Tone only, Numeric, Alphanumeric, Transparent, Long, Remote Program, and CTAP
System Information: Roaming, Time information
Data Rate: 6250 BPS, 4 level
Data Polarity: Normal and inverse
Maximum Message Length: 1000 ASCII characters
Built-in Message: 5 Numeric, 5 Transparent, Alphanumeric (7-bit only, KSC-5601, GB 2312, CNS)

POCSAG

Version: CCIR Radio-paging Code No 1
Message Type: Tone only, Numeric, Alphanumeric
Data Rate: 512, 1200 & 2400 BPS
Data Polarity: Normal and inverse
Built-in Message: 5 Numeric, Alphanumeric (7-bit only, KSC-5601, GB 2312, CNS)
Maximum Message Length: 1000 ASCII characters

Miscellaneous

Internal Reference Oscillator:12MHz TCXO, 1.0 PPM –20 to 70 deg C, 0.5 PPM/year
External Reference: 10MHz, >150mV RMS
DC Power Supply: 1.5 V, 150mA max, short circuit protected.
Remote Interface: RS-232C, 38.4K BPS
Line Voltage: 100 to 240 volt AC, 50/60Hz, 40Watt
Dimension: 375(w) x 380(d) x 183(h) mm
Weight: 8.5 Kg
Accessories supplied: N to N cable (1ea), BNC to BNC cable(1ea), N to BNC cable 30 cm (2 ea), N to BNC adapter(1ea), 3 dB power splitter(1ea), RS-232 cable(1ea), Power cord(1ea), Operating manual.

Installation

This section provides the information needed to install the TC-2000A Universal Pager Tester. Included is information pertinent to initial inspection, power requirements, environment, ROM upgrade, Storage and Shipment.

II

Appearance and Accessory Check

When TC-2000A is delivered, check for damage in appearance that could have occurred during its transportation.

Next, check for the standard accessories, table below, supplied with TC-2000A.

NO.	Name	Specification	Q'ty
1	Power Cord	2 meter	1
2	RS-232C Connection Cable	DS-9S-9S	1
3	RF Cable	N(m)-N(m)	1
4	RF Cable	N(m)-BNC 30cm	2
5	RF Cable	BNC-BNC	1
6	RF Cable	N(f)-BNC 1.5m	1
7	3 dB power splitter	Minicircuit	1
8	Program Upgrade Install Diskette	1.44" 2HD Floppy	1
9	Operating Manual		1

WARNING: *To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to the equipment.*

Power Requirement

Input voltage	100 ~ 240 VAC
Frequency	50 / 60 Hz
Power Consumption	Less than 40 watt.

CAUTION *: If AC power is beyond the range of operation, the equipment may malfunction or could be permanently damaged.*

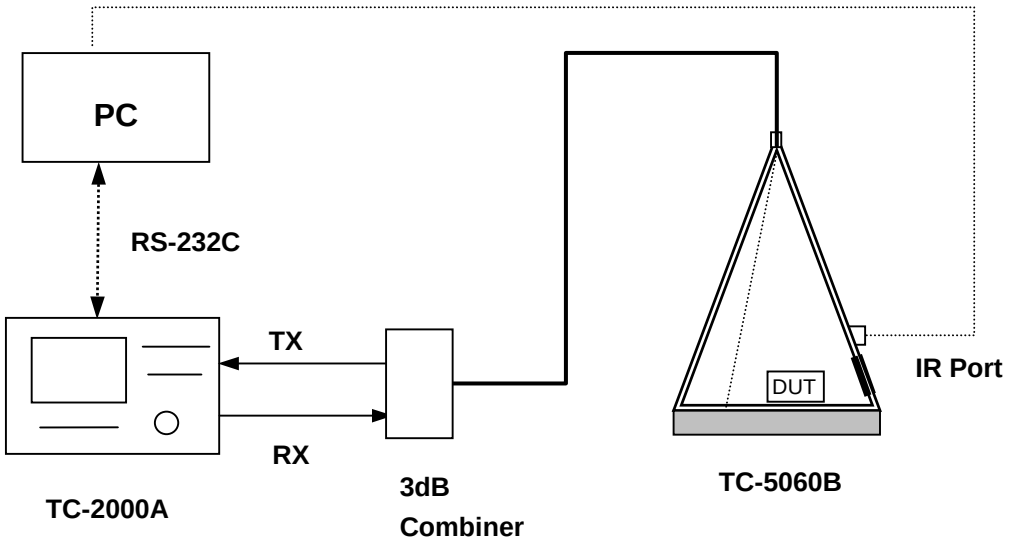
Operating Environment

Refrain from using this equipment in a place subject to high level of vibration, direct sunlight, or where corrosive gas is present. Also, do not use where the ambient temperature is beyond 0 °C to 50 °C or relative humidity is more than 85%.

The storage temperature range for this equipment is –20 °C to 70 °C. When this equipment is not used for a long period of time, store it in a dry place away from direct sunlight, covered with vinyl or placed in a cardboard box.

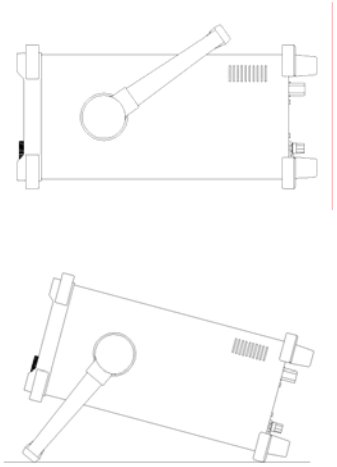
Typical Test Configuration

Diagram below is an ideal set up for testing 1 or 2-way pagers. TC-2000A has separate Tx and Rx connectors and 3dB hybrid combiner is required between TC-2000A and TC-5060B TEM Cell. TC-2000A can be fully automated by a PC via RS-232C. If the pager under test has IR interface, the PC can communicate with the pager via IR interface of TC-5060B.

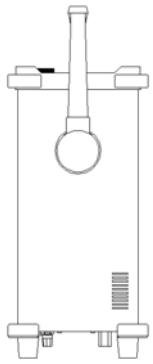


Carrying Handle Adjustment

To adjust the handle position, push both caps covering the rotary joints on each side. .
Then, rotate the handle to the desired position.



Bench-top viewing position



Carrying position

ROM Upgrade

TC-2000A uses Flash ROM for easy F/W upgrade. Upgrade program and the data file will be provided by TESCOM either electronically or by diskette eliminating much hassle.

What you need

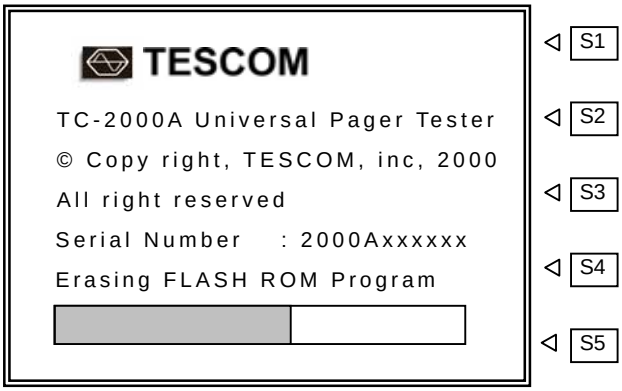
IBM PC or compatible with :
- Microsoft DOS, Windows 95 / 98 / 2000 / NT

TC-2000A Download Program: Download.exe
RS-232C Cable (TESCOM Provided or any standard serial cable)

F/W Upgrade

1) Turn Off the power of TC-2000A. Find the “DOWNLOAD” switch at rear panel and set it to DOWNLOAD.
2) Connect RS-232C cable between PC COM1 and TC-2000A. Turn on TC-2000A.
3) Running “Download.exe” to execute Download program on PC

4) Follow the instruction on the screen.
   Program will report error messages under the following circumstances:
   - If TC-2000A power is off
   - If cable is not connected properly
   - If download switch is in "Normal" position
   - If power booting was not performed after download failure.
5) TC-2000A clears its buffer before accepting download.
   Download takes 15 to 20 minutes depending on computer.



6) When the download is completed, turn TC-2000A OFF and return “DOWNLOAD” switch at the rear panel to NORMAL position.
7) Remove cable and turn TC-2000A ON. The new ROM version number should display on initial screen.
8) Repeat Downloading in case of download failure
   TC-2000A must be power reboot each time before repeating download sequence.

Storage and Shipment

Storage

The storage temperature range for this equipment is –20 °C to 70 °C. When this equipment is not used for a long period of time, covered with vinyl or placed in a cardboard box, store it in a dry place away from direct sunlight.

Shipment

When shipping this equipment, use the original packing materials. If they are not available, pack the equipment as follows:

1) Wrap this equipment, in appropriate shock absorbing materials and put it in a corrugated cardboard box at least 5 mm thick. (If shipping to a TESCOM Service Office, attach a tag indicating the type of service required, return address, model number and full serial number.)

2) Wrap its accessories separately in the same shock absorbing material and put them in the same corrugated cardboard box together with this equipment.

3) Fasten the corrugated cardboard box with packing strings.

4) Mark the shipping container FRAGILE to assume careful handing.

CAUTION : *Never use any chemical cleaner other than alcohol for the maintenance of this equipment. Organic solvent such as benzene, toluene or acetone may spoil the plastic parts of this equipment*.

Operation

This section describes the basic concepts and details of operating the TC-2000A Universal Pager Tester. Understanding the basic concepts of your TC-2000A helps you use it effectively. *Overview* quickly shows you how the TC-2000A is organized and gives some very general operating instructions. After you read *Overview* you can use *Operation Procedure* for detail information.

III

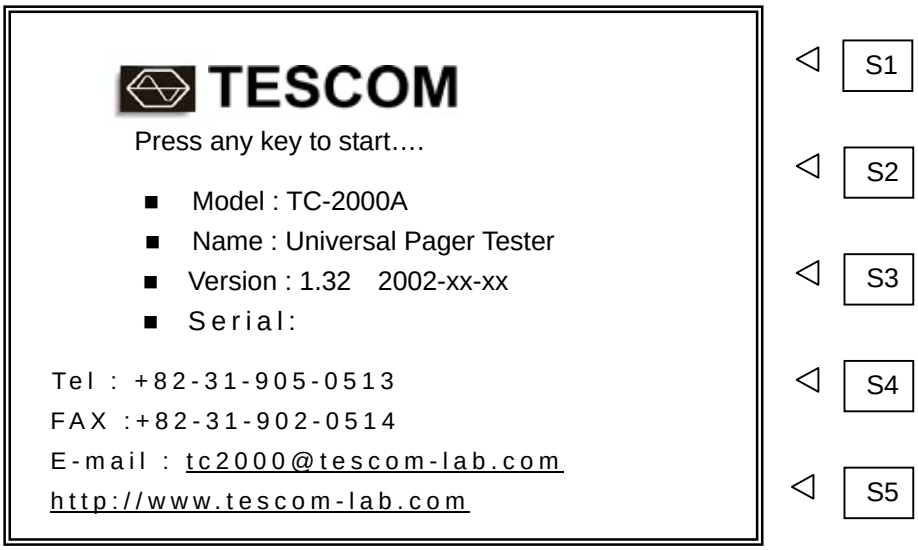
Overview

The Overview section contains illustrations of the display, the front and rear panels, and the menu system. These illustrations help you understand and operate the TC-2000A.

Start-up screen

When the power is turned on, the start-up screen will be displayed and it will change to main screen 20 seconds later. Pressing any key also will change the display immediately.

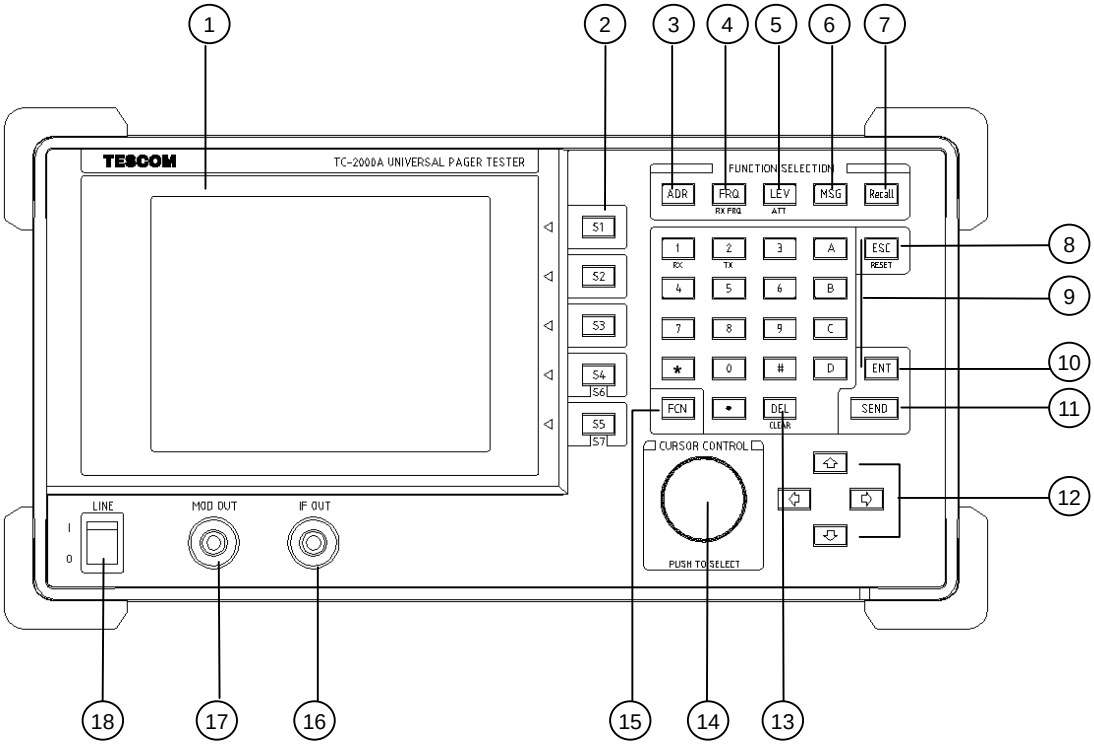
▣ **Note** : When TC-2000A is turn on, the instrument does not return to the power-off condition but recalls the setting from the most recently saved memory location (STORE Number). ☞ Refer to chapter 3-7



Display Contrast

Display contrast is an adjustment that is located on the rear panel. It allows you to adjust contrast for the front panel display. Turn the adjustment to optimize the display for viewing it from straight on. If the display is blank, first attempt to adjust the display contrast adjustment before returning the instrument for service.

Front panel view



① LCD Display.

② S1 thru S5 : Soft keys. Selects menu on LCD display.

③ ADR : Address (CAP Code) input.

④ FRQ : Frequency input.

⑤ LEV : Level input.

⑥ MSG : Message input.

⑦ Recall : Recall stored data.

⑧ ESC : Return to the previous state.

⑨ Data Input key pad.

⑩ ENT : Select input mode, Accept input and out.

⑪ SEND : Start and stop data transmission.

⑫ [⇧] [⇩] [⇦] [⇨] : Cursor movement.

⑬ [DEL] : Delete.

⑭ Rotary knob: Move cursor. Push to accept data or function like [ENT] .

⑮ [FCN] : Access second functions.

⑯ IF output.

⑰ Modulation Out: Encoder output in RX Test or analog FM demodulation output in FSK receiver mode.

⑱ Power switch.

Second Functions (Blue Label Functions)

Additional functions available by [FCN] key.

[FCN] [ESC] **(= RESET)** : Select INSTRUMENT reset, MESSAGE reset, or CANCEL.

[FCN] [S4] **(= S6)** : Select a Protocol or SERVICE or FSK Receiver mode.

[FCN] [S5] **(= S7)** : Screen select.

- Select RX Test or TX Test screen (FLEX, POCSAG, ERMES, and Service).
- Select SET UP or MONITOR screen (ReFLEX25, ReFLEX50).
- Select FSK SETUP or MONITOR screen (FSK Receiver).

[FCN] [FRQ] **(= TX FRQ)** : Set TX frequency (or Monitoring frequency) for DUT TX test.

[FCN] [LEV] **(= ATT)** : Set input Attenuation for TX test.

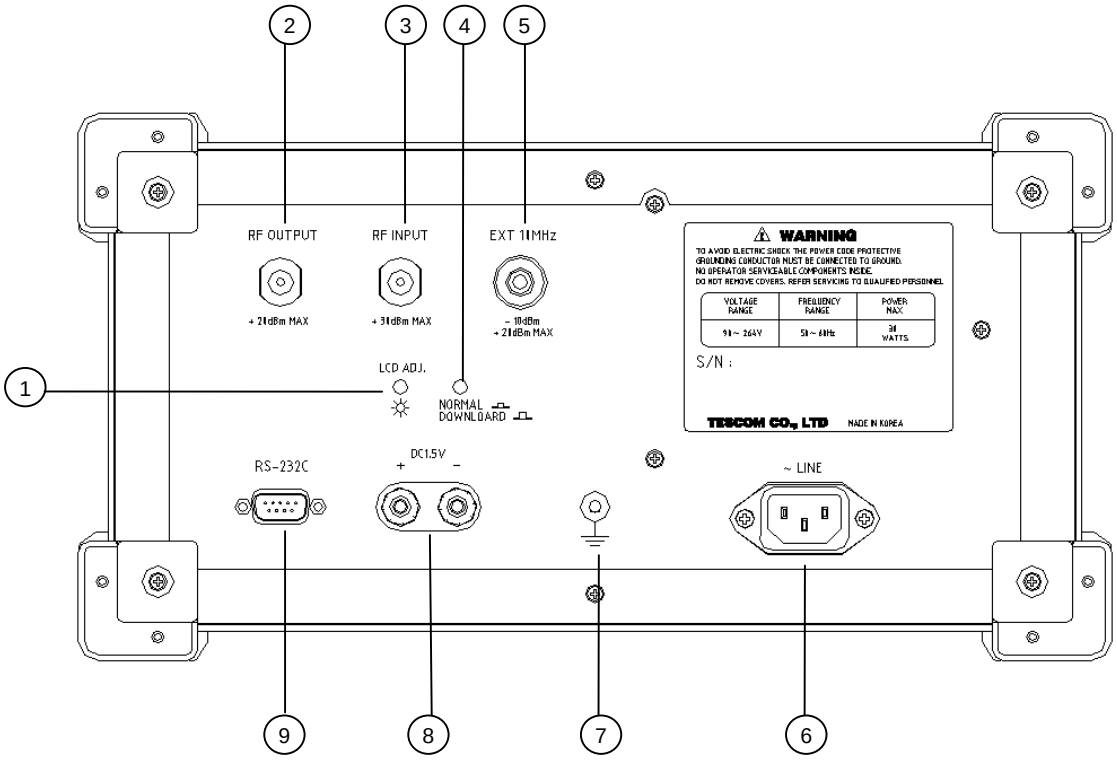
[FCN] [Recall] **(= STORE)** : Store the current instrument settings into memory (1 to 9) or Store the current setting of all messages into MESSAGE memory.

[FCN] [DEL] **(= CLEAR)**: Clear entered data during key pad entry

[FCN] [1] **(= TX)** : Short cut key to TX TEST or MONITOR screen depending on Protocol.

[FCN] [2] **(= RX)** : Short cut key to RX TEST or SET UP or FSK SETUP screen depending on Protocol.

Rear panel view



① LCD brightness adjustment

② RF output connector.

③ RF input connector.

④ Software download switch.

⑤ External reference oscillator input.

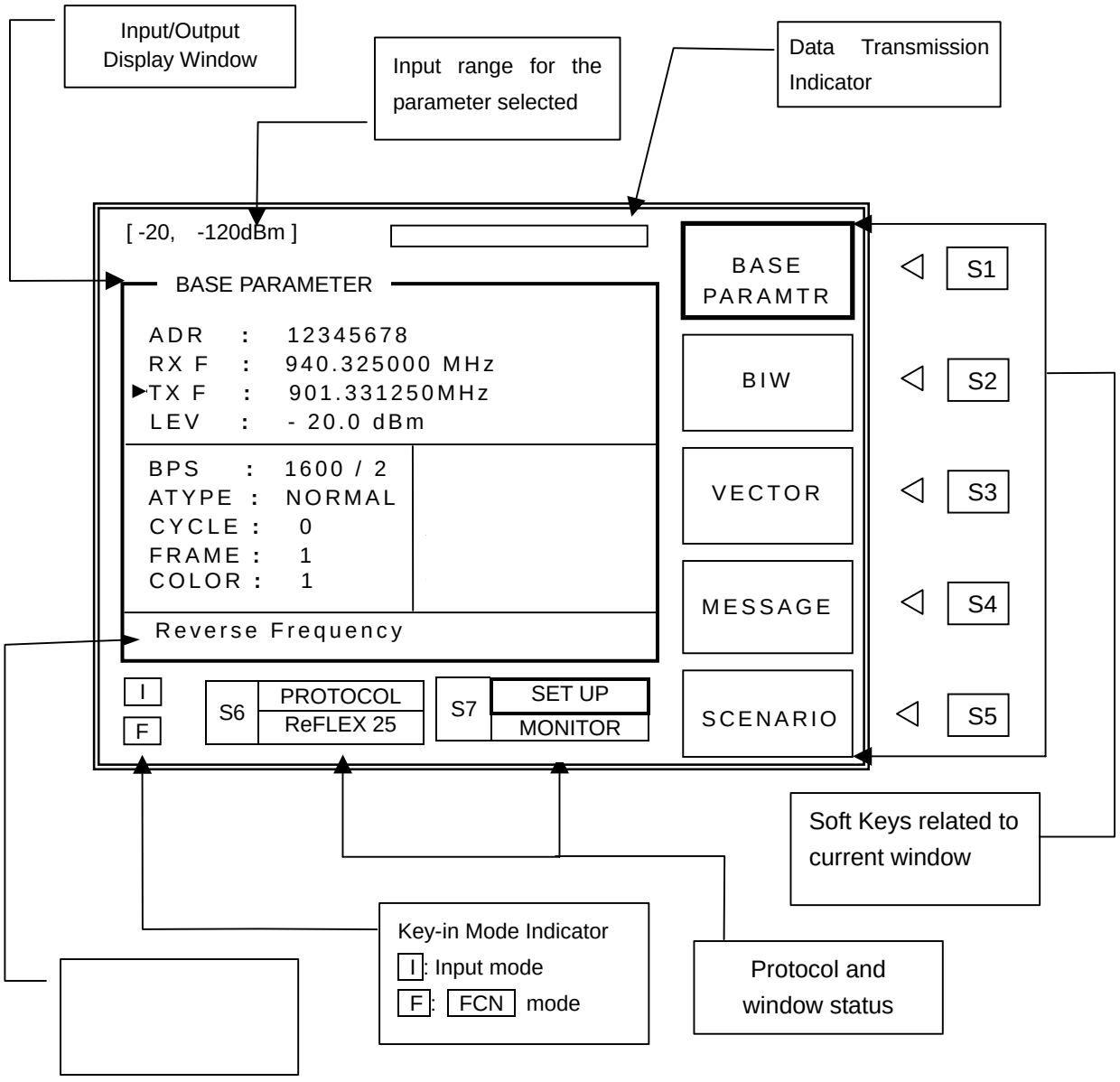
⑥ AC Inlet.

⑦ Ground terminal.

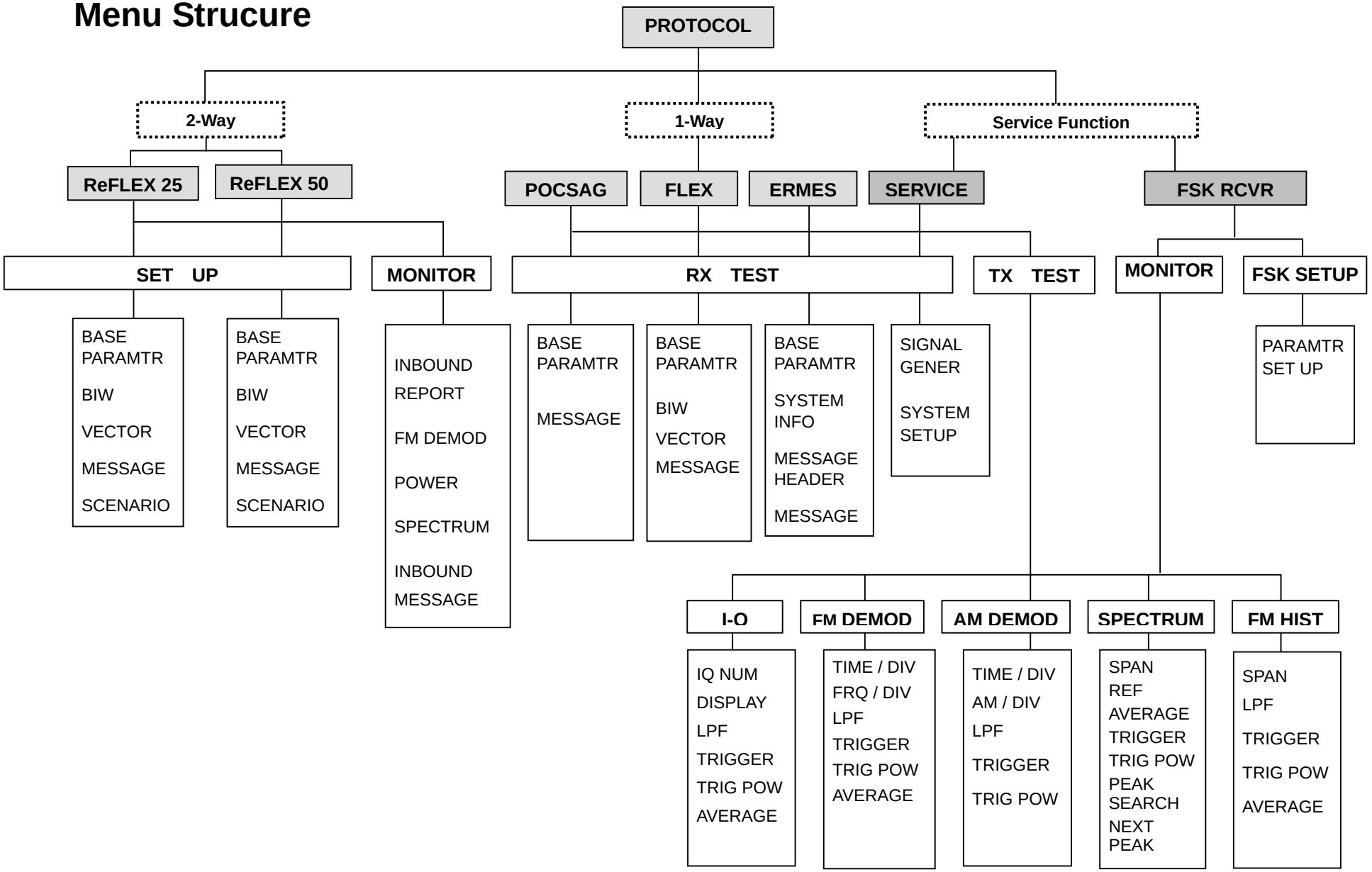
⑧ I.5 volt DC output.

⑨ RS-232C connector.

Display Screen



Menu Strucure



Basic Key Board Operation

Data Input and Edit

1) Move pointer "➔" to the desired input field. To move pointer, use Rotary Knob or ⇧ ⇩ keys. Push Rotary Knob or press ENT key, when the pointer "➔" is on desired position.

2) Input cursor will appear at selected field. Press ⇦ or ⇨ to move cursor. It indicates data entry position.

3) Change or edit the data value with Rotary Knob or ⇧ ⇩ keys. Or, enter data with Key Pad. Push Rotary Knob or press ENT key after entering or editing data. Pushing Rotary knob or pressing ENT , again toggle setting.

4) Input mode indicator at lower left corner of the screen darkens. "I" means Input Mode and "F" means Function Mode. Pushing Rotary knob or pressing ENT , again toggle setting.

5) DEL, or FCN DEL (CLEAR) key can be used during key pad entry.

Message input and edit: Message for transmission can be entered and edited in MESSAGE menu of each protocol. Use key pad or ⇧ ⇩ ⇦ ⇨ to enter the message, and use DEL or FCN DEL to make corrections. Use Rotary Knob for characters not available on front panel keypad to enter an alphanumeric message. Press ENT or Rotary Knob when done.

Menu selection : Select menu by pressing soft keys S1 through S7 .

Operation Procedure (2-Way Pager Test)

This chapter describes the operation procedure of testing 2-way pager.

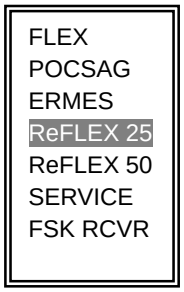
Step 1. Select Protocol (FCN + S4)

Press FCN + S4 (S7) and use Rotary Knob or ⇧ ⇩ to select protocol from pop-up menu.

Example) To select ReFLEX 25

FCN + S4 → Rotary Knob or ⇧ ⇩ → ENT

Pop-up Menu →



Step 2. Choose Test Screen (FCN + S5)

Use FCN + S5 to toggle test screen, or use short cut key FCN + 1 or FCN + 2.

The table below is the screens when 2-way pager testing mode is selected.

Short Cut Key	Test Screen	Description	Toggle Key
FCN + 2	SET UP	Test parameters are entered and test signal is transmitted to the pager under test	FCN + S5
FCN + 1	MONITOR	Signal from Inbound Channel such as Spectrum, Power, FM Demodulation is measured	

Example)

To monitor the reverse channel test results, the MONITOR screen is accessed.
Select protocol (ReFLEX 25 or ReFLEX 50), setup and start test, then select FCN + 1.

Step 3. Set up Test Parameters by SETUP (FCN + 2)

"SET UP" screen is used to enter 2-way protocol test parameters.

1) Select a 2-way protocol and press [FCN] + [2] to enter parameter setup screen.
2) Open desired parameter group using soft keys [S1] through [S5].
3) Move pointer to a parameter and press [ENT] or Rotary Knob for input mode.
4) Enter or edit values using Key Pad, Rotary Knob, or Cursor.
5) Press [ENT] or Rotary Knob to finish.

▣ **Note** : Refer to Paragraph IV, "Parameter Descriptions" for selected protocol parameter details.

Example)

Address / Level : [S1] → Select parameter "ADR" or "LEV" → Input address → [ENT]
or [ADR] or [LEV] → Input address or level → [ENT]

TX / RX Frequency : [S1] → Select parameter "RX F" or "TX F" → Input frequency → [ENT]
or [FRQ] or [FCN] + [FRQ] → Input frequency → [ENT]

Service Provider Identification : [S1] → Select parameter "SPID" → Input number → [ENT]

Vector type : [S3] → Select parameter "TYPE" → Select a desired vector type from pop-up menu → Set related parameters → Input number → [ENT]

Message : [S4] or [MSG] → Select parameter "NO" to use default messages→ [ENT]
or [S4] or [MSG] → Modify message → [ENT]

Step 4. Select Test Scenario # (S5) and Start Test

TC-2000A tests 2-way pagers using preset scenarios. Select a desired "SCEN" (Scenario Number) before starting the test.

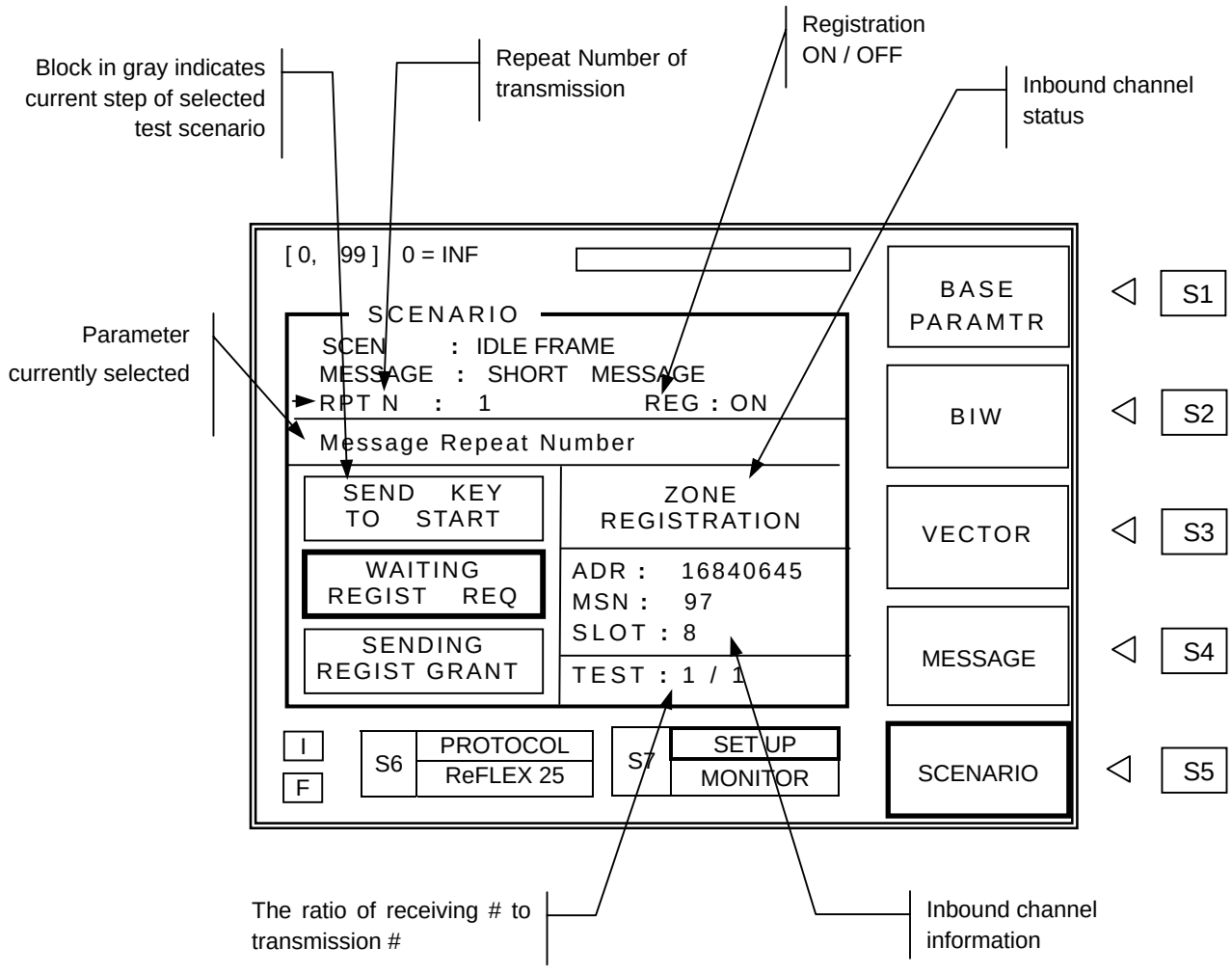
[S5] → Pointer at "SCEN" → Input Scenario Number → [ENT]

.

Number	SCEN	Description
0	IDLE FRAME	Transmits the Idle cord word continuously
1	Outbound MSG Test	Transmits test messages and detects inbound ACK.
2	Inbound MSG Test	Tests received inbound message.

2-way Pager Set Up Screen : Enter “Scenario Number”, “Registration ON / OFF”, “Repeat number of transmissions”. Then press [SEND] to transmit data.

▣ **Note** : Refer to Paragraph IV, “Parameter Descriptions” for the SCENARIO details.

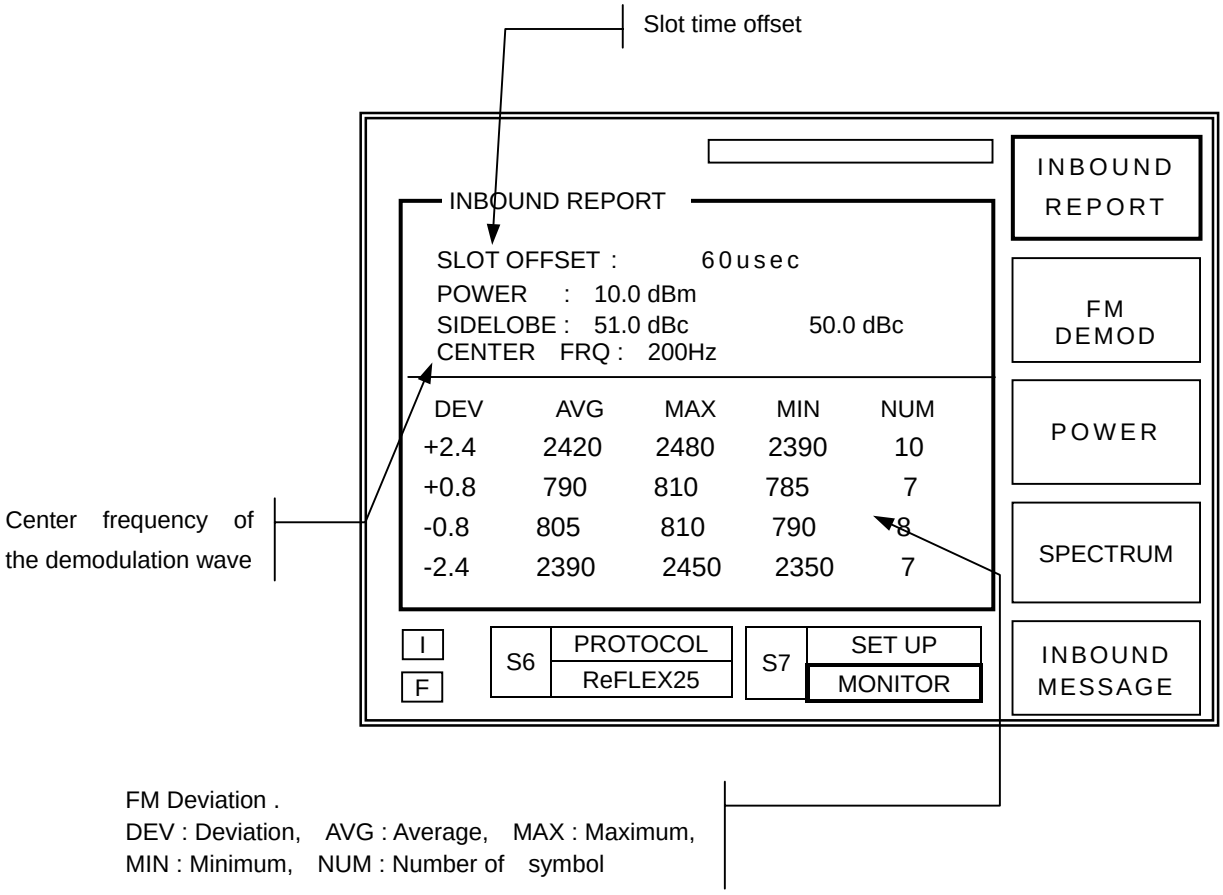


Step 5. View Inbound Channel Data by MONITOR

"MONITOR" screen is available when 2-way protocol test is selected.
Press **FCN** + **1** to view inbound channel information after completion of Scenario #1 or #2.

Menu	Key	Description
INBOUND REPORT	S1	Summary report of the inbound channel
FM DEMOD	S2	FM Demodulation screen
POWER	S3	Power and Slot Time Accuracy screen
SPECTRUM	S4	Spectrum screen
INBOUND MESSAGE	S5	Check reverse messages in HEX format

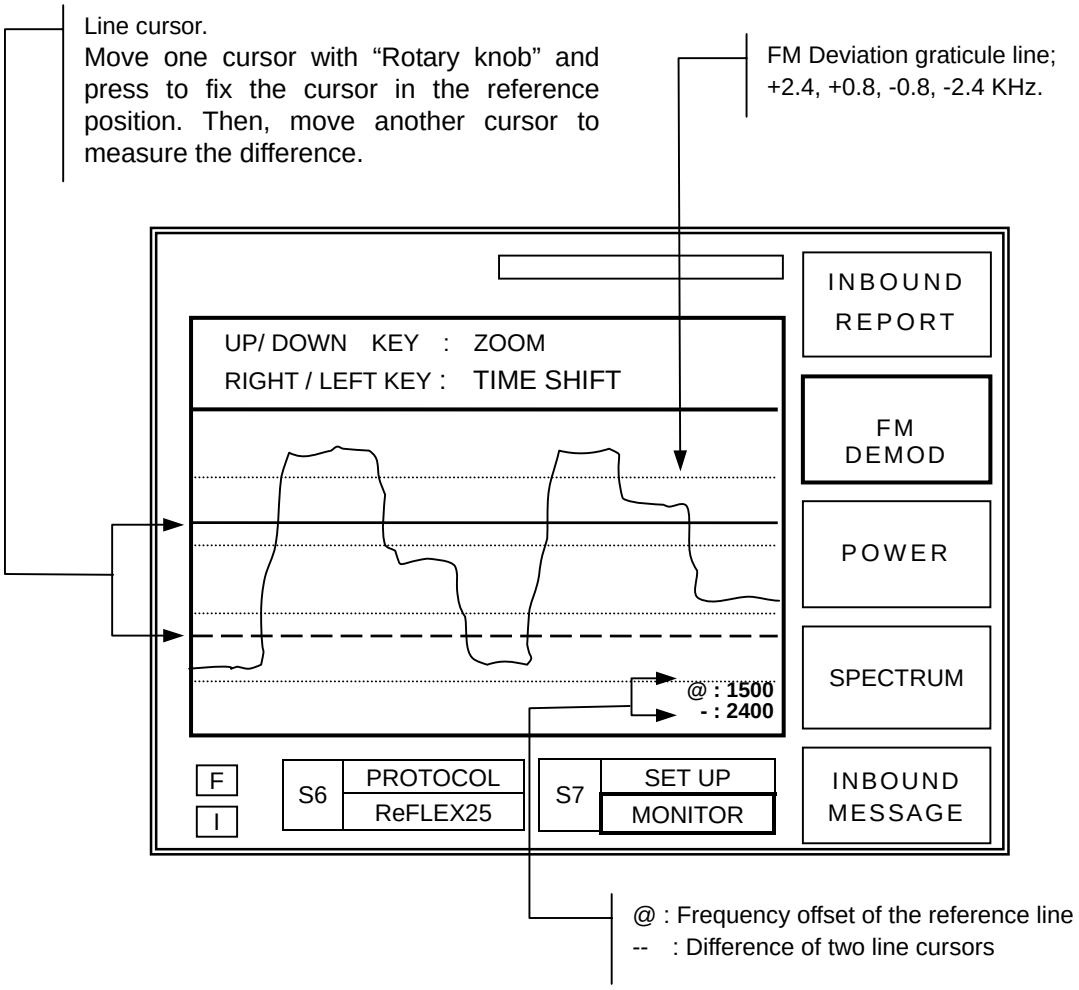
INBOUND REPORT (S1)



FM DEMOD (S2)

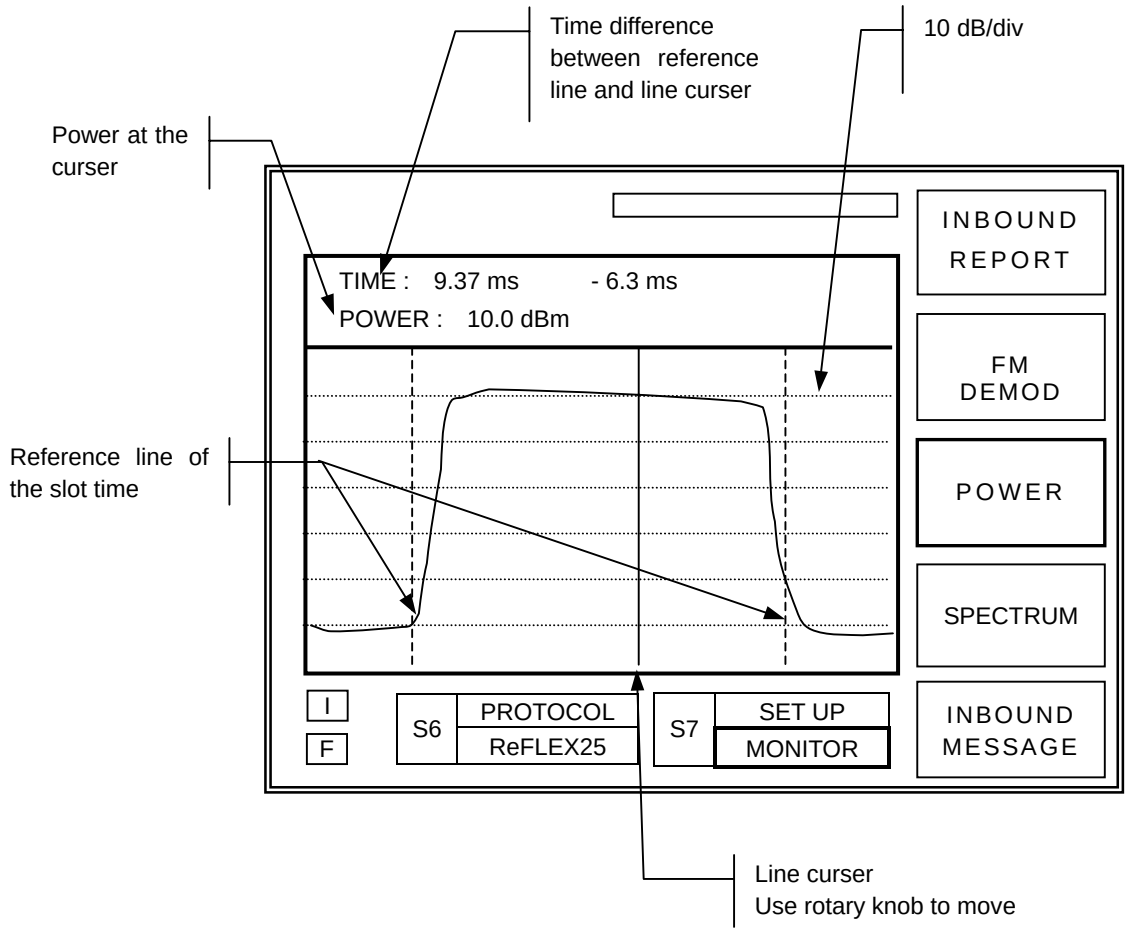
Zoom In / Out : Press ⇧, ⇩

Time Shift : Press ⇦ , ⇨

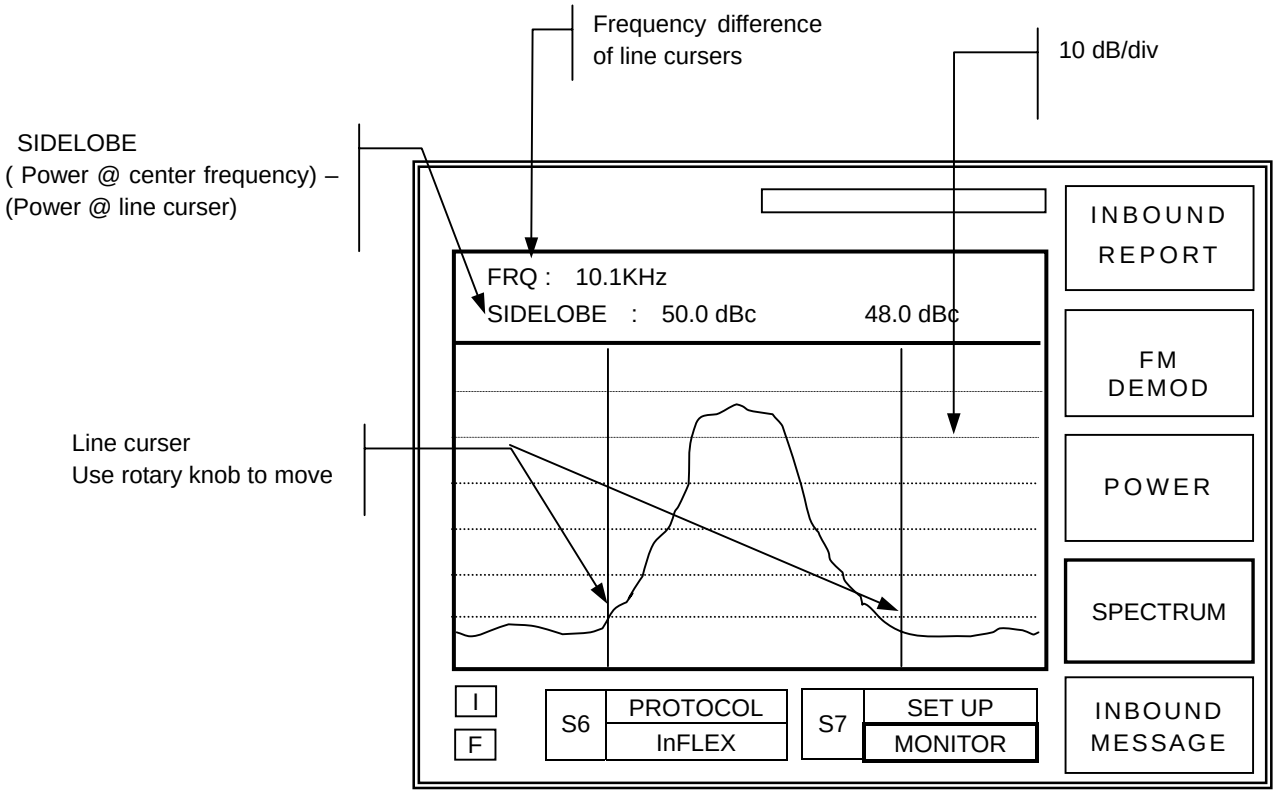


POWER (S3)

Inbound channel	Allowed Slot Time
800 / 4	160 ms
1600 / 4	80 ms
6400 / 4	24.06 ms
9600 / 4	16.04 ms



SPECTRUM (S4)



INBOUND MESSAGE (S5)

TC- 2000A display inbound messages as HEX code.

Operation Procedure (1-Way Pager Test)

This chapter describes the operation procedure of testing 1-way pager. Procedure are generally same as 2-way pager testing. Refer to paragraph 3-2 Operation Procedure (2-way Pager Test)..

Step 1. Select Protocol (FCN + S4)

Refer to paragraph 3-2-1

Step 2. Choose Test Screen (FCN + S5)

Use FCN + S5 to toggle test screen, or use short cut key FCN + 1 (TX) or FCN + 2 (RX).

Test screen for 1-way pager testing is shown on following table. Refer to paragraph 3-4-2, Signal Analyzer, for TX test mode details

Short Cut Key	Test Screen	Description	Toggle Key
FCN + 2	RX TEST	Enter test parameter and transmit test signal to pager under test.	FCN + S5
FCN + 1	TX TEST	Measure signal transmitted from pager under test to analyze received signal, i.e., I-Q, FM/AM Demodulation, FM Histogram and Frequency Spectrum.	

Step 3. Set up Test Parameters and Start Test (FCN + 2)

"RX TEST" screen is used to enter 1-way protocol test parameters.

1) Select a 1-way protocol and press FCN + 2 to enter parameter RX TEST screen.
2) Open desired parameter group using soft keys S1 through S5.
3) Move pointer to a parameter and press ENT or Rotary Knob for input mode.
4) Enter or edit values using Key Pad, Rotary Knob, or Cursor.
4) Press ENT or Rotary Knob to finish.
5) Press SEND to transmit data.

▣ **Note** : Refer to Paragraph IV, "Parameter Descriptions" for selected protocol parameter details.
▣ **Note** : Output frequency and level can be changed during the signal transmission.

FLEX Test Example) **In case the FLEX protocol is selected.**

Address / Level : [S1] → Select parameter "ADR" or "LEV" → Input address → [ENT]
or [ADR] or [LEV] → Input address or level → [ENT]

Frequency : [S1] → Select parameter "FRQ" → Input frequency → [ENT]
or [FRQ] → Input frequency → [ENT]

Vector type : [S3] → Select parameter "VECTOR" → Select a desired vector type from pop-up menu → Set related parameters → Input number → [ENT]

Message : [S4] or [MSG] → Select parameter "NO" to use default messages→ [ENT]
or [S4] or [MSG] → Modify message → [ENT]

General-Purpose Communication Analyzer

Signal Generator (RX TEST)

TC-2000A provides a general-purpose RF source for narrowband receiver test.

Select "SERVICE" from protocol pop-up menu and set Test screen to RX Test..

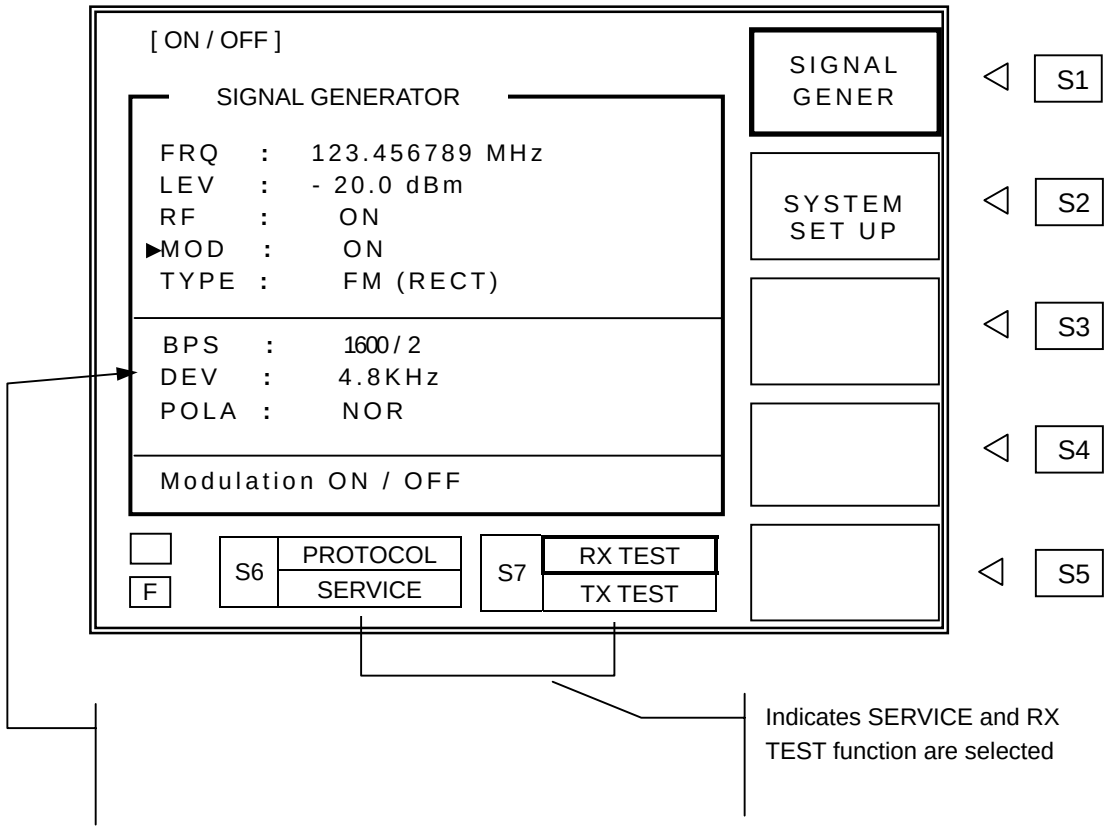
MOD OUT SETUP menu permits change of polarity and adjustment of voltage for the audio modulation output. This setting is effective for encoder output and FSK receiver output as well.

RS232 SETUP allows user to set TC-2000A RS-232C configuration. TC-2000A RS-232C configuration must match to that of the controller PC.

Menu	Key	Description
SIGNAL GENER	[S1]	Generate AM and FM (Rectangular / Sign) modulation signal.
SYSTEM SETUP	[S2]	MOD OUT SETUP :Set peak voltage and polarity of modulation /demodulation signal at the front panel BNC RS232C SETUP : Set TC-2000A RS-232C configuration

Example) **Generate RF signal with square wave FM modulation**

[S1] → Select modulation "TYPE: FM (RECT)" → [ENT] → Set BPS and DEViation and POLarity



Parameters of SIGNAL GENERATER Menu

FRQ : Set Frequency.

Press [FRQ] or move pointer to “FRQ” and press [ENT] . Enter data at cursor location and press [ENT] .

- Range : 0.1 ~ 50MHz (IF OUT port), 130MHz ~ 960MHz
- Resolution : 6.25kHz, 5kHz

LEV : Set RF output level

Press [LEV] or move pointer to “LEV” and press [ENT] . Enter data at cursor location and press [ENT] . Set level can be stored for future convenience. (☞ Refer to paragraph 3-7).

- Range : -20 to -120dBm
- Level Step : 0.1dB

RF : Set RF on/off.
RF output on or off toggle.

MOD : Set Modulation on/off.
When in OFF position, the RF output is CW

TYPE : Set modulation type. Displays parameters related to Mod type selected..

Type	Description	Menu
AM (SIN)	AM Modulation	FRQ, DEPTH
FM (RECT)	FM Modulation (Rectangular)	BPS, DEV, POLA
FM (SIN)	FM Modulation (Sign)	FRQ, DEV

■ **AM : AM Modulation**

FRQ : AM Modulation Frequency (20Hz ~ 4000Hz)
DEPTH : AM Depth (0 ~ 100%)

■ **FM (SIN) : FM Modulation (Sign wave)**

FRQ : FM Modulation Frequency (20Hz ~ 4000Hz)
DEV : FM Deviation (0.1KHz ~ 7.0KHz)

■ **FM (RECT) : FM Modulation (Rectangular wave)**

BPS : Bit Per Second . Resynchronization signal is transmitted when “RESYNC” is selected. RESYNC is a FLEX only function to prevent the FLEX pager under test from synchronizing to local paging station and is useful during the RF board is serving.
DEV : FM Deviation (0.1KHz ~ 7.0KHz)
POLA : FSK Modulation Polarity.
Toggles between “NOR” and “INV”.

FSK Modulation (2 LEVEL)

NOR (Normal polarity)	INV (Inverse polarity)
“1” : Carrier **–** Deviation “0” : Carrier **+** Deviation	“1” : Carrier **+** Deviation “0” : Carrier **–** Deviation

FSK Modulation (4 LEVEL)

NOR (Normal polarity)	INV (Inverse polarity)
“10” : Carrier **+** Deviation “11” : Carrier **+** (Deviation/3) “01” : Carrier – (Deviation/3) “00” : Carrier – Deviation	“10” : Carrier – Deviation “11” : Carrier – (Deviation/3) “01” : Carrier **+** (Deviation/3) “00” : Carrier **+** Deviation

Parameter of SYSTEM SETUP Menu

MOD OUT SETUP

TYPE : Selects Bipolar or Unipolar Modulation.

PEAK : Selects modulation peak voltage between 0 to 2 volt.

RS232 SETUP

Parameter	Range	Description
MAX SPEED	110 ~ 56000 BPS	Maximum Speed
DATA BITS	5 ~ 8 BIT	Word Length
PARITY	EVEN, ODD, NONE, MARK, SPACE	Parity Check
STOP BITS	1, 2	Stop Bits

Signal Analyzer (TX TEST)

"TX TEST" Test Function is available in all one-way protocol, service, and FSK receiver mode.

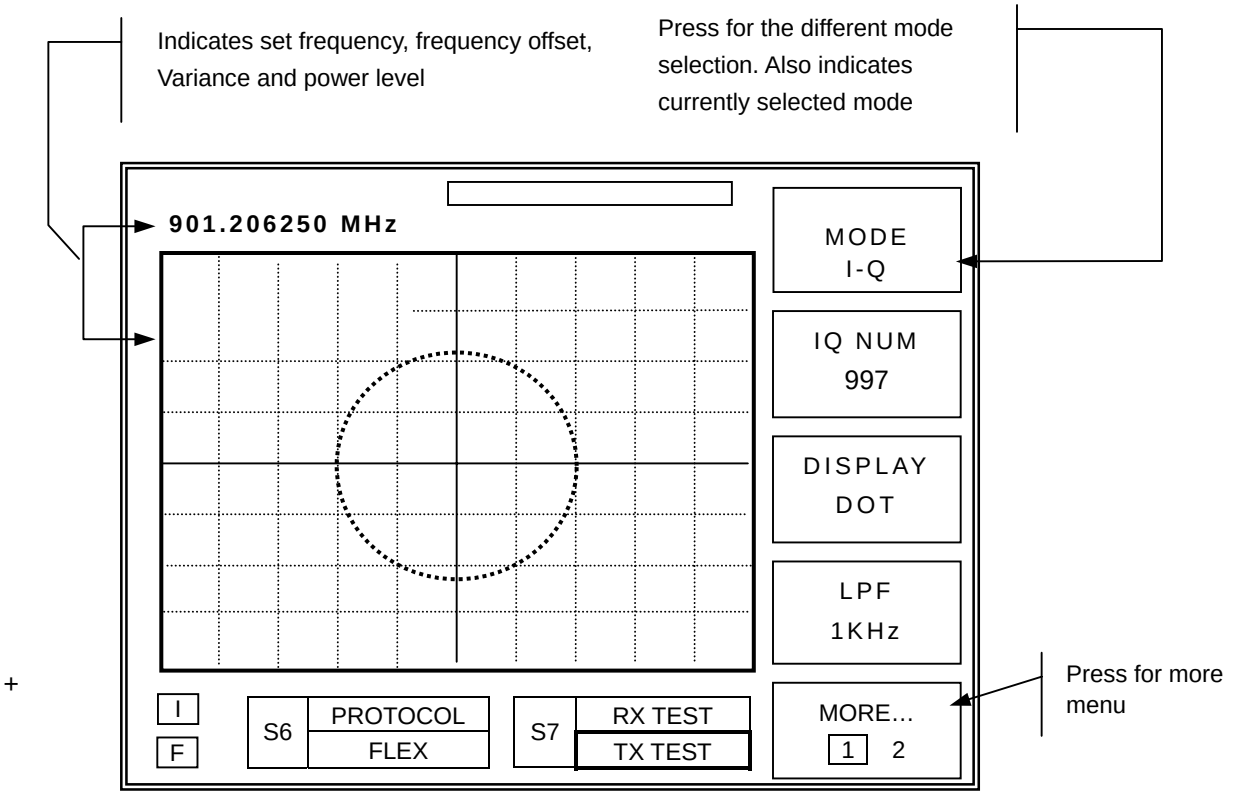
Menu	Description	Key
I-Q	I-Q scatter diagram	Press [S1] → Select "I-Q" from pop-up menu
FM DEMOD	FM Demodulation	Press [S1] → Select "FM DEMOD" from pop-up menu
AM DEMOD	AM Demodulation	Press [S1] → Select "AM DEMOD" from pop-up menu
SPECTRUM	Spectrum	Press [S1] → Select "SPECTRUM" from pop-up menu
FM HIST	FM Histogram	Press [S1] → Select "FM HIST" from pop-up menu

▣ **Note** : This function is independent of Rx test mode. TC-2000A can simultaneously transmit and receive signal. It can be used for detecting signal from pager under repair while the pager being tuned eliminating needs of other instruments.

I-Q

Display I-Q Scatter diagram of measured signal

Note that the input bandwidth of TC-2000A is 90 KHz of the set frequency. Press [FCN] + [FRQ] and enter frequency for the measurement. Press [S5] for more menu.



TX FRQ : Press [FCN] + [FRQ] and enter measurement frequency at upper left corner. Measured frequency is the sum of set frequency and offset frequency. For an example, set frequency of 850.000000 MHz and offset frequency of –1500 Hz means the measured frequency is 849.998500 MHz.

- TX frequency range : 455KHz to 960MHz
- Offset range : -20KHz to 20KHz

I-Q NUM : Set I-Q Data Points. Press [S2] and enter desired data.

- Input range : 10 to 1000

DISPLAY : Wave form display mode
Toggles between dot and line display when [S3] is pressed.

LPF : Select Low Pass Filter . Press [S4] and select filter from pop up menu..

- LPF : 1KHz, 3KHz, 15KHz

TRIGGER : Trigger Mode. Same as oscilloscope. Press [S5] for "MORE [2]" screen, press [S3] and to select a trigger mode.

Trigger Mode	Description	Example Display
AUTO	Continuous sweep	
NORMAL	Display appear only when signal is present	
SINGLE	Press [ESC] to start a sweep	

TRIG POW (Power Trigger)

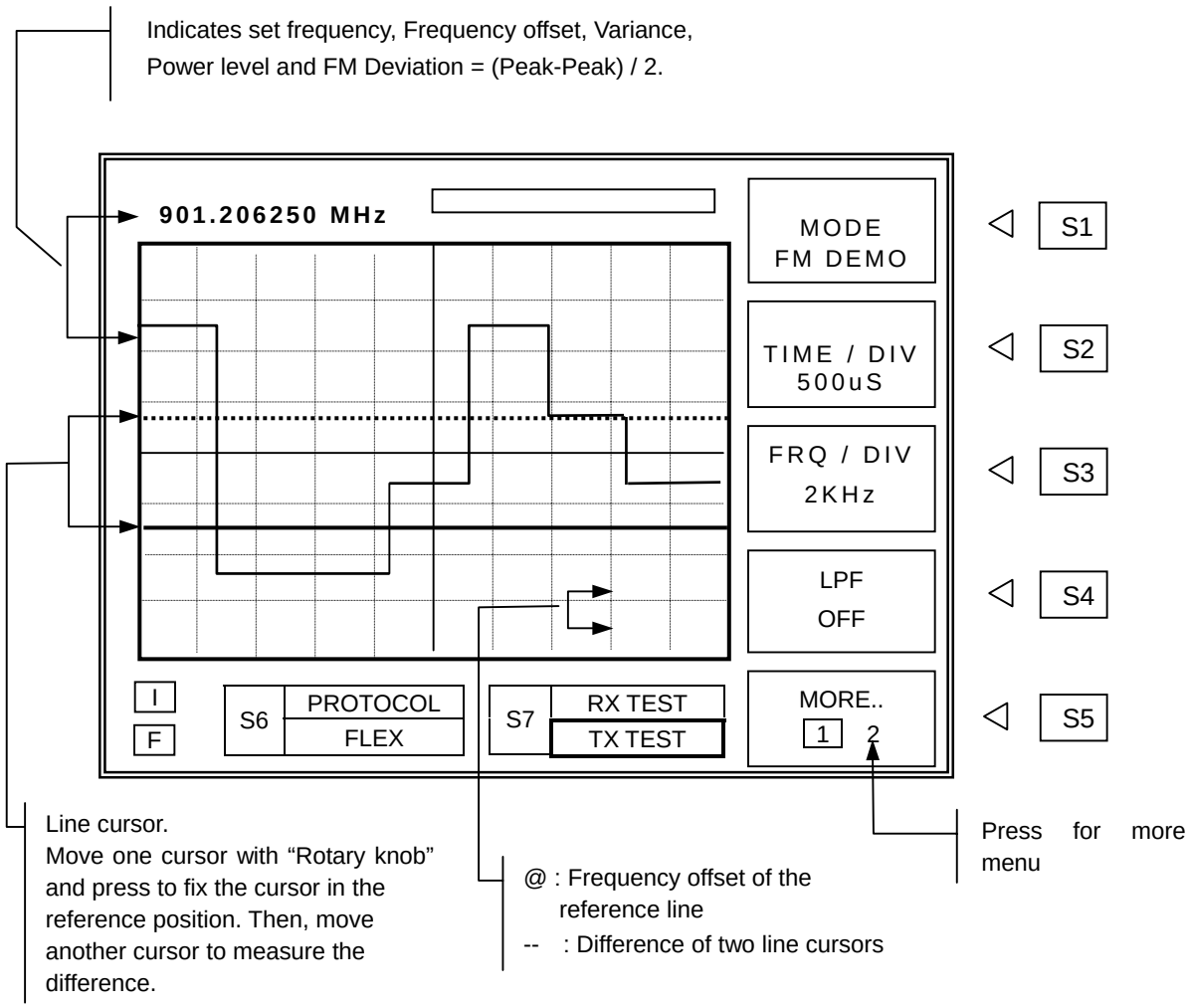
Trigger Level sets the Internal trigger level as a function of instantaneous signal power in SINGLE or NORMAL trigger mode. Input Range is -80 ~ 10 dBm,

AVERAGE : Measurement Averaging. The signal averaging improves the signal to noise ratio. The noise, i.e., the measurement error, decreases by 1/SQRT(N) for N averages, but the measurement time increases by N times. Increasing averaging will reduce the measurement fluctuation and noise floor of the spectrum.

FM DEMOD (FM Demodulation)

Displays FM demodulated wave form. Move cursor line to measure the frequency offset

Most menu and operations are the same as the I-Q mode.



TIME/DIV : Set horizontal axis time per division. Press [S2] and select the time.

- Time per div range : 100uS, 200uS, 500uS, 1000uS

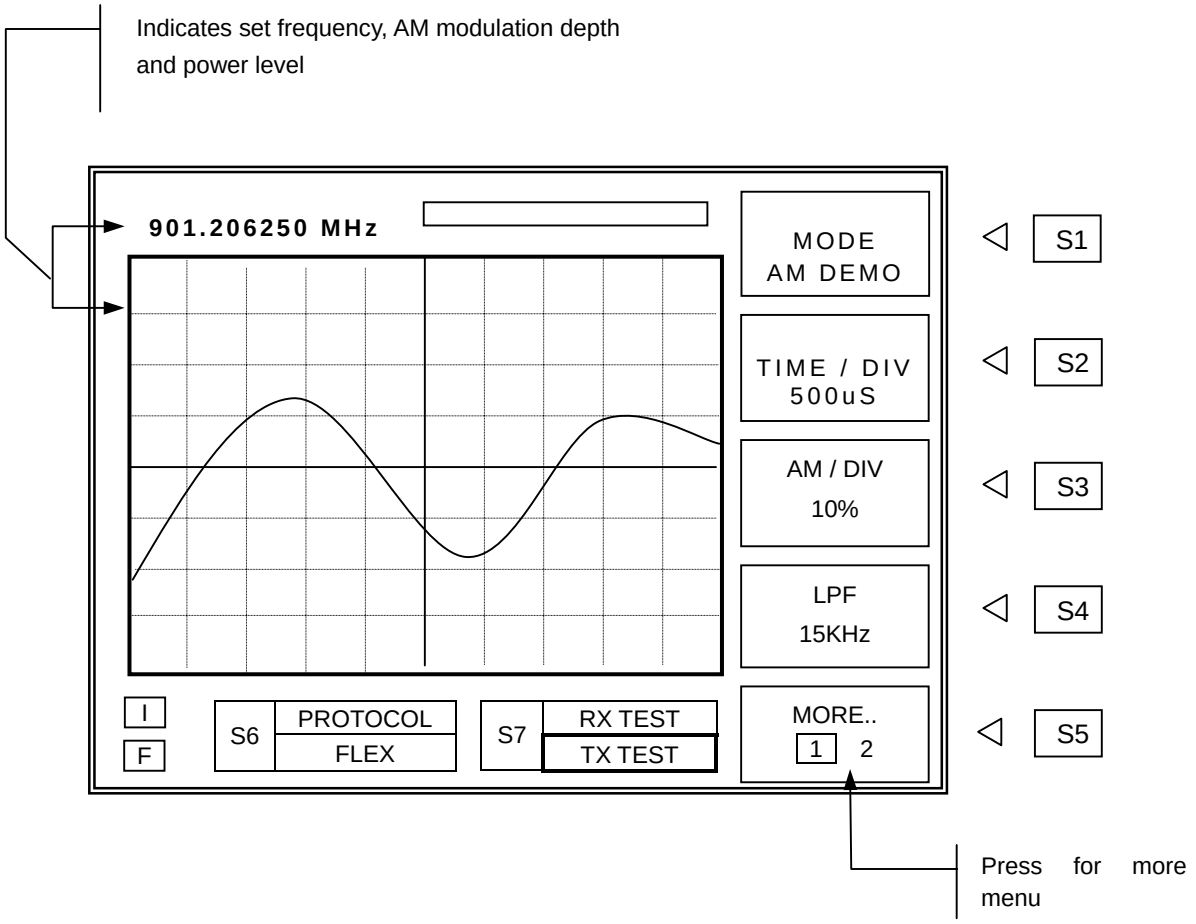
FRQ/DIV : Set vertical axis frequency per division. Press [S3] and select the frequency.

- Frequency per div range : 5KHz, 2KHz, 1KHz, 500Hz, 200Hz, 100Hz

AM DEMOD (AM Demodulation)

Displays AM demodulated wave form.

Most menu and operations are the same as the I-Q mode.



TIME/DIV : Set horizontal axis time per division. Press [S2] and select the time.

- Time per div range : 100uS, 200uS, 500uS, 1000uS

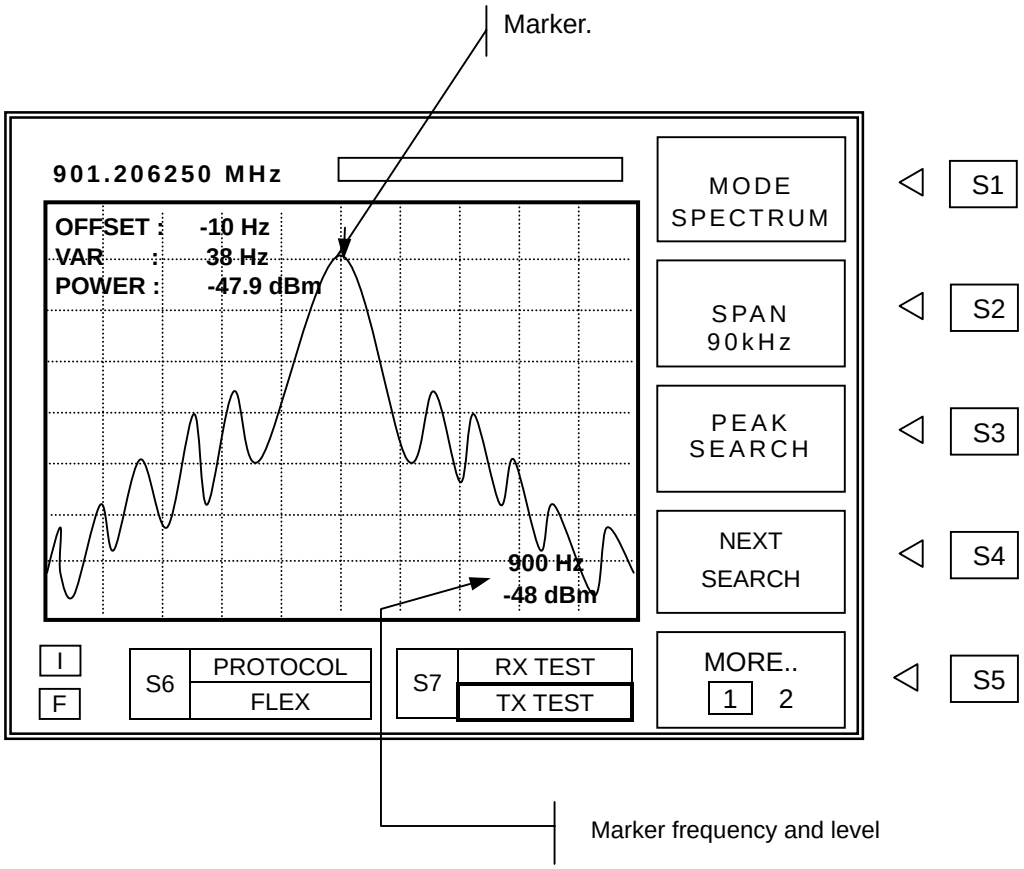
AM/DIV : Set vertical axis AM Depth per division. Press [S3] and select the AM Depth.

- AM Depth per div range : 1%, 2%, 5%, 10%, 20%, 50%

SPECTRUM

Display frequency spectrum

Most menu and operations are the same as the I-Q mode.



SPAN : Select full screen frequency span width
Press [S2] and set span width frequency with rotary knob, and press [ENT].

- Span range : 1 to 90KHz

REF : Set RF reference level of top graticule line.
Press [S5] for "MORE [2]" screen, press [S4] and set reference level with rotary knob, and press [ENT] .

- Input Range : -90dBm ~ 50dBm

PEAK SEARCH : When [S3] is pressed, the marker finds the peak value of the waveform. The frequency and level at the marker are displayed at the lower right of the screen.

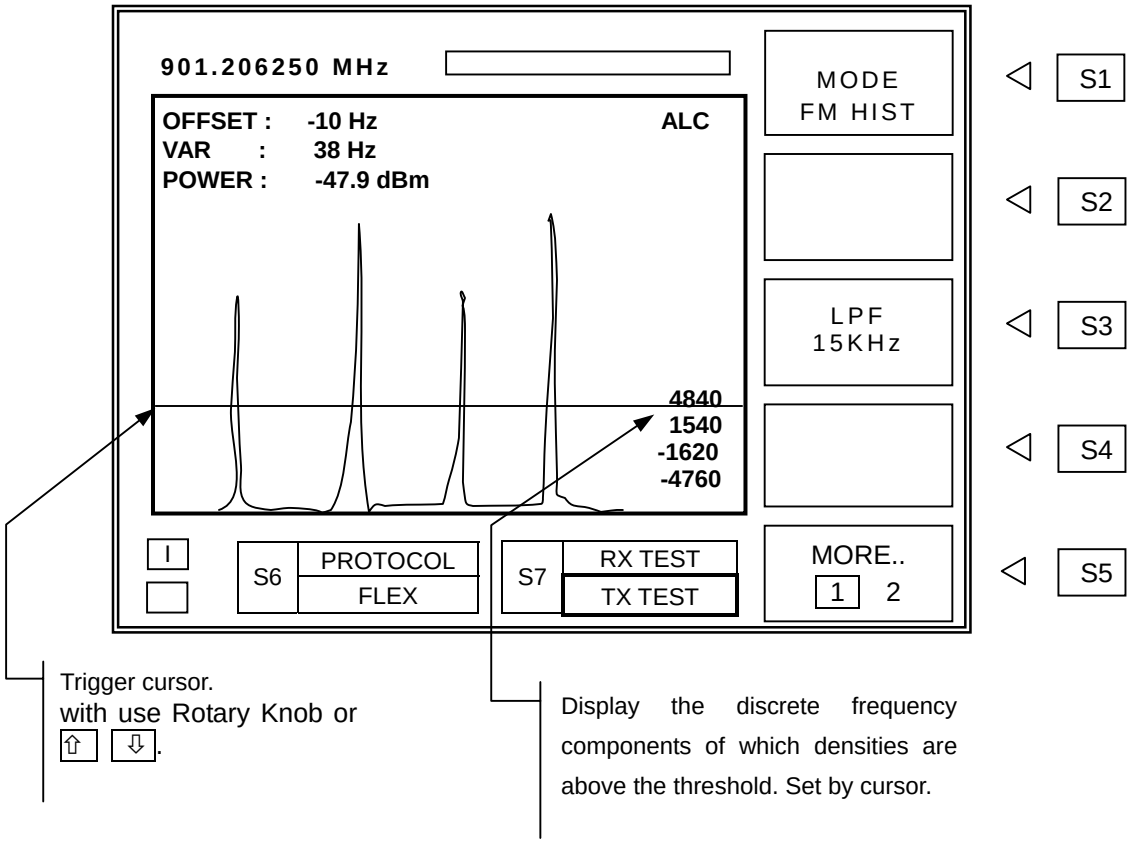
NEXT PEAK : When [S4] is pressed, the marker finds the 2nd peak of the waveform.

▣ **Note** : The "Power "on the upper left corner of the screen is the total signal power(Including Noise) and may be different from the signal level of the marker.

FM HIST (FM Histogram)

Displays the probability distribution of a FM signal on frequency domain. It's very useful for FSK analysis.

Most menu and operations are the same as the I-Q Mode.



SPAN : Select full screen span width
Press [S2] and set span width frequency with rotary knob, and press [ENT].

- Span range : 1 to 90KHz

General-Purpose FSK Receiver Mode

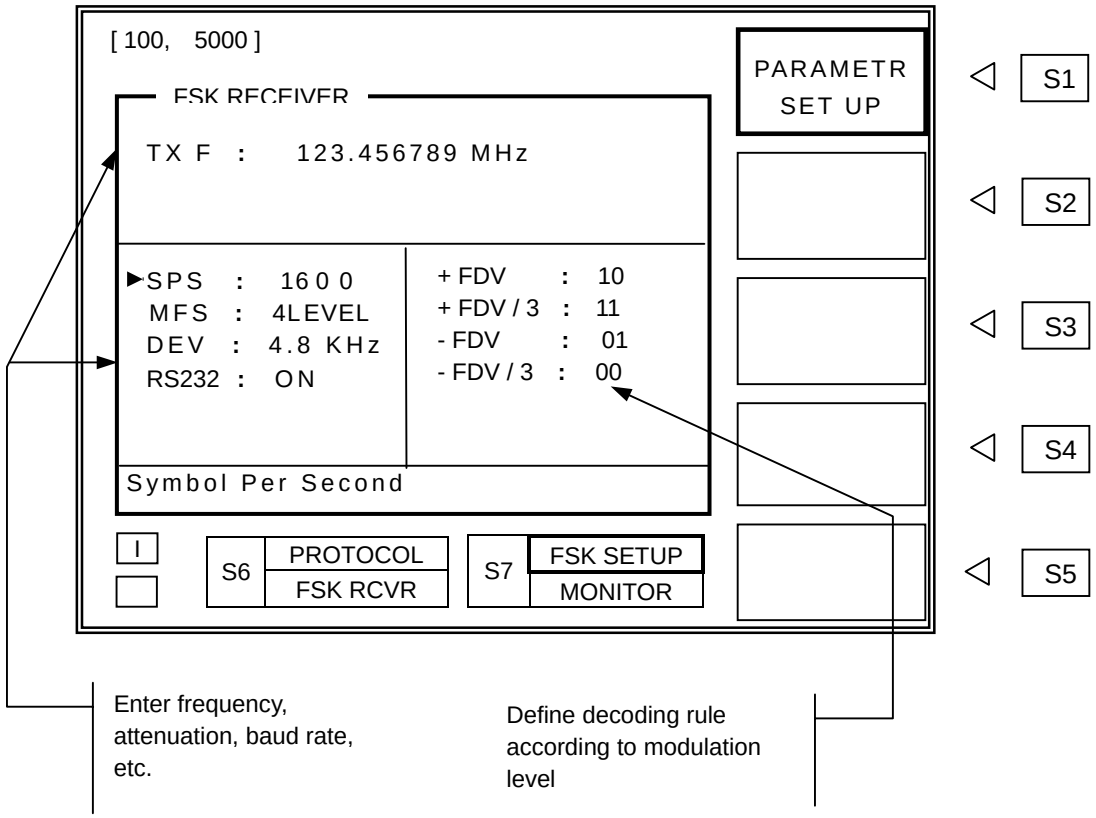
TC-2000A is a general-purpose narrow band FSK receiver to test transmitters.

In the FSK Receiver mode, TC-2000A demodulates FSK signal and forwards data to RS-232C. The analog demodulated signal is also available at the “MOD OUT” port at the front panel for use with digital decoder.

Select “FSK RCVR” from the protocol menu.

While demodulating, the signal may be monitored in Monitor Screen.

Menu	Short cut Key	Toggle Key	Description
FSK SETUP	FCN + 2	FCN + S5	FSK receiver set up
MONITOR	FCN + 1		Monitor FSK signal. The operating method are same as “TX TEST” mode. “AUTO” is only available in the TRGGER mode. (☞ refer to 3-4-2)



TX F : Enter test signal frequency.

- Frequency range : 455KHz to 960MHz

SPS : Symbol per Second (100 ~ 5000).
Set same as BPS rate for the 2 level and reduce it by a half when the signal is 4 level. See table below.

FSK LEVEL	BPS	SPS
2 Level	800	800
	1600	1600
4 Level	1600	800
	6400	3200

MFSK : Number of FSK Level (2 Level / 4 Level).

DEV : FM Deviation (0.1 KHz ~ 7.0KHz)

FDV : FSK Decoding Bit Value Define decoding rule according to modulation level

RS-232C : ON / OFF. Send decoded data to RS-232C port.

Store/Recall Instrument Setting, Messages, RF Levels

***Instrument settings and messages**:*

Store: [FCN] + [Recall] (STORE) → Select a store number (or "MESSAGE") → [ENT]

Recall: [Recall] → Select a store number(or "MESSAGE")→ [ENT]

▣ **Note** : When TC-2000A is turn on, the instrument does not return to the power-off condition but recalls the setting from the most recently saved memory location (STORE Number).

Signal Generator RF Level

Store: : [LEV] or Select parameter "LEV" → Input level → [FCN] + [Recall]
(STORE) → Select an alphabet from pop-up menu → [ENT]

Recall: [LEV] + [A], [LEV] + [B], [LEV] + [C], [LEV] + [D]

Parameter Descriptions

This chapter describes various protocol parameters as well as other parameter details of TC-2000A.

IV

POCSAG

This manual does not include protocol details. Unless operator is proficient with the protocol and has specific use, not altering the default value is highly recommended.

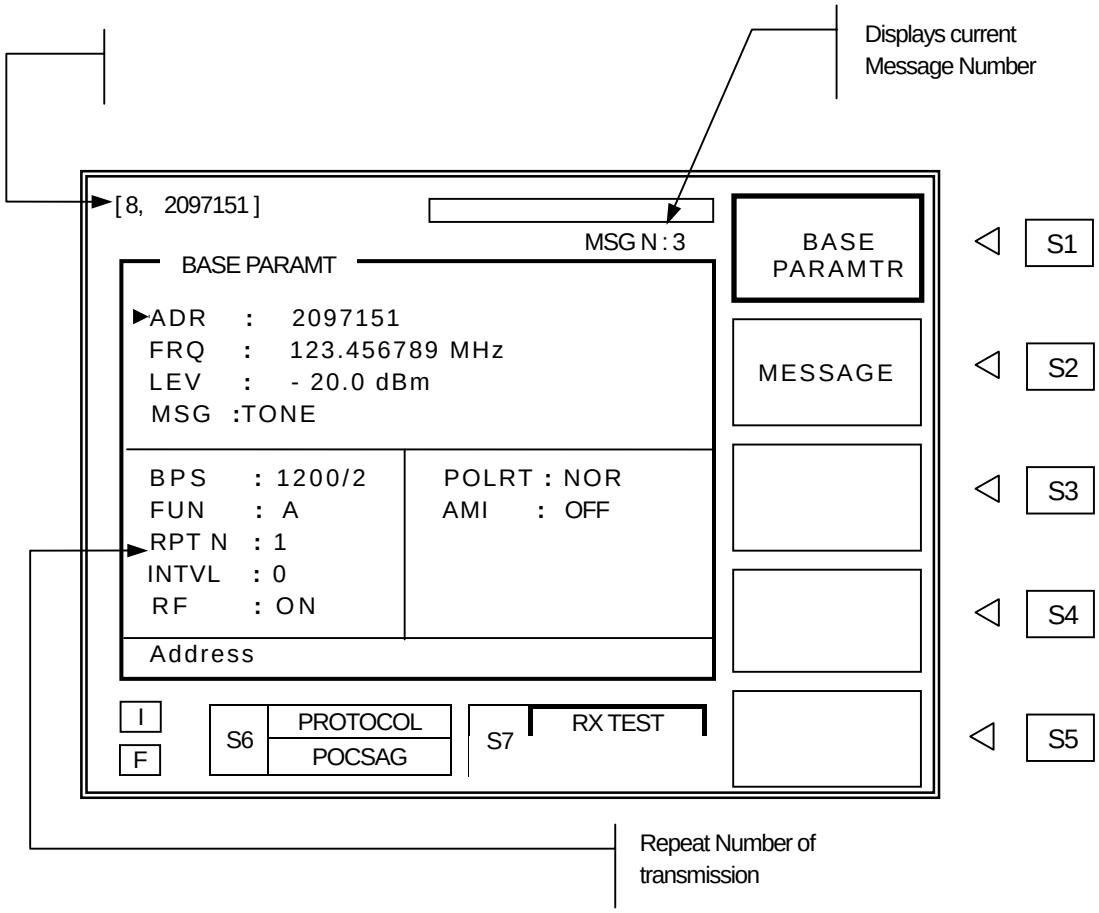
Parameters not specified in the protocol documents but supported in TC-2000A are in gray on this operating manual.

To select POCSAG screen, press [FCN] + [S4], choose it from pop-up menu and press [ENT].

Refer to 3-1 for the operation, choosing menu, moving cursor, data input, etc.

BASE PARAMT (Base Parameters)

Press [S1] to select base test parameter settings.



ADR : Address setting. Press [ADR] key or move cursor to "ADR" and press [ENT] and then input the pager address,

- Range : 8 ~ 2097151

FRQ : Frequency setting.

Press [FRQ] key or move cursor to "FRQ" and press [ENT] , then input frequency.

Frequency value can be changed while TC-2000A is transmitting.

- Range : 100KHz ~ 50MHz (IF OUT port) or 130MHz ~ 960MHz
- Resolution : 6.25KHz or 5KHz

LEV : RF output level.

Press [LEV] key or move cursor to "LEV" and press [ENT] , then enter level. Level value can be changed while TC-2000A is transmitting.

Frequently used value can be conveniently stored and recalled(☞ Refer to 3-7).

- Range : -20dBm to -120dBm
- Level Step : 0.1dB

MSG : Message Type Selection (Tone only, Numeric, Alphanumeric) .

Move arrow to "MSG" and press [ENT]. Select desired Message Type from the pop up menu.

Function Bit ("FUN") are automatically set when Message Type is selected.

PRC : PRC (People's Republic of China). Chinese character transmission.

Select "NUMERIC"' from the pop up menu and press [ENT]. Move arrow to "PRC" and press [ENT].

BPS : Data Baud Rate.

Range of POCSAG is 512/2, 1200/2, 2400/2

FUN : Select Function Bit (A / B / C / D)

Move arrow to "FCN" and press [ENT]. Change to A, B, C, or D by rotary knob.

A : Numeric, B : Reserved, D : Alpha Numeric

RPT N : Repeat Number.

Choose number of messages to be sent.

Message repeat range is 0 to 999. "0" is continuous repeat until [SEND] is pressed again.

INTVL : Message Repeat Interval.

Enter the repeat interval number by keypad. Each digit represent one second. Message transmission is shown on table below.

INTVL : 0

RPT N		1	2	3	4
DATA	Preamble	BATCH	BATCH	BATCH	BATCH

INTVL : >=1

RPT N		1	**Interval**		2
DATA	Preamble	BATCH		Preamble	BATCH

RF : RF **ON /OFF** RF Power ON/OFF during Interval time.

Move arrow to "RF". Pressing [ENT] toggles RF on and off.

POLA : FSK Modulation Polarity.

Move arrow to "POLRT" and press [ENT] . Pressing [ENT] again will toggle NOR / INV.

FSK Modulation

NOR (Normal polarity)	**INV (Inverse polarity)**
"1" : Carrier – 4.5 KHz "0" : Carrier + 4.5 KHz	"1" : Carrier + 4.5 KHz "0" : Carrier – 4.5 KHz

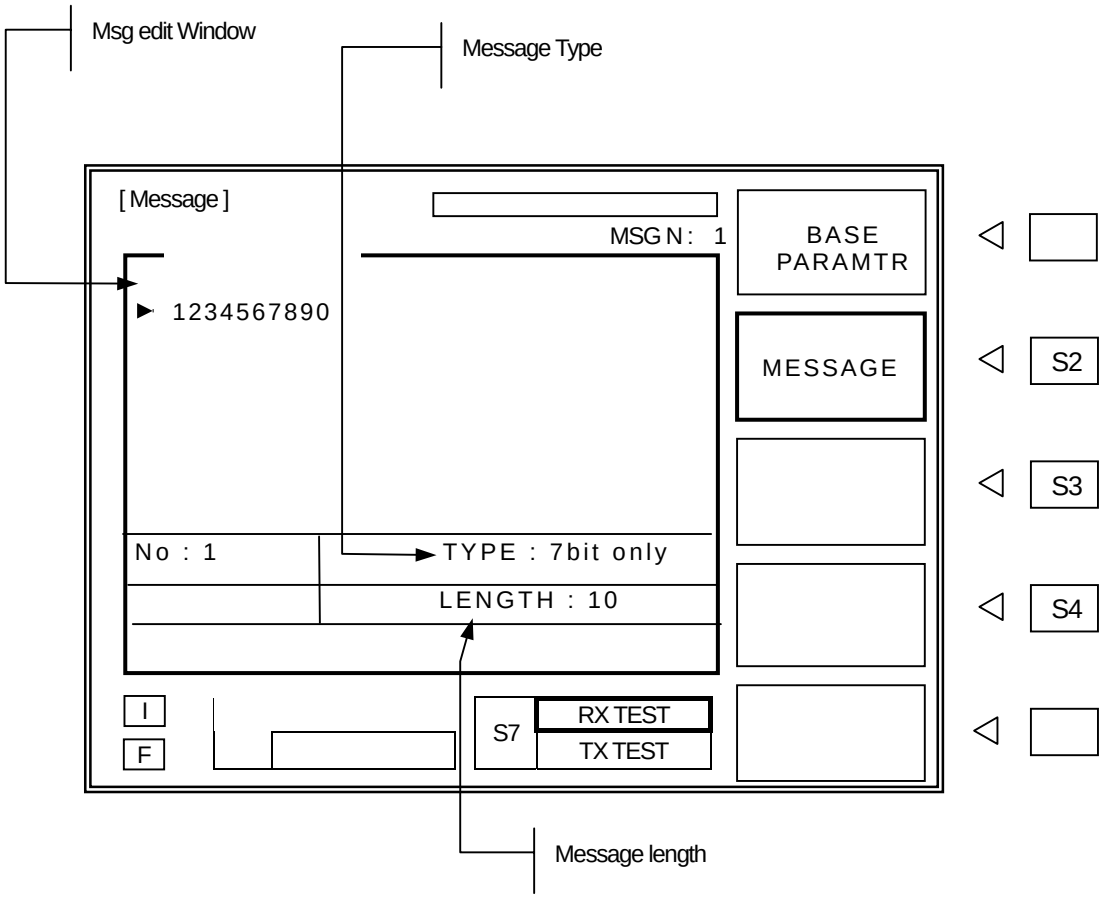
AMI : **Automatic-Numbering Message Function ON/OFF.** This function automatically inserts the message number with a space at the end of messages when message is sent repeatedly.

Example : When RPT N (Message Repeat Number) is 3.

Count	**Message**	**Transmission**
1	12345	12345 **00**
2	12345	12345 **01**
3	12345	12345 **02**

MESSAGE

Press [S2] to select [MESSAGE] menu. Messages for transmission can be edited on this screen.



MESSAGE Display Window : Message content and editing.

Messages either can be directly entered on screen or recalled the stored messages. Numeric messages can be enter by front panel keypad. To enter Alphanumeric messages, use Rotary Knob and [⇦] [⇨] key and choose characters. Messages also can be entered by PC via RS-232C interface. Stored messages are not editable on screen.

TYPE : Select Character Code Type (7 bit, KSC-5601, GB 2312 or CNS).

Move cursor to "TYPE" , press ENT , select Character Code type from pop-up menu and press ENT. This is only possible when "ALPHA" on "VECTOR" pop up menu is selected. When "TONE" or "NUMERIC" is selected, only "TYPE" is displayed.

NO : Select the stored messages.

Move cursor to "NO" and press ENT . Enter stored message number and press ENT . TC-2000A has 40 stored messages of Arabic numbers, ASCII, Korean (KS-S601), Chinese Characters (GB-2312-80) for testing various types of pagers. Stored messages are in following table.

TC-2000A Built-in Message List

Message Type	Number / Length	Size of Buffer	Message
Numeric (4bit)	No : 1	100	1234567890
	No : 2	100	3456789012
	No : 3	100	5678901234
	No : 4	100	7890123456
	No : 5	100	9012345678
Alphanumeric (7bit only)	No : 1 (10 Char.)	100	1234567890
	No : 2 (26 Char.)	100	ABCDEFGHIJKLMNOPQRSTUVWXYZ
	No : 3 (36 Char.)	100	Abcdefghijklmnopqrstuvwxyz1234567890
	No : 4 (100 Char.)	100	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2
	No : 5 (1000 Char.)	1000	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T 2U 2V 2W 2X 2Y 2Z 3A 3B 3C 3D 3E 3F 3G 3H 3I 3J 3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T 3U 3V 3W 3X 3Y 3Z 4A 4B 4C 4D 4E 4F 4G 4H 4I 4J 4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T 4U 4V 4W 4X 4Y 4Z 5A 5B 5C 5D 5E 5F 5G 5H 5I 5J 5K 5L 5M 5N 5O 5P 5Q 5R 5S 5T 5U 5V 5W 5X 5Y 5Z 6A 6B 6C 6D 6E 6F 6G 6H 6I 6J 6K 6L 6M 6N 6O 6P 6Q 6R 6S 6T 6U 6V 6W 6X 6Y 6Z 7A 7B 7C 7D 7E 7F 7G 7H 7I 7J 7K 7L 7M 7N 7O 7P 7Q 7R 7S 7T 7U 7V 7W 7X 7Y 7Z 8A 8B 8C 8D 8F 8G 8H 8I 8J 8K 8L 8M 8N 8O 8P 8Q 8R 8S 8T 8U 8V 8W 8X 8Y 8Z 9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O 9P 9Q 9R 9S 9T 9U 9V 9W 9X 9Y 9Z 0A 0B 0C 0D 0E 0F 0G 0H 0I 0J 0K 0L 0M 0N 0O 0P 0Q 0 R0S 0T 0U 0V 0W 0X 0Y 0Z 1a 1b 1c 1d 1e 1f 1g 1h 1i 1j 1k 1l 1m 1n 1o 1p 1q 1r 1s 1t 1u 1v 1w 1x 1y 1z 2a 2b 2c 2d 2e 2f 2g 2h 2i 2j 2k 2l 2m 2n 2o 2p 2q 2r 2s 2t 2u 2v 2w 2x 2y 2z 3a 3b 3c 3d 3e 3f 3g 3h 3I 3j 3k 3l 3m 3n 3o 3p 3q 3r 3s 3t 3u 3v 3

Message Type	Number / Length	Size of Buffer	Message
Alphanumeric (KSC-5601)	No : 1 (26 Char)	100	한글문자 Pager 시험.
	No : 2 (28 Char)	100	무궁화 꽃이 피었습니다.
	No : 3 (41 Char)	100	무궁화 꽃이 피었습니다. 123456789012
	No : 4 (54 Char)	100	무궁화 꽃이 피었습니다. Pager Test 123456789012
	No : 5 (32 Char)	1000	테스콤 Pager Tester 世界第一
Alphanumeric (GB 2312-80)	No : 1 (13 Char)	100	中文傳呼測試
	No : 2 (40 Char)	100	TESCOM 傳呼機測試儀器, 品質第一
	No : 3 (41 Char)	100	祝 生意興隆, 萬事如意, 財源滾滾
	No : 4 (41 Char)	100	緊急事件, 太太我 , 速回電家裏
	No : 5 (35 Char)	1000	交通阻塞, 約會改爲 1630 金
Alphanumeric (CNS)	No : 1, 2, 3, 4 (70 Char)	100	CNS CODE MESSAGE : TESCOM 祝 各 用 戶 業 務 蒸 蒸 日 上
	No : 5 (284 Char)	1000	FLEX和POCSAG碼制的區別:FLEX是用GPS的絕對時鍾作爲標準的全同步傳輸方式,尋呼機在指定的時間內打開接收電路,接收信息,這樣就比POCSAG碼尋呼機省電好幾倍以上;同時,FLEX采用的4電平FSK調制而代替POCSAG制式的2電平FSK,因而 FLEX的傳輸容量能增加幾倍.

LENGTH : Indicates current message length.

F L E X

This manual does not include protocol details. Unless operator is proficient with the protocol and has specific use, not altering the default value is highly recommended.

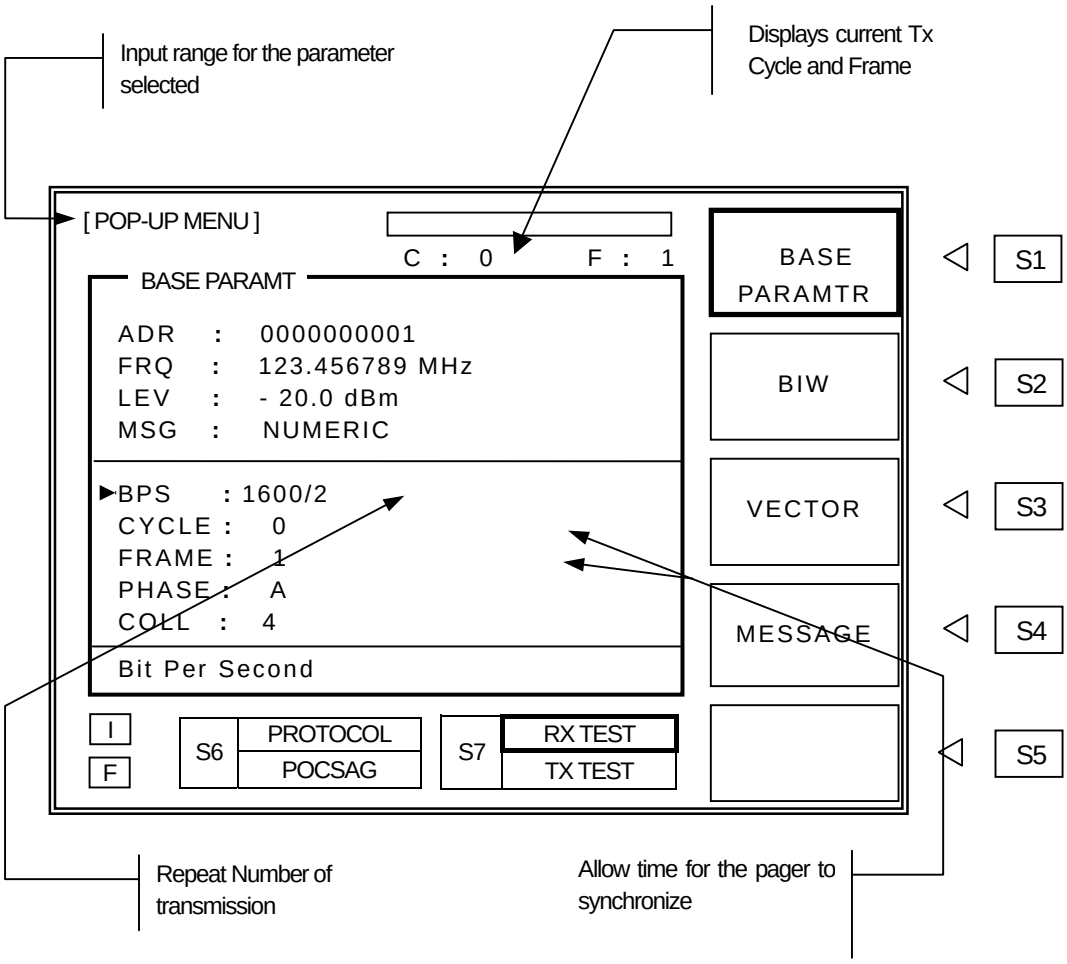
Parameters not specified in the protocol documents but supported in TC-2000A are in gray on this operating manual.

To select FLEX screen, press [FCN] + [S4], choose it from pop-up menu and press [ENT].

Refer to 3-1 for the operation, choosing menu, moving cursor, data input, etc.

BASE PARAMT (Base Parameters)

Press [S1] to select base test parameter settings.



ADR : Address setting. Press [ADR] key or move cursor to "ADR" and press [ENT] and then input the pager address,

- Input Range : 0000001 ~ 4297068542

FRQ : Set Frequency.

Press [FRQ] or move pointer to "FRQ" and press [ENT] . Enter data at cursor location and press [ENT] . Frequency can be changed during message transmission.

- Range : 0.1 ~ 50MHz (IF OUT port), 130MHz ~ 960MHz
- Resolution : 6.25 kHz, 5 kHz

LEV : Set RF output level

Press [LEV] or move pointer to "LEV" and press [ENT] . Enter data at cursor location and press [ENT] . Output level can be changed during message transmission. Set level can be stored for future convenience. (☞ Refer to paragraph 3-7).

- Range : -20 to -120dBm
- Level Step : 0.1dB

MSG : Select Message Type (Numeric, Alphanumeric, Short Instruction, HEX/BIN, SECURE, Short)

Move arrow to "MSG" and press [ENT] and select desired message type from pop up menu.

BPS : Data Baud Rate.

Range of FLEX 25 is 1600/2, 3200/2, 3200/4, 6400/4 BPS..

CYCLE : Starting cycle number of transmission (0 ~ 14)

Move cursor to "CYCLE" and press [ENT] , then input the start cycle number.

FRAME : Set Base Frame .

Move arrow to "FRAME" and press [ENT], then input the start frame number. Normally, the Base Frame information is included in the pager address and Base Frame number is automatically set. Unless the case is special, changing the number is not recommended.

PHASE : Set Phase (A/B/C/D)

As the Base Frame, Phase information is included in the pager address and Phase parameter is automatically set. Unless the case is special, changing the parameter not recommended.

COLL : Set Collapse (battery save cycle)

Selects time interval between pager to receive signal for the battery saving. Receive cycle = 2^m, where m is collapse value; i.e., for m= 0, 1, 2, 3, .7 then receive cycle varies to 1, 2, 4, 8,... 128. For instance, if a receiver has a collapse m=4, then the receiver monitors every 2^4=16 frames starting from its base frame.

RPT N :. Repeat Number.

Choose number of messages to be sent.

Message repeat range is 0 to 999. "0" is continuous repeat until [SEND] is pressed again.

HEAD : Reserve Fame

When the Header is ON, it sends Idle Code for the pager to synchronize before the message transmission in the base frame.

RESY : RESY=ON allows asynchronous tests of FLEX pagers.

Without this feature, FLEX pagers must power reboot or need be under simulated signal-loss condition for asynchronous tests. During RESYNCH pattern transmission, transmission power is increased by 20dB, if applicable, to ensure the reception of RESYNCH signal.

POLRT : **NOR / INV**, FSK Modulation Polarity.

Toggles between "NOR" and "INV".

FSK Modulation (2 LEVEL)

NOR (Normal polarity)	**INV (Inverse polarity)**
"1" : Carrier **+** 4.8 kHz "0" : Carrier **–** 4.8 kHz	"1" : Carrier **–** 4.8 kHz "0" : Carrier **+** 4.8 kHz

FSK Modulation (4 LEVEL)

NOR (Normal polarity)	**INV (Inverse polarity)**
"10" : Carrier **+** 4.8 kHz "11" : Carrier **+** 1.6 kHz "01" : Carrier – 1.6 kHz "00" : Carrier – 4.8 kHz	"10" : Carrier – 4.8 kHz "11" : Carrier – 1.6 kHz "01" : Carrier **+** 1.6 kHz "00" : Carrier **+** 4.8 kHz

DUMMY : Dummy Call inserts a message with all 5s(Hex) in all non-call phases. It turns off automatically when any one of SSID, NID or TIME in BIW menu is on.

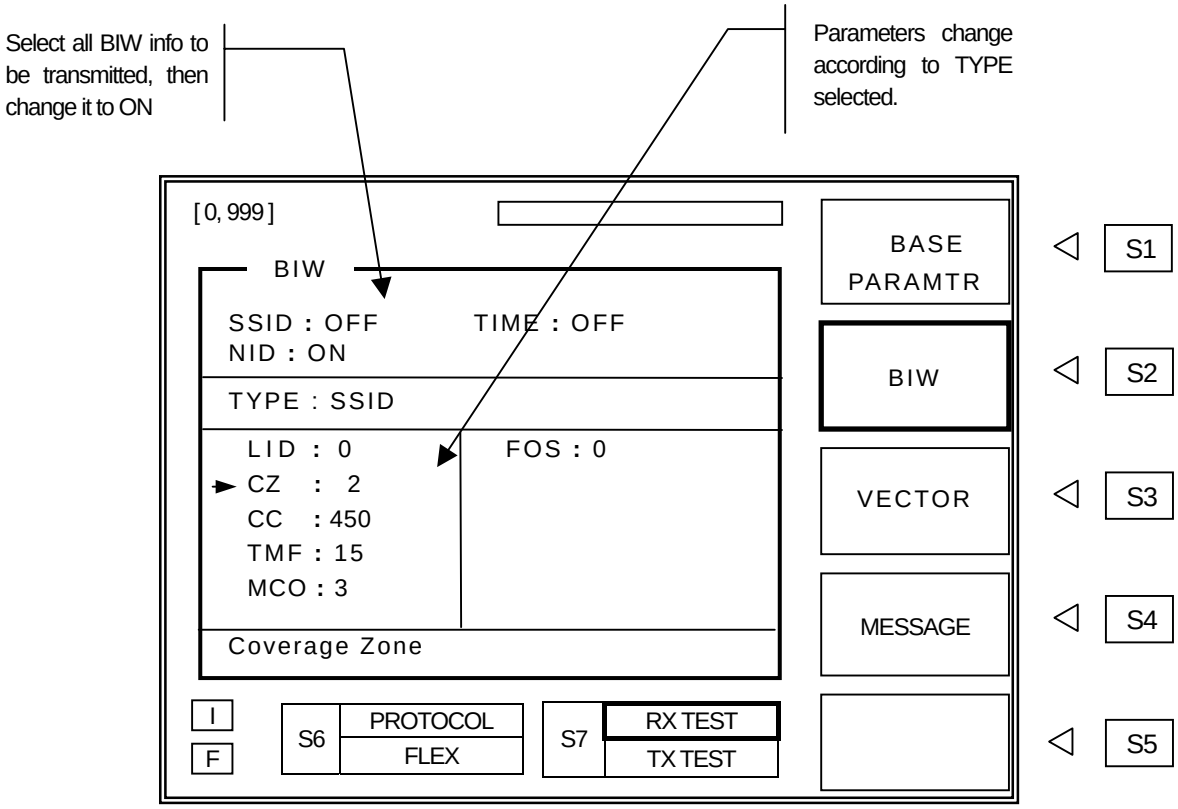
ON : Activate the dummy call function for equalizing the FSK deviation.

OFF : Default setting. Does not activate the dummy call function. Idle frames are set in the non-call phases.

Ex) Address : 1234567, Phase : B, BPS : 6400/4, Vector Type : Numeric, Message : 1234567890			
Dummy Call ON			**Dummy Call OFF**
Word	**Phase**	**MSB LSB**	
0 (BIW)	A	11001100011000000000100000010110	01101101010000000000010000001011
	B	11001100011000000000100000010110	11001100011000000000100000010110
	C	11001100011000000000100000010110	01101101010000000000010000001011
	D	11001100011000000000100000010110	01101101010000000000010000001011
1 (Address)	A	01010101010101010101010101010101 – Dummy Address	11111111111111111111111111111111
	B	10010000001100110101011010000111 – Address	10010000001100110101011010000111
	C	01010101010101010101010101010101 – Dummy Address	11111111111111111111111111111111
	D	01010101010101010101010101010101 – Dummy Address	00000000000000000000000000000000
2 (Vector)	A	11010110000010100100000110110101 – Dummy Vector	00000000000000000000000000000000
	B	01010101010101000100000110111010 – Vector	01010101010101000100000110111010
	C	11010110000010100100000110110101 – Dummy Vector	00000000000000000000000000000000
	D	11010110000010100100000110110101 – Dummy Vector	00000000000000000000000000000000
3 (Message)	A	01010101010101010101010101010101- Dummy Message	11111111111111111111111111111111
	B	11111111001101010000011001000011110 – Message	11111111001101010000011001000011110
	C	01010101010101010101010101010101 – Dummy Message	11111111111111111111111111111111
	D	01010101010101010101010101010101 – Dummy Message	00000000000000000000000000000000
4 (Message)	A	01010101010101010101010101010101 – Dummy Message	00000000000000000000000000000000
	B	00011101101000010011000011101100 – Message	00011101101000010011000011101100
	C	01010101010101010101010101010101- Dummy Message	00000000000000000000000000000000
	D	01010101010101010101010101010101 – Dummy Message	00000000000000000000000000000000

BIW

Press S2 to select [BIW] parameter settings.



TYPE

: **Select SSID / NID / TIME** from BIW (Block Information Word), S2.
Move cursor to TYPE and press ENT. Select test function from pop up menu and press ENT. Test parameters related to test function selected will appear next to "TYPE" on screen. Each parameter can be changed ON or OFF. Selected status is shown on upper side of screen.

When message are sent with roaming service selected (SSID or NID is ON), regardless of Base Frame, TC-2000A start with Frame "0". This will enable pager to receive roaming information correctly.

"RPT N" is limited to 0 – 1 when the Roaming is ON. Refer to paragraph 4-2-1.

■ **SSID**

LID : LOCAL ID (0 ~511)

CZ : Coverage Zone (0 ~ 31)

CC : Country code (0 ~ 1023)

TMF : Traffic Management Flag (0 ~ 15)

MCO : Maximum Carry On (0 ~ 3)

FOS : Frame Offset (0 ~ 63)

■ **NID**

NA : Network Address (0 ~ 4049). Network Address =NA + 2025472

SA : Service Area (0 ~ 31)

MULT : Multiplier (0 ~ 7)

TMF : Traffic Management Flag (0 ~ 15)

MCO : Maximum Carry On (0 ~ 3)

FOS : Frame Offset (0 ~ 63)

■ **TIME**

MONT : Month (1 ~ 12)

DAY : Date (1 ~ 31)

YEAR : Year (1994 ~ 2025)

HOUR : Hour (0 ~ 23)

MIN : Minute (0 ~ 59)

CS : Second (0 ~ 63)

6 bit code is used in FLEX. 1 minute is divided by 64 and 1 unit is 0.9375 seconds.

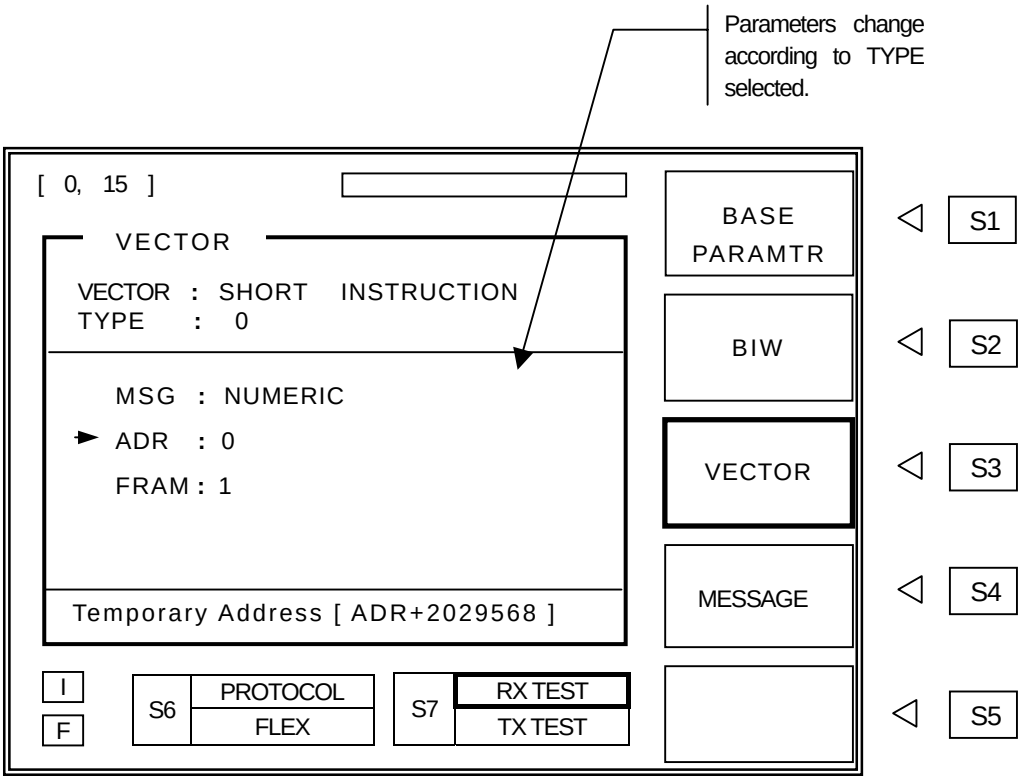
DLS : Daylight Saving Time (0 / 1)

LTZ : Local Time Zone (0 ~ 31)

VECTOR

VECTOR menu contains parameters related to Vector type.

Press [S3] to select [VECTOR] menu.



VECTOR Choosing VECTOR Type

Move cursor to VECTOR, press [ENT] , select desired vector type from pop up menu and press [ENT] . Parameters change according to VECTOR TYPE selected.

■ **SECURE : Secure Vector**

MSN : Message Sequence Number (0 ~ 63)

NSR : Number of Sequential Roaming Registration (1~7). It indicates the number of locations to be registered time coordinated with the users itinerary.

SN : Select Sequential Number. SN is the arbitrary number used in TC-2000A to distinguish different roaming locations. Total number of roaming location set on NSR, and SN number must be equal or less than NSR number, i.e., if NSR is 5, SN must be 1 though 5.

ST : Start Time (0 ~ 524287 x 1Minute).

RT (#) : Registration Type. Selects NID or SSID. It send signal to pager whether it is to follow the NID or the SSID. Some parameters are changed according to Registration Type selected.

DT (#) : Duration Time (0 ~ 524287 x 1Minute).

OT (#) : Overlap Time (0 ~ 127 x 30 Minute).

FRQ (#) : Frequency (0 ~ 2097151 x 1.25 kHz).

MASK (#) : CZ / SA Wildcard Mask (0 ~ 7).

CC (#) : Country Code. (0 ~ 1023). It appears when SSID is selected in "RT"

LID (#) : Local ID. (0 ~ 511). It's appeared when SSID is selected in "RT"

CZ (#) : Coverage Zone (0 ~ 31). It's appeared when SSID is selected in "RT"

NA (#) : Network Address (0 ~ 4095 + 2025472) It's appeared when NID is selected in "RT"

MULT (#) : Multiplier (0 ~ 7) It's appeared when NID is selected in "RT"

SA (#) : Service area (0 ~ 31)). It's appeared when NID is selected in "RT

■ **SHORT IN : Short Instruction Vector (Group Call Service)**

Send Group Call message as following.

1) Enter pager address, frequency and message on "BASE PARAMTR" screen.
2) Press [S3] (VECTOR), move arrow to "VECTOR" press [ENT], select "SHORT IN" from pop up menu and press [ENT] then select desired data.
3) Press [SEND]. Short Instruction Vector and message included in address will be sent first and then group message entered in 1) and temporary address entered in 2) of above will be sent.

TYPE : Short Instruction Type (0 ~ 2), Related parameters appear according to Short Instruction Type selected.

TYPE	Description	Parameter
0	Temp. Address activation	MSG, ADR, FRAM
1	System Event	MSG, EVEN
2	Temp. Address with MSN	MSG, ADR, FRAM, MSN

MSG : Message Type (Numeric , HEX / BIN, Alphanumeric).
Message can be edited in MESSAGE(S4) menu.

ADR : Temporary Address (0 ~ 15)
Actual Temporary Address is ADR + 2029568

FRAM : Relative Frame Number. (1 ~ 120). Time interval between Short Instruction Vector Frame and Temporary Address Message Frame. If the FRAM number entered is not equal to or bigger than $2^{Collapse}$, the Collapse value will automatically change. When the "TYPE" on "VECTOR" screen is set to 2, as per the Protocol Definition, 0~62 is sent as "0" and 63~120 is sent as "1".

Example of FRAM : 2

Frame Number	0	1	2	3
Transmit	ADR + Short Instruction Vector	Idle	Idle	TEMP. ADR + Message

EVEN : System Event Notification (0 ~ 2047)

MSN : Message Sequence Number (0 ~ 63)

■ **SHORT MG : Short Message**

TYPE : Set Short Message Type (0 / 1 / 2)

Parameters change according to Short Message Type selected

TYPE	Parameter	Description	Input Range
0	.	.	.
1	SOUR	Source	0 ~ 7
2	SOUR	Source	0 ~ 7
	MSN	Message Sequence Number	0 ~ 63
	IOMF	In Order Message Flag	0, 1

■ **NUMERIC : Numeric Vector**

TYPE : Numeric Type (Standard / Special / Numbered)

Parameters change according to Type selected.

TYPE	Parameter	Description	Input Range
STANDARD	*AMI	Automatic-Numbering Message.	ON/OFF
SPECIAL	*AMI	Automatic-Numbering Message	ON/OFF
NUMBERED	MSN	Message Sequence Number	0 ~ 63
	IOMF	In Order Message Flag	0, 1
	SF	Special Format	0, 1
	*AMI	Automatic-Numbering Message	ON/OFF

***AMI : Automatic-Numbering Message Function** This function automatically inserts the message number with a space at the end of messages when message is sent repeatedly.

■ **ALPHA : Alpha Numeric Vector**

MSN : Message Sequence Number (0 ~ 63)

IOMF : In Order Message Flag (0 / 1).

MAIL : Mail drop flag

AMI : Automatic-Numbering Message Function

■ **HEX / BIN**

MSN : Message Sequence Number (0 ~ 63)

IOMF : In Order Message Flag (0 / 1)

LENG : Blocking Length (0 ~ 15)

MAIL : Mail Drop Flag (0 / 1)

HEAD : Header Message (0 / 1)

SIF : Status Information Field Enabler (0 / 1)

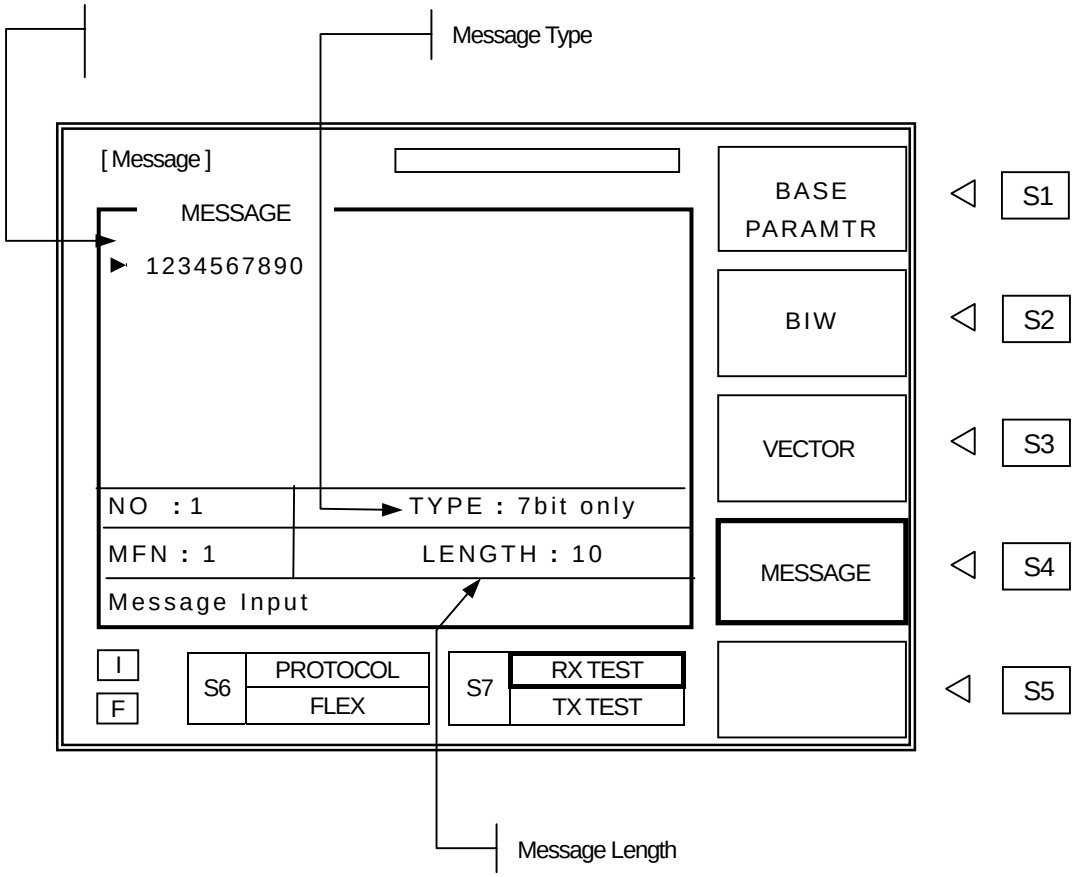
■ **SECURE (ALPHA) :** To send Alphanumeric (7bit) Message in Secure Vector.

Edit Message in MESSAGE(S5) menu.

MSN : Message Sequence Number (0 ~ 63)

MESSAGE

Press [S4] to select [MESSAGE] menu. Messages for transmission can be edited on this screen.



MESSAGE Display Window : Message content and editing.

Messages either can be directly entered on screen or recalled the stored messages. Numeric messages can be enter by front panel keypad. To enter Alphanumeric messages, use Rotary Knob and [⇦] [⇨] key and choose characters. Messages also can be entered by PC via RS-232C interface. Stored messages are not editable on screen.

TYPE : Select Character Code Type (7 bit, KSC-5601, GB 2312 or CNS).

Move cursor to "TYPE" , press ENT , select Character Code type from pop-up menu and press ENT. This is only possible when "ALPHA" on "VECTOR" is selected. When "TONE" or "NUMERIC" is selected, only "TYPE" is displayed.

NO : Select the stored messages.

Move cursor to "NO" and press ENT . Enter stored message number and press ENT . TC-2000A has 40 stored messages of Arabic numbers, ASCII, Korean (KS-S601), Chinese Characters (GB-2312-80) for testing various types of pagers. Stored messages are in following table.

TC-2000A Stored Message List

Message Type	Number / Length	Size of Buffer	Message
Numeric (4bit)	No : 1	100	1234567890
	No : 2	100	3456789012
	No : 3	100	5678901234
	No : 4	100	7890123456
	No : 5	100	9012345678
Alphanumeric (7bit only)	No : 1 (10 Char.)	100	1234567890
	No : 2 (26 Char.)	100	ABCDEFGHIJKLMNOPQRSTUVWXYZ
	No : 3 (36 Char.)	100	Abcdefghijklmnopqrstuvwxyz1234567890
	No : 4 (100 Char.)	100	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2
	No : 5 (1000 Char.)	1000	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T 2U 2V 2W 2X 2Y 2Z 3A 3B 3C 3D 3E 3F 3G 3H 3I 3J 3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T 3U 3V 3W 3X 3Y 3Z 4A 4B 4C 4D 4E 4F 4G 4H 4I 4J 4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T 4U 4V 4W 4X 4Y 4Z 5A 5B 5C 5D 5E 5F 5G 5H 5I 5J 5K 5L 5M 5N 5O 5P 5Q 5R 5S 5T 5U 5V 5W 5X 5Y 5Z 6A 6B 6C 6D 6E 6F 6G 6H 6I 6J 6K 6L 6M 6N 6O 6P 6Q 6R 6S 6T 6U 6V 6W 6X 6Y 6Z 7A 7B 7C 7D 7E 7F 7G 7H 7I 7J 7K 7L 7M 7N 7O 7P 7Q 7R 7S 7T 7U 7V 7W 7X 7Y 7Z 8A 8B 8C 8D 8F 8G 8H 8I 8J 8K 8L 8M 8N 8O 8P 8Q 8R 8S 8T 8U 8V 8W 8X 8Y 8Z 9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O 9P 9Q 9R 9S 9T 9U 9V 9W 9X 9Y 9Z 0A 0B 0C 0D 0E 0F 0G 0H 0I 0J 0K 0L 0M 0N 0O 0P 0Q 0 R0S 0T 0U 0V 0W 0X 0Y 0Z 1a 1b 1c 1d 1e 1f 1g 1h 1i 1j 1k 1l 1m 1n 1o 1p 1q 1r 1s 1t 1u 1v 1w 1x 1y 1z 2a 2b 2c 2d 2e 2f 2g 2h 2i 2j 2k 2l 2m 2n 2o 2p 2q 2r 2s 2t 2u 2v 2w 2x 2y 2z 3a 3b 3c 3d 3e 3f 3g 3h 3I 3j 3k 3l 3m 3n 3o 3p 3q 3r 3s 3t 3u 3v 3

Message Type	Number / Length	Size of Buffer	Message
Alphanumeric (KSC-5601)	No : 1 (26 Char)	100	한글문자 Pager 시험.
	No : 2 (28 Char)	100	무궁화 꽃이 피었습니다.
	No : 3 (41 Char)	100	무궁화 꽃이 피었습니다. 123456789012
	No : 4 (54 Char)	100	무궁화 꽃이 피었습니다. Pager Test 123456789012
	No : 5 (32 Char)	1000	테스콤 Pager Tester 世界第一
Alphanumeric (GB 2312-80)	No : 1 (13 Char)	100	中文傳呼測試
	No : 2 (40 Char)	100	TESCOM 傳呼機測試儀器, 品質第一
	No : 3 (41 Char)	100	祝 生意興隆, 萬事如意, 財源滾滾
	No : 4 (41 Char)	100	緊急事件, 太太我 , 速回電家裏
	No : 5 (35 Char)	1000	交通阻塞, 約會改爲 1630 金
Alphanumeric (CNS)	No : 1, 2, 3, 4 (70 Char)	100	CNS CODE MESSAGE : TESCOM 祝 各 用 戶 業 務 蒸 蒸 日 上
	No : 5 (284 Char)	1000	FLEX和POCSAG碼制的區別:FLEX是用GPS的絶對時鍾作爲標準的全同步傳輸方式,尋呼機在指定的時間內打開接收電路,接收信息,這樣就比POCSAG碼尋呼機省電好幾倍以上;同時,FLEX采用的4電平FSK調制而代替POCSAG制式的2電平FSK,因而 FLEX的傳輸容量能增加幾倍.
HEX / BIN	No : 1, 2, 3, 4, 5	100 (No 5:1000)	123456789ABCDEF

MFN : Message Fragment Number..

HEX/BIN and Alphanumeric message can be transmitted in fragmented form. The fragmentation range is dependant with message length.

LENGTH : Indicates current message length.

ERMES

This manual does not include protocol details. Unless operator is proficient with the protocol and has specific use, not altering the default value is highly recommended.

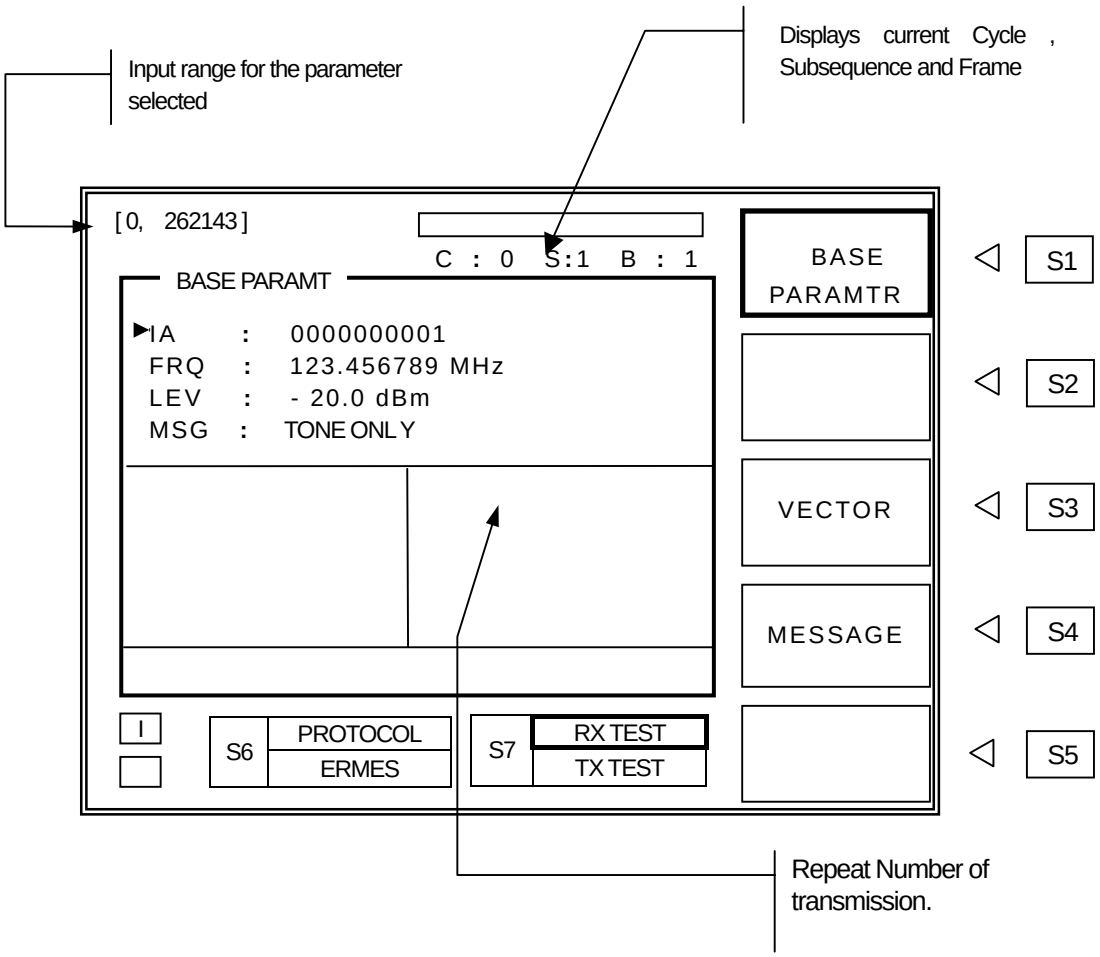
Parameters not specified in the protocol documents but supported in TC-2000A are in gray on this operating manual.

To select ERMES screen, press [FCN] + [S4], choose it from pop-up menu and press [ENT].

Refer to 3-1 for the operation, choosing menu, moving cursor, data input, etc.

BASE PARAMT (Base Parameters)

Press [S1] to select base test parameter settings.



IA : Set Initial Address (CAPCODE) .

Press [ADR] key or move cursor to "IA" and press [ENT] and then input the pager address,

ADR = IA (18bit) + BT (4bit)

- Input Range : 0 ~ 262143

BT : Set Batch Type (0 ~ 15)

Move arrow to "BT" then input Pager Batch Number.

FRQ : Set Frequency.

Press [FRQ] or move pointer to "FRQ" and press [ENT] . Enter data at cursor location and press [ENT]. Frequency can be changed during message transmission.

- Range : 0.1 to 50MHz, 130MHz to 960MHz
- Resolution : 6.25kHz, 5kHz

▣ **Note** : The frequency is automatically set when the Channel number is entered. When the frequency is manually entered, channel number is ignored and transmits on manually entered frequency.

LEV : Set RF output level

Press [LEV] or move pointer to "LEV" and press [ENT] . Enter data at cursor location and press [ENT] . Output level can be changed during message transmission. Set level can be stored for future convenience. (☞ Refer to paragraph 3-7).

- Range : -20 to -120dBm
- Level Step : 0.1dB

MSG : Set Message Type.

Move arrow to "MSG" press [ENT] and select Message Type. Press [S4] or [MSG] and enter message to be sent.

CHAN : Channel Number (0 ~ 15)

Frequencies assigned for each channel are as table below.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	169.425000	8	169.625000
1	169.450000	9	169.650000
2	169.475000	10	169.675000
3	169.500000	11	169.700000
4	169.525000	12	169.725000
5	169.550000	13	169.750000
6	169.575000	14	169.775000
7	169.600000	15	169.800000

CYCLE : Starting cycle number of transmission (0 ~ 14)

SSN : Starting Subsequence Number of transmission (0 ~ 4)

BATCH : Starting Batch of transmission (0 ~ 15)

▣ **Note** : This batch number selects the batch that starts sending message. It is different from "BT", Pager Batch Number.

RPT N : Repeat Number.

Choose number of messages to be sent.

Message repeat range is 0 to 999. "0" is continuous repeat until [SEND] is pressed again.

.

POLRT : FSK Modulation Polarity.

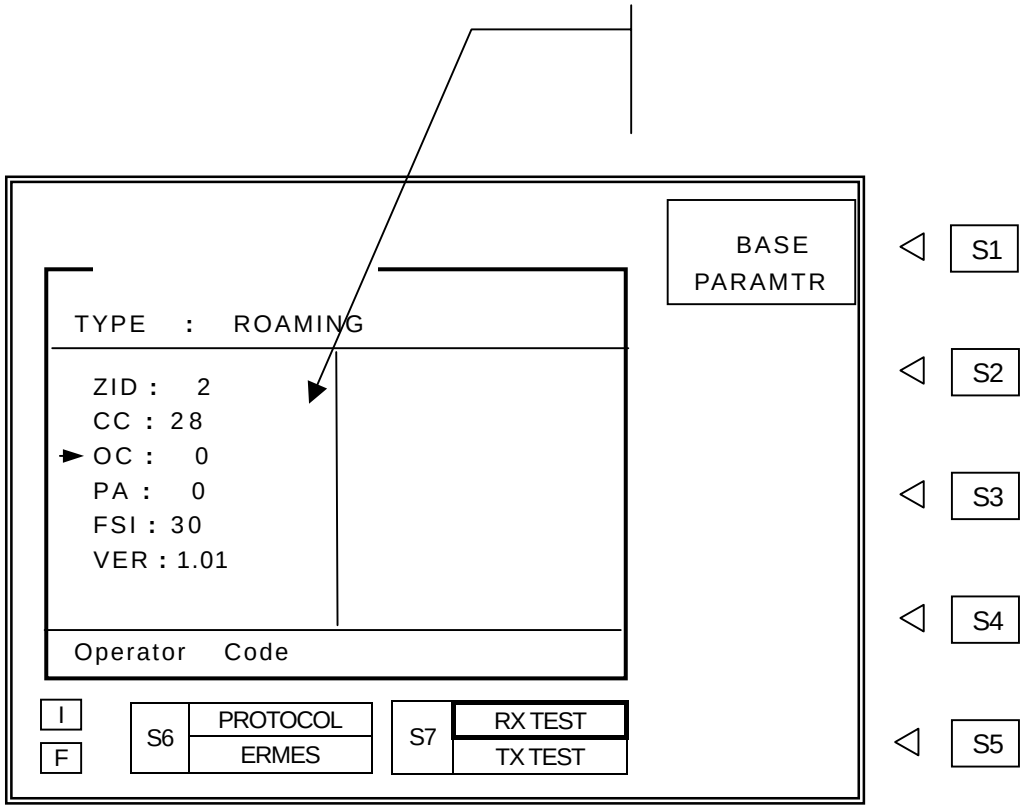
Toggles between "NOR" and "INV".

FSK Modulation (4 LEVEL)

NOR (Normal polarity)	INV (Inverse polarity)
"10" : Carrier **+** 4687.5 Hz "11" : Carrier **+** 1562.5 Hz "01" : Carrier – 1562.5 Hz "00" : Carrier – 4687.5 Hz	"10" : Carrier – 4687.5 Hz "11" : Carrier – 1562.5 Hz "01" : Carrier **+** 4687.5 Hz "00" : Carrier **+** 1562.5 Hz

SYSTEM INFO

Press [S2] to select System Information parameter settings



TYPE

: **ROAMING / TIME** Select System Information Parameter Group.

Move cursor to TYPE and press [ENT] . Toggles between "ROAMING" and "TIME".

Test parameters related to test function selected will appear on screen.

Following chart shows various parameters available in TC-2000A depending on Parameter Group selected.

Group	Description	Parameter
ROAMING	Roaming Parameters	ZID, CC, OC, PA, FSI, VER
TIME	Time Information Parameters	YEAR, MON, DAY, WEEK, HOUR

■ **ROAMING**

ZID : Zone ID (2 ~ 7)

CC : Country Code (0 ~ 127)

OC : Operator Code (0 ~ 7)

PA : Paging Area Code (0 ~ 63)

FSI : Frequency Subset Indicator (0 ~ 30)

VER : Protocol Version Number (1.01 / 2.01)

■ **TIME**

YEAR : Year (1990 ~ 2117)

MONT : Month (1 ~ 12)

DAY : Date (1 ~ 31)

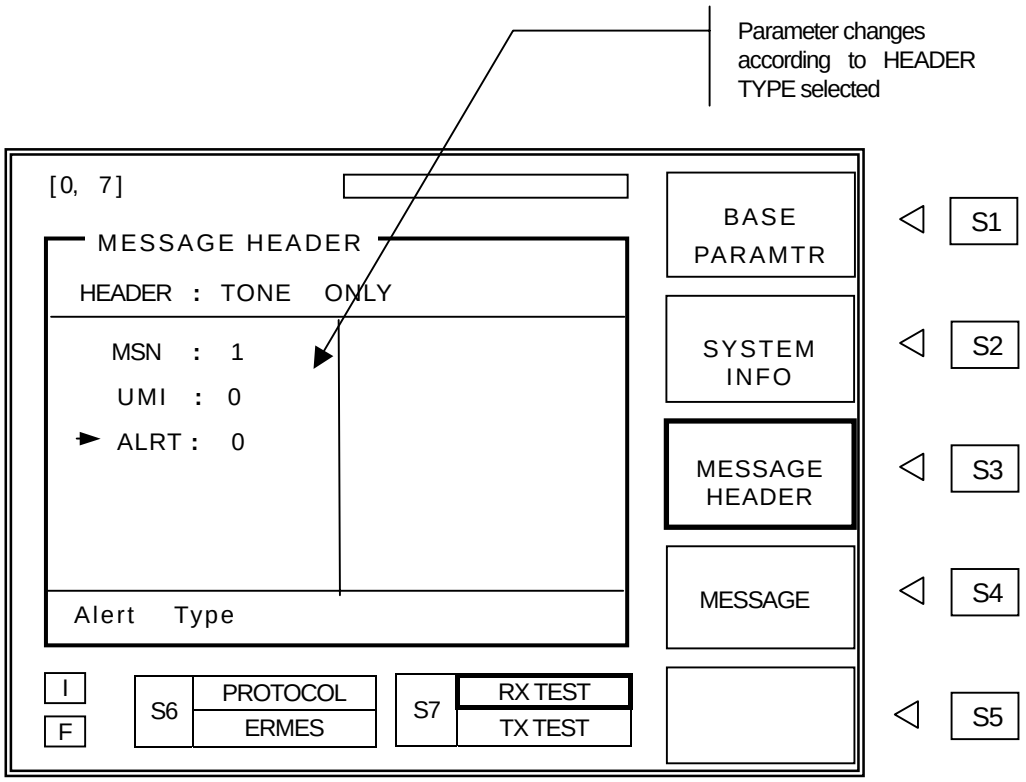
WEEK : Day of the week (1 ~ 7)

HOUR : Hour (0 ~ 23)

MESSAGE HEADER

MESSAGE HEADER menu contains parameters related to Message Header type.

Press [S3] to select [MESSAGE HEADER] menu.



HEADER Choosing Message Header Type

Move cursor to HEADER, press [ENT], select desired header type from pop up menu and press [ENT]. Parameters change according to HEADER TYPE selected.

■ **TONE : Tone Only**

MSN : Message Sequence Number (0 ~ 31)

UMI : Urgent Message Indicator (0 ~ 1)

ALRT : Alert Type (0 ~ 7)

■ **NUMERIC : Numeric Message Header**

MSN : Message Sequence Number (0 ~ 31)

UMI : Urgent Message Indicator (0 ~ 1)

ALRT : Alert Type (0 ~ 7)

■ **ALPHA NU : Alphanumeric Message Header**

MSN : Message Sequence Number (0 ~ 31)

UMI : Urgent Message Indicator (0 ~ 1)

ALRT : Alert Type (0 ~ 7)

■ **TRANS : Transparent**

MSN : Message Sequence Number (0 ~ 31)

UMI : Urgent Message Indicator (0 ~ 1)

ALRT : Alert Type (0 ~ 7)

■ **LONG MSG : Long Message**

TYPE : Select Long Message Type (Numeric, Alphanumeric, Transparent)

MSN : Message Sequence Number (0 ~ 31)

UMI : Urgent Message Indicator (0 ~ 1)

ALRT : Alert Type (0 ~ 7)

■ **OTAP : Over The Air Programming** (Remote Programming of pager parameters)

TYPE : Select Remote Programming Type

IA : Initial Address

Parameter	Range	Description
FUN	Replace, Remove, Restore	Function bit
ZID	2 ~ 7	Zone ID
CC	0 ~ 99	Country Code
OC	0 ~ 7	Operator Code
IA	0 ~ 262143	Initial Address

PA : Paging Area

Parameter	Range	Description
FUN	Replace, Remove, Restore	Function bit
ZID	2 ~ 7	Zone ID
CC	0 ~ 99	Country Code
OC	0 ~ 7	Operator Code
PA	0 ~ 63	Paging Area Code

OPID : Operator Identity

Parameter	Range	Description
FUN	Replace, Remove, Restore	Function bit
ZID	2 ~ 7	Zone ID
CC	0 ~ 99	Country Code
OC	0 ~ 7	Operator Code

HIDX Q : Home Index Query Command

Parameter	Range	Description
FUN	Replace, Remove, Restore	Function bit
ZID	2 ~ 7	Zone ID
CC	0 ~ 99	Country Code
OC	0 ~ 7	Operator Code
IA	0 ~ 262143	Initial Address

IN HOME : In Home

Parameter	Description	Description
FUN	Replace, Remove, Restore	Function bit
SM	0 ~ 31	Subsequence Mask
HNL	0 ~ 99	Subset of the Sixty Cycles

OUT HOME : Out Home

Parameter	Range	Description
FUN	Replace, Remove, Restore	Function bit
SM	0 ~ 31	Subsequence Mask
HNL	0 ~ 99	Subset of the Sixty Cycles

■ **CTAP : CTAPs (Group Call Service)**

TC-2000A supports Group Call Service as described in Protocol Document..

1) Sends Temporary Address information to pager.
2) Sends message to Temporary Address.

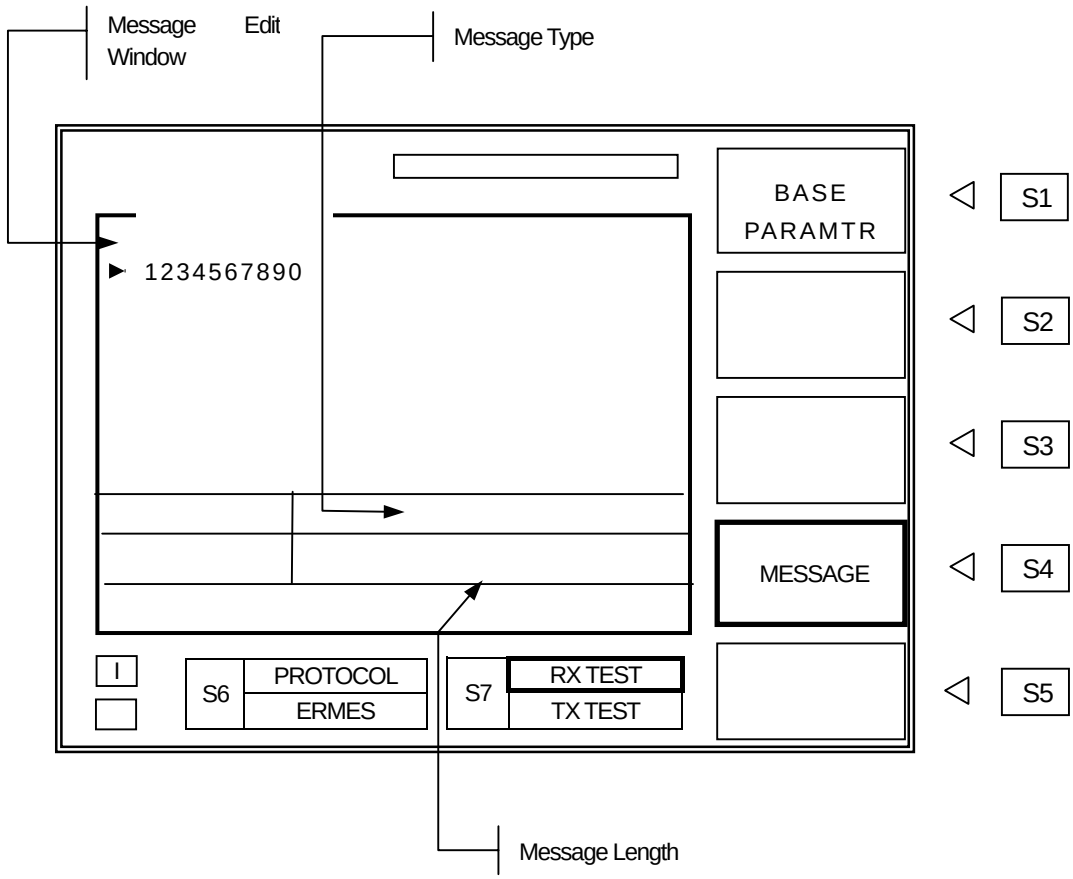
CTAP : Common Temporary Address (0 ~ 15)

MSG : CTAP Message Type

Message can be edited in MESSAGE , S4 or MSG, screen.

MESSAGE

Press [S4] to select [MESSAGE] menu. Messages for transmission can be edited on this screen.



MESSAGE Display Window : Message content and editing.

Messages either can be directly entered on screen or recalled the stored messages. Numeric messages can be enter by front panel keypad. To enter Alphanumeric messages, use Rotary Knob and [⇦] [⇨] key and choose characters. Messages also can be entered by PC via RS-232C interface. Stored messages are not editable on screen.

TYPE : Select Character Code Type (7 bit, KSC-5601, GB 2312 or CNS).

Move cursor to "TYPE" , press ENT , select Character Code type from pop-up menu and press ENT. This is only possible when "ALPHA" on "VECTOR" is selected. When "TONE" or "NUMERIC" is selected, only "TYPE" is displayed.

NO : Select the stored messages.

Move cursor to "NO" and press ENT . Enter stored message number and press ENT . TC-2000A has 40 stored messages of Arabic numbers, ASCII, Korean (KS-S601), Chinese Characters (GB-2312-80) for testing various types of pagers. Stored messages are in following table.

TC-2000A Stored Message List

Message Type	Number / Length	Size of Buffer	Message
Numeric (4bit)	No : 1	100	1234567890
	No : 2	100	3456789012
	No : 3	100	5678901234
	No : 4	100	7890123456
	No : 5	100	9012345678
Alphanumeric (7bit only)	No : 1 (10 Char.)	100	1234567890
	No : 2 (26 Char.)	100	ABCDEFGHIJKLMNOPQRSTUVWXYZ
	No : 3 (36 Char.)	100	Abcdefghijklmnopqrstuvwxyz1234567890
	No : 4 (100 Char.)	100	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2
	No : 5 (1000 Char.)	1000	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T 2U 2V 2W 2X 2Y 2Z 3A 3B 3C 3D 3E 3F 3G 3H 3I 3J 3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T 3U 3V 3W 3X 3Y 3Z 4A 4B 4C 4D 4E 4F 4G 4H 4I 4J 4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T 4U 4V 4W 4X 4Y 4Z 5A 5B 5C 5D 5E 5F 5G 5H 5I 5J 5K 5L 5M 5N 5O 5P 5Q 5R 5S 5T 5U 5V 5W 5X 5Y 5Z 6A 6B 6C 6D 6E 6F 6G 6H 6I 6J 6K 6L 6M 6N 6O 6P 6Q 6R 6S 6T 6U 6V 6W 6X 6Y 6Z 7A 7B 7C 7D 7E 7F 7G 7H 7I 7J 7K 7L 7M 7N 7O 7P 7Q 7R 7S 7T 7U 7V 7W 7X 7Y 7Z 8A 8B 8C 8D 8F 8G 8H 8I 8J 8K 8L 8M 8N 8O 8P 8Q 8R 8S 8T 8U 8V 8W 8X 8Y 8Z 9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O 9P 9Q 9R 9S 9T 9U 9V 9W 9X 9Y 9Z 0A 0B 0C 0D 0E 0F 0G 0H 0I 0J 0K 0L 0M 0N 0O 0P 0Q 0 R0S 0T 0U 0V 0W 0X 0Y 0Z 1a 1b 1c 1d 1e 1f 1g 1h 1i 1j 1k 1l 1m 1n 1o 1p 1q 1r 1s 1t 1u 1v 1w 1x 1y 1z 2a 2b 2c 2d 2e 2f 2g 2h 2i 2j 2k 2l 2m 2n 2o 2p 2q 2r 2s 2t 2u 2v 2w 2x 2y 2z 3a 3b 3c 3d 3e 3f 3g 3h 3I 3j 3k 3l 3m 3n 3o 3p 3q 3r 3s 3t 3u 3v 3

Message Type	Number / Length	Size of Buffer	Message
Alphanumeric (KSC-5601)	No : 1 (26 Char)	100	한글문자 Pager 시험.
	No : 2 (28 Char)	100	무궁화 꽃이 피었습니다.
	No : 3 (41 Char)	100	무궁화 꽃이 피었습니다. 123456789012
	No : 4 (54 Char)	100	무궁화 꽃이 피었습니다. Pager Test 123456789012
	No : 5 (32 Char)	1000	테스콤 Pager Tester 世界第一
Alphanumeric (GB 2312-80)	No : 1 (13 Char)	100	中文傳呼測試
	No : 2 (40 Char)	100	TESCOM 傳呼機測試儀器, 品質第一
	No : 3 (41 Char)	100	祝 生意興隆, 萬事如意, 財源滾滾
	No : 4 (41 Char)	100	緊急事件, 太太我 , 速回電家裏
	No : 5 (35 Char)	1000	交通阻塞, 約會改爲 1630 金
Alphanumeric (CNS)	No : 1, 2, 3, 4 (70 Char)	100	CNS CODE MESSAGE : TESCOM 祝 各 用 戶 業 務 蒸 蒸 日 上
	No : 5 (284 Char)	1000	FLEX和POCSAG碼制的區別:FLEX是用GPS的絶對時鍾作爲標準的全同步傳輸方式,尋呼機在指定的時間內打開接收電路,接收信息,這樣就比POCSAG碼尋呼機省電好幾倍以上;同時,FLEX采用的4電平FSK調制而代替POCSAG制式的2電平FSK,因而 FLEX的傳輸容量能增加幾倍.
TRANSPARENT	No : 1, 2, 3, 4, 5	100 (No 5:1000)	123456789ABCDEF

MFN : Message Fragment Number..

TRANSPARENT and Alphanumeric message can be transmitted in fragmented form. The fragmentation range is dependant with message length.

LENGTH : Indicates current message length.

ReFLEX 25

This manual does not include protocol details. Unless operator is proficient with the protocol and has specific use, not altering the default value is highly recommended.

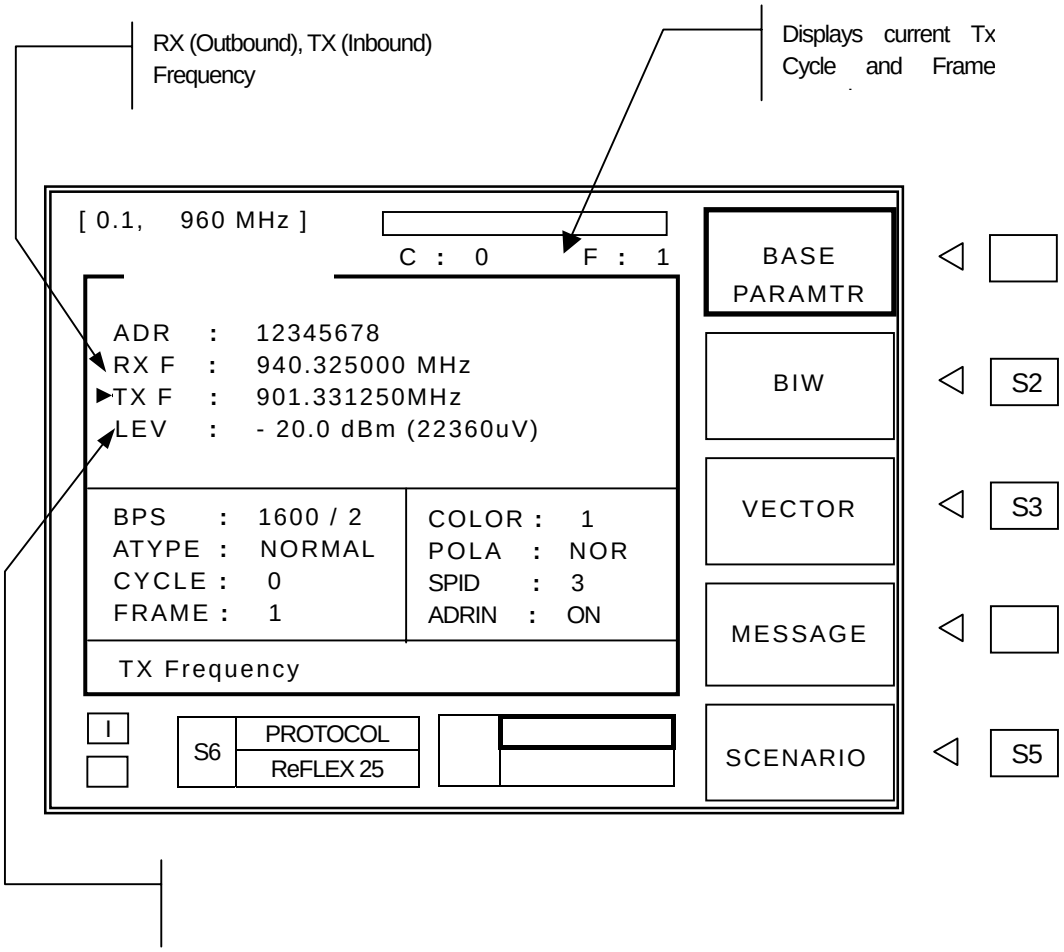
Parameters not specified in the protocol documents but supported in TC-2000A are in gray on this operating manual.

To select ReFLEX 25 screen, press [FCN] + [S4], choose it from pop-up menu and press [ENT].

Refer to 3-1 for the operation, choosing menu, moving cursor, data input, etc.

BASE PARAMT (Base Parameters)

Press [S1] to select base test parameter settings.



ADR : Address setting. Press [ADR] key or move cursor to "ADR" and press [ENT] and then input the pager address,

- Range : 16777216 ~ 1073741823

RX F : Outbound channel (Rx) frequency.

Press [FRQ] key or move cursor to "RX F" and press [ENT] , then input frequency. Frequency value can be changed while TC-2000A is transmitting.

- Range : 100 KHz ~ 50 MHz or 130 MHz ~ 960 MHz
- Resolution : 6.25 KHz or 5 KHz

TX F : Inbound channel (Rx) frequency.

Press [FRQ] key or move cursor to "TX F" and press [ENT] , then input frequency. Frequency value can be changed while TC-2000A is transmitting.

- Range : 455 kHz ~ 960 MHz
- Resolution : 6.25 kHz, 5 KHz

LEV : RF output level.

Press [LEV] key or move cursor to "LEV" and press [ENT] , then input frequency. Level value can be changed while TC-2000A is transmitting.

Frequently used value can be conveniently stored and recalled(☞ Refer to 3-7).

- Level Step : 0.1dB

BPS : Data Baud Rate.

Range of ReFLEX 25 is 1600/2, 3200/2, 3200/4, 6400/4 BPS.

ATYPE : Address Type .

Move cursor to "ATYPE" then choose NORMAL or INFOR (Information) by pressing [ENT] for the correct Address Type.

CYCLE : Starting cycle number of transmission (0 ~ 14)

Move cursor to "CYCLE" and press [ENT] , then input the start cycle number.

FRAME : Starting frame number of transmission (0 ~ 127)

Move cursor to "FRAME" and press [ENT] , then input the start frame number.

COLOR : Color Code . (0 ~ 127)

Move cursor to "ATT" and press [ENT] , then input value.

POLRT : FSK Modulation Polarity.

Move cursor to "POLRT" and press [ENT] . Pressing [ENT] again will toggle NOR / INV.

This function inverts FSK modulation polarity depending on interleaving data row number as following charts.

Odd number row 4 level FSK Modulation

NOR (Normal polarity)	INV (Inverse polarity)
"10" : Carrier **+** 2.4 kHz "11" : Carrier **+** 0.8 kHz "01" : Carrier – 0.8 kHz "00" : Carrier – 2.4 kHz	"10" : Carrier – 2.4 kHz "11" : Carrier – 0.8 kHz "01" : Carrier **+** 0.8 kHz "00" : Carrier **+** 2.4 kHz

Even number row 4 level FSK Modulation

NOR (Normal polarity)	INV (Inverse polarity)
"01" : Carrier **+** 2.4 kHz "11" : Carrier **+** 0.8 kHz "10" : Carrier – 0.8 kHz "00" : Carrier –2.4 kHz	"10" : Carrier **+** 0.8 kHz "00" : Carrier **+** 2.4 kHz "01" : Carrier – 2.4 kHz "11" : Carrier – 0.8 kHz

SPID : Service provider ID (1 ~ 16383)

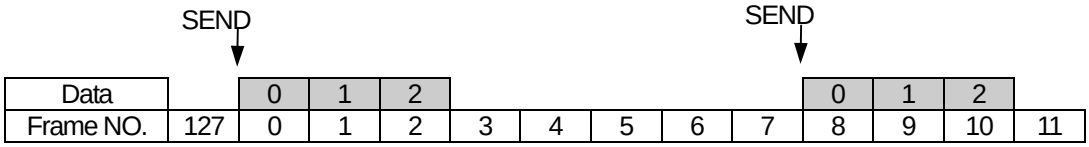
If SPID is inadequate, the pager cannot receive messages.

ADRIN : Auto-setting of the address ON/OFF

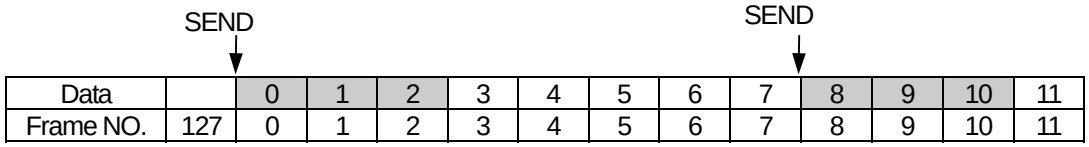
Some testing it is necessary to send preset address to the pager under test. This feature turns on and off the auto-setting of the address.

SYNC : Synchronous Transmit ON / OFF.

SYNC OFF : "SEND" key initiates transmission with Frame=0. During no transmission, unmodulated CW signal is output



SYCN ON : "SEND" key initiates transmission at the next frame using the frame number of the internal reference. During non-transmission, IDLE Frame is repeated to allow synchronization of the pager under test.

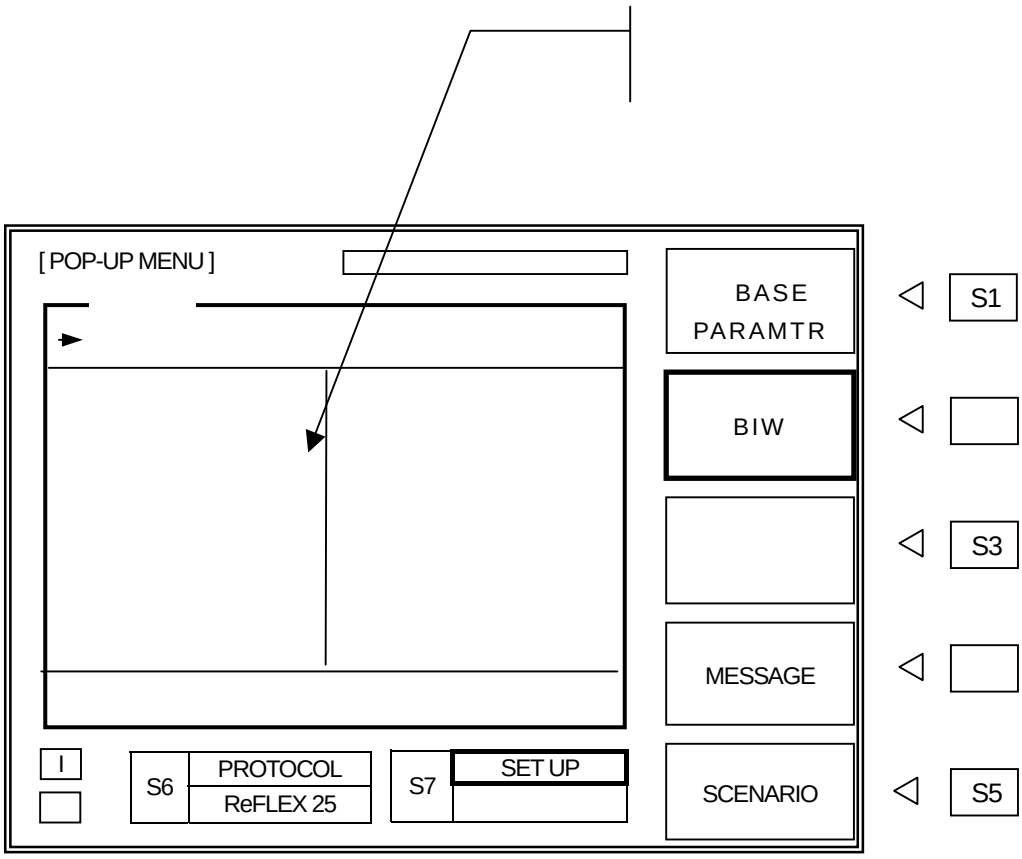


TXPOW : Expected TX Power (-30dBm ~ 15dBm)

To receive TX signal correctly, an expected Tx Power value should be entered. Power value can be changed while TC-2000A is transmitting.

B I W (Block Information Word)

Press S2 to select [BIW] parameter settings.



TYPE : **ROAMING / TX SCH / RX SCH / CH FRQ / TIME**

BIW (Block Information Word) Parameter Group Select.

Move cursor to TYPE and press ENT . Select test function from pop up menu and press ENT. Test parameters related to test function selected will appear on screen.

Following chart shows various parameters available in TC-2000A depending on Parameter Group selected.

Group	Description	Parameters
ROAMING	Roaming Parameters	ZID, SZID, SD, NM, L, RP, SE, IN
TX SCH	Outbound channel Parameters	SC, SF, IC, IF, AL, PF, PN, PS, CN, CS, PC
RX SCH	Inbound channel Parameters	CC, RS, RN, AA, AB, RI, AT, LT, RT
CH FRQ	Channel Frequency Parameters	DEFAULT SET, FBF,RBF, FS, S, C, SD
TIME	Time information and others Parameters	YEAR, MON, DAY, WEEK, HOUR, MIN SEC, DS, TZ, MT, VER

■ **ROAMING**

ZID : Zone ID (1 ~ 16383)

SH : Subzone Handoff flag (0,1)

SZID : Subzone ID (0 ~ 127)

SD : Subzone notification delay (0 ~ 15)

NM : Number of 'Subzone Validation' Failures = nm+1 (nm : 0 ~ 7)

L : Leading Service Provider ID (0,1)

RP : Registration Interval (0 ~ 15)

SE : Subzone notification control flag (0 ~ 1)

IN : Incommunicado delay (0 ~ 255)

S : Surrogate SPID Flag (0,1)

ZT : Zone Time-sharing flag (0,1)

ST : Subzone Time-sharing flag (0,1)

OW : One-Way zone flag (0,1)

OK : Other Kind flag (0,1)

PC : Partial inbound flag (0,1)

■ **FORWARD SCH (Schedule)**

SC : SCI Collapse mask (0 ~ 5)

SP : SCI Frame Pair flag (0,1)

SF : Frame number of SCI Base Frame in cycle(0 ~ 31)

Parameters for the pager Base Frame are as following table.

Base_frame (i) = MOD (pf+I* (ps+1), 128), i =[0,pn]

Control_frame (j,k) = MOD(Base_Frame (I(a)) + j * 2^{pc} + k * (cs + 1), 128) for all j, and k=[0,cn]

Parameter	Range	Description
PF	0 ~ 127	Frame number of the first base frame in any cycle
PN	0 ~ 127	PN + 1= Number of families, or number of different base frame in cycle
PS	0 ~ 63	PS + 1 = Spacing between base frames.
CN	0 ~ 63	CN + 1 = Number of control frames in a cluster
CS	0 ~ 7	CS + 1 = Spacing between control frames within a cluster
PC	0 ~ 7	2^{PC} = Spacing between the start frame of two consecutive clusters

IC : Information Service Collapse mask (0 ~ 7)

IF : Frame number of the Information service base frame in a cycle (0 ~ 126)

AL : PMU must decode the Information service Frame (0, 1)

EC : Extended Collapse Value (0, 1)

■ **REVERSE SCH (Schedule)**

CC : Reverse channel cluster collapse value (0 ~ 7)

RS : Starting frame number of reverse channel cluster group (0 ~ 127)

RN : RN + 1 = Number of Families (0 ~ 63)

AA : ALOHA Allowed (0, 1)

AB : ALOHA Boundary (0 ~ 127)

RI : ALOHA Randomization Interval = 2^{ri} (0 ~ 7)

AT : ALOHA time-out (1 ~ 255)

RT : Number of allowed ALOHA retries (0 ~ 14)

LR : Maximum Inbound Message Length (0~3)

LL : Maximum Inbound Message Length (0~511)

AN : # of ALOHA Messaging SAUs (0~31)

LT : Linear randomization flag (0, 1)

IA : Implied ACK flag (0,1)

■ **CH FRQ : CHANNEL FREQUENCY**

Correct frequencies for following parameters are automatically computed and set when TX F and RX F on BASE PARAMTR is selected. Unless operator has a unusual needs for changing the individual parameter frequencies, changing the frequency from BASE PARAMTR screen is recommended.

FDF : Forward Default Set **ON / OFF**

In ON mode, FBF is not transmitted. Pager uses internally stored default values.

RDF : Reverse Default Set **ON / OFF**

In ON mode, RBF is not transmitted. Pager uses internally stored default values.

S : Forward Channel Assignment **=** (ChFreq – FBF) / FS

C : Reverse Channel Assignment **=** (ChFreq – RBF) / FS

SD : Reverse Channel Speed (800, 1600, 6400, 9600 bps)

FBF : Forward Base Frequency (0 ~ 8191) ***** 1MHz

RBF : Reverse Base Frequency (0 ~ 8191) * 1MHz

CS : Channel Spacing Indicator ON/OFF

■ **TIME**

YEAR : Year (1994 ~ 2025)

MONT : Month (1 ~ 12)

DAY : Date (1 ~ 31)

WEEK : Day of the week (0 ~ 7 : Sun ~ Sat)

HOUR : Hour (0, 23)

MIN : Minute (0 ~ 59)

SEC : Second (0 ~ 59)

DS : Daylight Saving ON / OFF (0, 1)

TZ : Time Zone Index (0 ~ 31)

MT : Multiple Time Zones (0 ~ 1)

VER : Protocol Version Number (0 ~ 255)

■ **LOCAL SCAN**

HL : Increment for MSST (0 ~ 63)

DL : Signal strength difference (0 ~ 63)

UL : Increment for Lower Signal (0 ~ 63)

E : Registration Threshold (0 ~ 127)

LN : #of Measurement Frame (0 ~ 15)

MC : Measurement Frame Collapse (0 ~ 7)

NC : Number of Local Scan List (0 ~ 9)

CN : Local scan Channel Number (0~ 15)

Related Parameters. # is CN value

S# : Forward Channel assignment (0~ 2047)

CS# : Channel Spacing Indicator (0, 1)

SC# : SCI Collapse Mask (0 ~ 5)

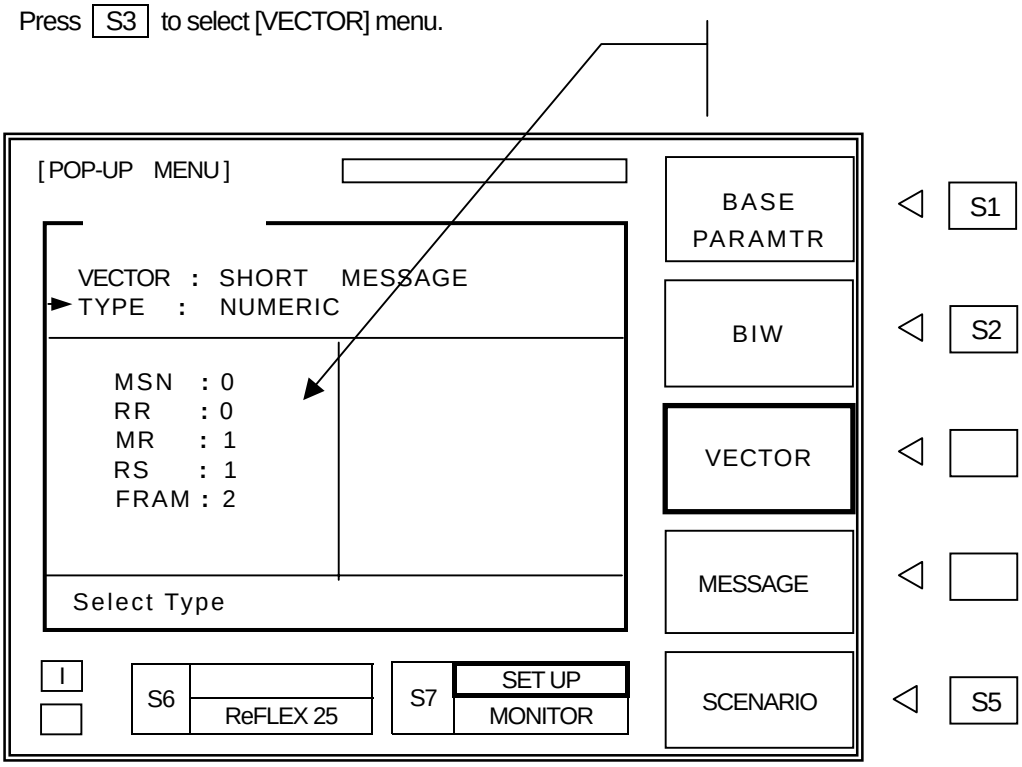
SF# : SCI Base Frame (0 ~ 31)

PR# : SCI Pair Indicator (0,1)

VECTOR

VECTOR menu contains parameters related to Vector type.

Press [S3] to select [VECTOR] menu.



VECTOR

Choosing VECTOR Type

Move cursor to VECTOR, press [ENT] , select desired vector type from pop up menu and press [ENT] . Parameters change according to VECTOR TYPE selected.

■ **SHORT : Short Message Vector**

Move cursor to "TYPE", press [ENT] , select desired Short Message Type from pop up menu and press [ENT] . Parameters change according to TYPE selected. Details of selected Short Message Types are shown on tables below.

NUMERIC / SPECIAL

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MR	0, 1	Message Read Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
AMI	ON/OFF	Automatic-Numbering Message

FT	0,1	First Time Flag

TEST MODE : Forward channel BER Test Vector

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
TM	0, 1	TEST Mode
RR	0, 1	Response Required Flag
WT	0, 1	Word error rate (WER) measurement
BT	0, 1	Bit error rate (BER) measurement
FF	1 ~ 127	Relative Test Frame
NF	0 ~ 255	Number of frames
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
FT	0,1	First Time Flag

■ **NUMERIC : Numeric Vector**

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MR	0, 1	Message Read Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
AMI	ON/OFF	Automatic-Numbering Message

■ **ALPHANUMERIC : Alphanumeric Vector**

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MR	0, 1	Message Read Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
MC	0, 1	Multiple Choice Response flag

AMI	ON/OFF	Automatic-Numbering Message
FT	0,1	First Time Flag

■ **BINARY : Binary Message**

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MR	0, 1	Message Read Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
RD	0,1	Response Disable Flag
FT	0,1	First Time Flag

■ **SECURE : Secure Message Vector.** Vector to change the Pager Parameter.

PASSWORD : Home Index Value Password.

Password can be ASCII code 10 characters long. Use Rotary Knob and ⇦ ⇨ key to enter each characters.

HIX VALUE : Home Index Value

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MR	0, 1	Message Read Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number
RD	0,1	Response Disable Flag
FT	0,1	First Time Flag

■ **WRU : Where are you Query Command**

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
LR	0 ~ 3	Maximum amount of memory required for the message
LL	0 ~ 15	Maximum amount of memory required for the message
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

■ **COMMAND : Command Vector**

Move cursor to TYPE, press [ENT] , and select COMAND VECTOR type from pop up menu. Parameters change according to vector selected. Vector type details are shown on tables.

CH REG : Change Registration

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
G	0, 1, 3	Specifies the type of registration
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

SZ QUERY : Subzone Query Command

Parameter	Range	Description
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

MEMORY : Memory Status Query Command

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

HIDX Q : Home Index Query Command

Parameter	Range	Description
QI	0 , 1	Response HIDX Type
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

TX QUERY : Transaction Status Query Command

Parameter	Range	Description
MSN	32 ~ 127	Message Sequence Number
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

AD MSN : Advance MSN Window

Parameter	Range	Description
MSN	8 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

RL MSN : Release Message Sequence Number Command

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

TONE : Tone Only Message Flag

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

PD CLEAR : Message Pending Clear

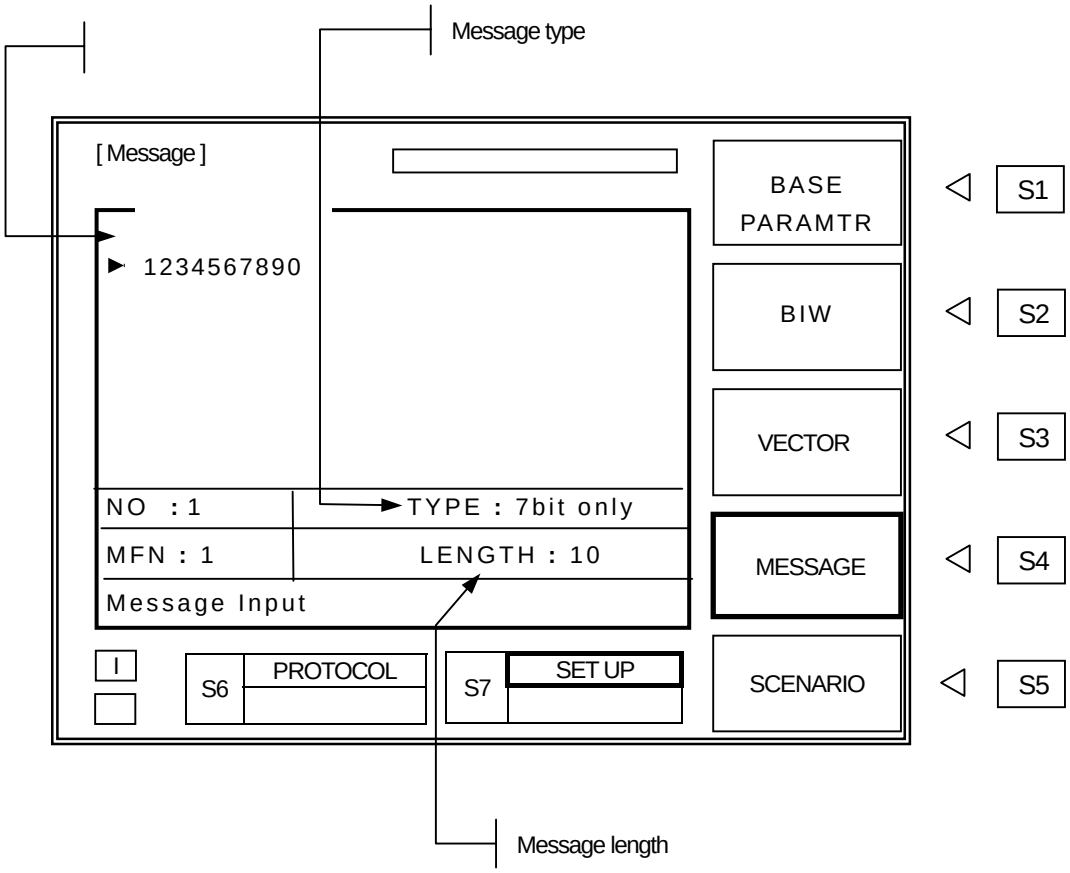
Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
MP	0, 1	Specifies whether the message pending flag be cleared.
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

ABORT TR : Abort Transaction Command

Parameter	Range	Description
MSN	0 ~ 127	Message Sequence Number
RR	0, 1	Response Required Flag
RS	0 ~ 115	Response Packet slot
FRAM	0 ~ 127	Relative Frame Number

MESSAGE

Press [S4] to select [MESSAGE] menu. Messages for transmission can be edited on this screen.



MESSAGE Display Window : Message content and editing.

Messages either can be directly entered on screen or recalled the stored messages. Numeric messages can be enter by front panel keypad. To enter Alphanumeric messages, use Rotary Knob and [⇦] [⇨] key and choose characters. Messages also can be entered by PC via RS-232C interface. Stored messages are not editable on screen.

TYPE : Select Character Code Type (7 bit, KSC-5601, GB 2312 or CNS).

Move cursor to "TYPE" , press [ENT] , select Character Code type from pop-up menu and press [ENT]. This is only possible when "ALPHA" on "VECTOR" is selected. When "TONE" or "NUMERIC" is selected, only "TYPE" is displayed.

NO : Select the stored messages.

Move cursor to "NO" and press [ENT] . Enter stored message number and press [ENT] . TC-2000A has 40 stored messages of Arabic numbers, ASCII, Korean (KS-S601), Chinese Characters (GB-2312-80) for testing various types of pagers. Stored messages are in following table.

TC-2000A Stored Message List

Message Type	Number / Length	Size of Buffer	Message
Numeric (4bit)	No : 1	100	1234567890
	No : 2	100	3456789012
	No : 3	100	5678901234
	No : 4	100	7890123456
	No : 5	100	9012345678
Alphanumeric (7bit only)	No : 1 (10 Char.)	100	1234567890
	No : 2 (26 Char.)	100	ABCDEFGHIJKLMNOPQRSTUVWXYZ
	No : 3 (36 Char.)	100	Abcdefghijklmnopqrstuvwxyz1234567890
	No : 4 (100 Char.)	100	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2
	No : 5 (1000 Char.)	1000	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T 2U 2V 2W 2X 2Y 2Z 3A 3B 3C 3D 3E 3F 3G 3H 3I 3J 3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T 3U 3V 3W 3X 3Y 3Z 4A 4B 4C 4D 4E 4F 4G 4H 4I 4J 4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T 4U 4V 4W 4X 4Y 4Z 5A 5B 5C 5D 5E 5F 5G 5H 5I 5J 5K 5L 5M 5N 5O 5P 5Q 5R 5S 5T 5U 5V 5W 5X 5Y 5Z 6A 6B 6C 6D 6E 6F 6G 6H 6I 6J 6K 6L 6M 6N 6O 6P 6Q 6R 6S 6T 6U 6V 6W 6X 6Y 6Z 7A 7B 7C 7D 7E 7F 7G 7H 7I 7J 7K 7L 7M 7N 7O 7P 7Q 7R 7S 7T 7U 7V 7W 7X 7Y 7Z 8A 8B 8C 8D 8F 8G 8H 8I 8J 8K 8L 8M 8N 8O 8P 8Q 8R 8S 8T 8U 8V 8W 8X 8Y 8Z 9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O 9P 9Q 9R 9S 9T 9U 9V 9W 9X 9Y 9Z 0A 0B 0C 0D 0E 0F 0G 0H 0I 0J 0K 0L 0M 0N 0O 0P 0Q 0 R0S 0T 0U 0V 0W 0X 0Y 0Z 1a 1b 1c 1d 1e 1f 1g 1h 1i 1j 1k 1l 1m 1n 1o 1p 1q 1r 1s 1t 1u 1v 1w 1x 1y 1z 2a 2b 2c 2d 2e 2f 2g 2h 2i 2j 2k 2l 2m 2n 2o 2p 2q 2r 2s 2t 2u 2v 2w 2x 2y 2z 3a 3b 3c 3d 3e 3f 3g 3h 3I 3j 3k 3l 3m 3n 3o 3p 3q 3r 3s 3t 3u 3v 3

Message Type	Number / Length	Size of Buffer	Message
Alphanumeric (KSC-5601)	No : 1 (26 Char)	100	한글문자 Pager 시험.
	No : 2 (28 Char)	100	무궁화 꽃이 피었습니다.
	No : 3 (41 Char)	100	무궁화 꽃이 피었습니다. 123456789012
	No : 4 (54 Char)	100	무궁화 꽃이 피었습니다. Pager Test 123456789012
	No : 5 (32 Char)	1000	테스콤 Pager Tester 世界第一
Alphanumeric (GB 2312-80)	No : 1 (13 Char)	100	中文傳呼測試
	No : 2 (40 Char)	100	TESCOM 傳呼機測試儀器, 品質第一
	No : 3 (41 Char)	100	祝 生意興隆, 萬事如意, 財源滾滾
	No : 4 (41 Char)	100	緊急事件, 太太我 , 速回電家裏
	No : 5 (35 Char)	1000	交通阻塞, 約會改爲 1630 金
Alphanumeric (CNS)	No : 1, 2, 3, 4 (70 Char)	100	CNS CODE MESSAGE : TESCOM 祝 各 用 戶 業 務 蒸 蒸 日 上
	No : 5 (284 Char)	1000	FLEX和POCSAG碼制的區別:FLEX是用GPS的絶對時鍾作爲標準的全同步傳輸方式,尋呼機在指定的時間內打開接收電路,接收信息,這樣就比POCSAG碼尋呼機省電好幾倍以上;同時,FLEX采用的4電平FSK調制而代替POCSAG制式的2電平FSK,因而 FLEX的傳輸容量能增加幾倍.
BINARY	No : 1, 2, 3, 4, 5	100 (No 5:1000)	123456789ABCDEF

MFN : Message Fragment Number..

BINARY and Alphanumeric message can be transmitted in fragmented form. The fragmentation range is dependant with message length.

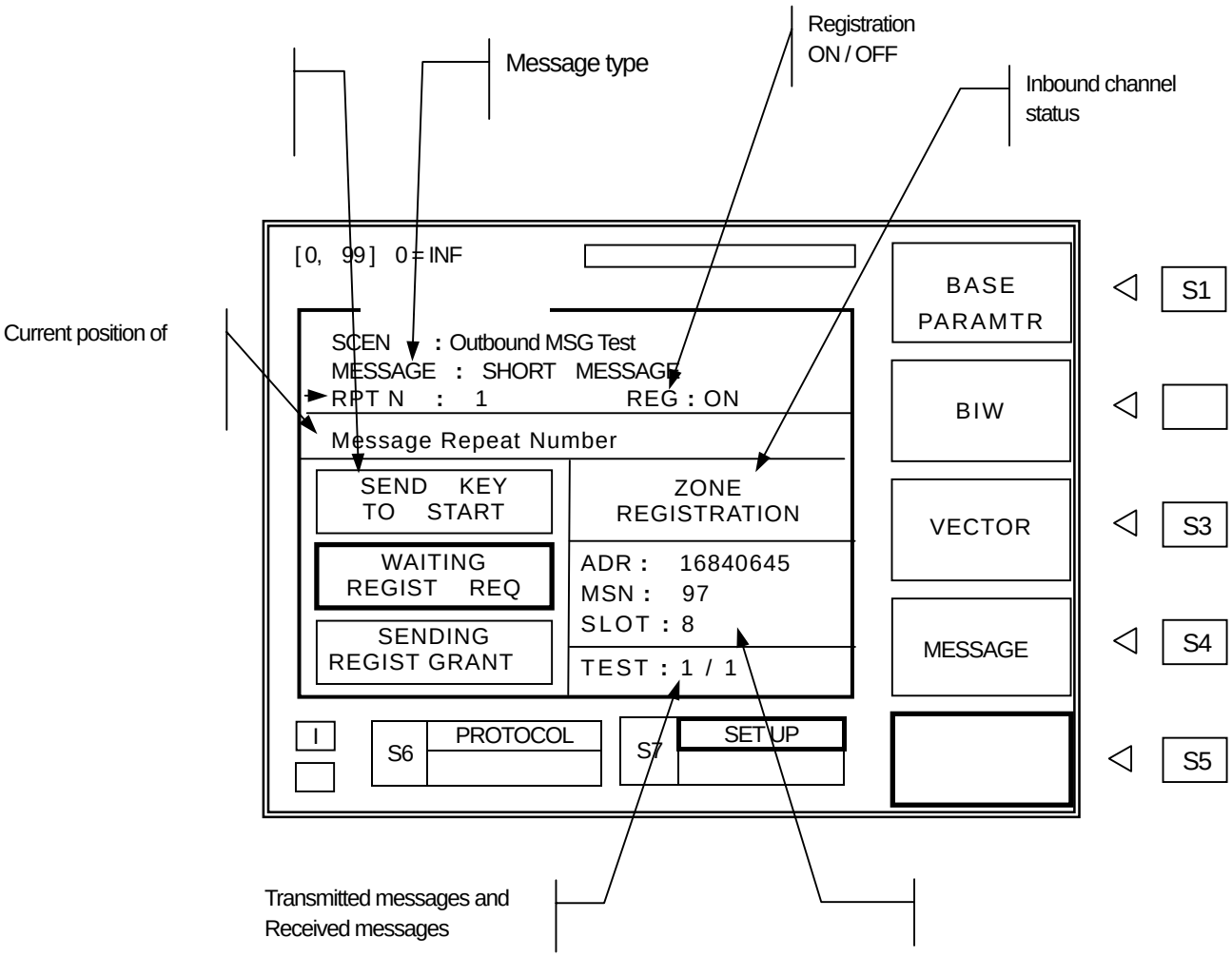
LENGTH : Indicates current message length.

SCENARIO

The 2-Way pager communication is not as simple as 1-Way pager, network send messages and pager receive it. It proceeds roaming information, zone registration request, registration grant, inbound request, inbound message command, acknowledge message receipt, etc. TC-2000A has several built-in test scenario automatically executes steps required for 2-Way pager testing. Each step including signal transmitted from the pager under test can be monitored on TC-2000A screen.

To select SCENARIO screen, press [S5] . Select appropriate SCENARIO, then press [SEND] key.

After the test completion, inbound signal information can be viewed on screen by pressing [FCN] + [1] or [FCN] + [S5] , and pressing [S1] thru [S5] , (☞ Refer to 3-2-5).



SCEN : Select SCENARIO

. Move cursor to SCEN, press [ENT] , and select SCENARIO number from pop up menu.

Details of scenarios are as following.

Number	SCEN	Description
0	IDLE FRAME	Transmits the Idle cord word continuously
1	Outbound MSG Test	Transmits test messages and detects inbound ACK.
2	Inbound MSG Test	Tests received inbound message.
3	ALOHA MSG Test	To test ALOHA message
4	Multiple Choice	To test a Multiple Choice Message application. (Refer to page 164, specification 2.72)
5	Read Notification	To test a message read notification. (Refer to page 163, specification 2.72)

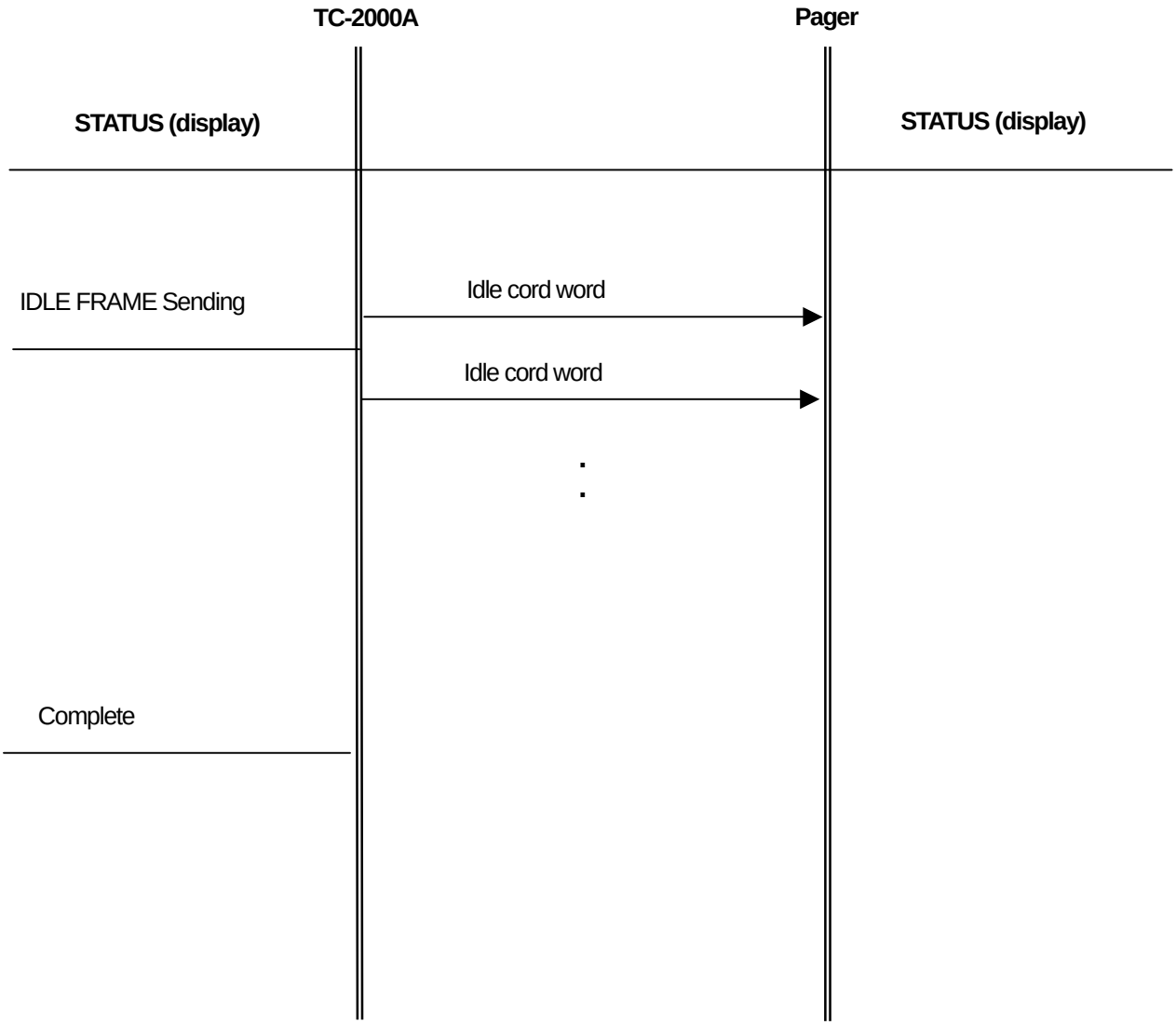
RPT N : Repeat Number.

Choose number of messages to be sent.

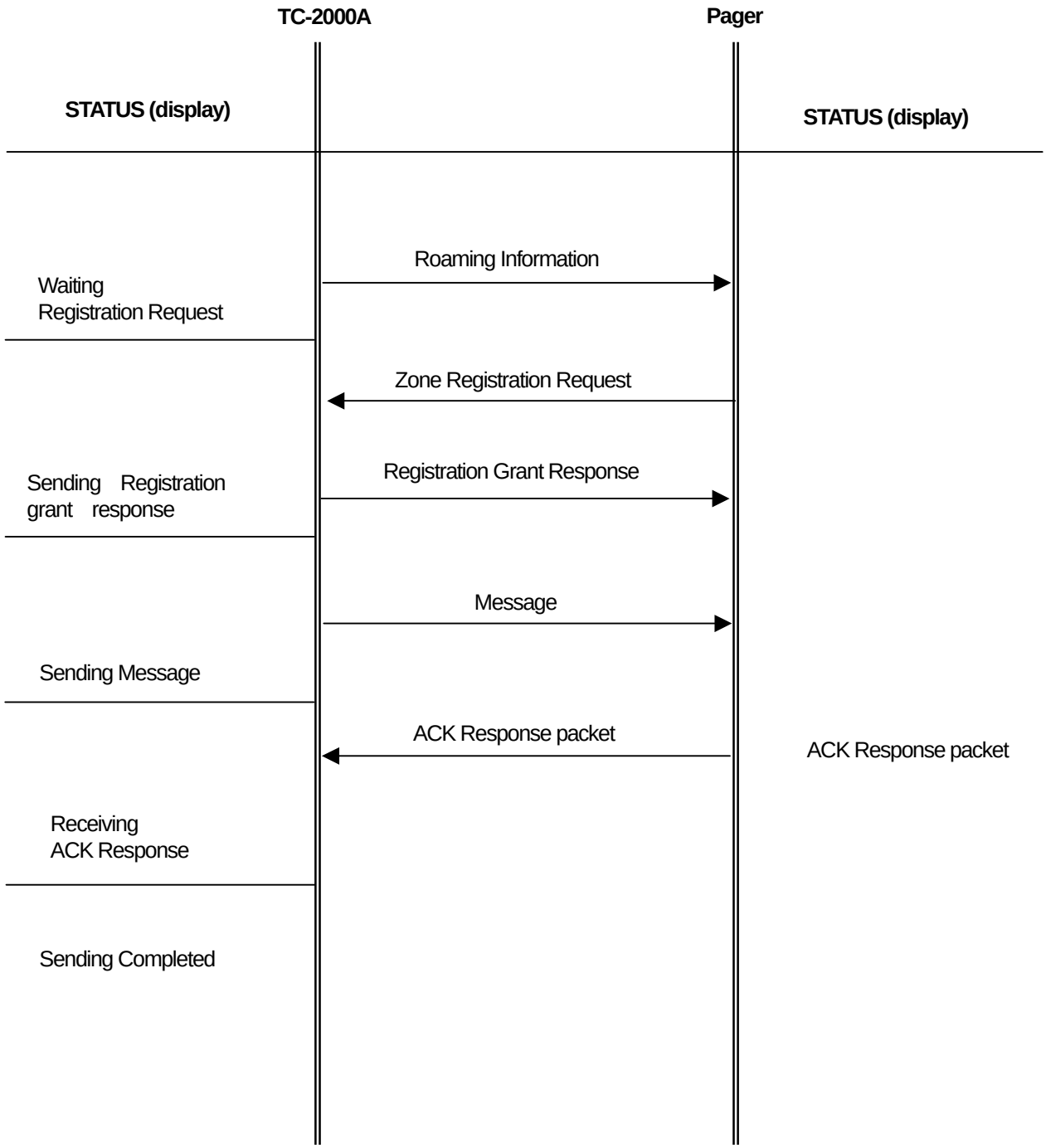
TC-2000A does not repeat SCENARIO. It only repeats message. Message repeat range is 0 to 99. “0” is continuous repeat until [SEND] is pressed again.

REG : When it is off, it will skip registration process during the SCINARIO test.

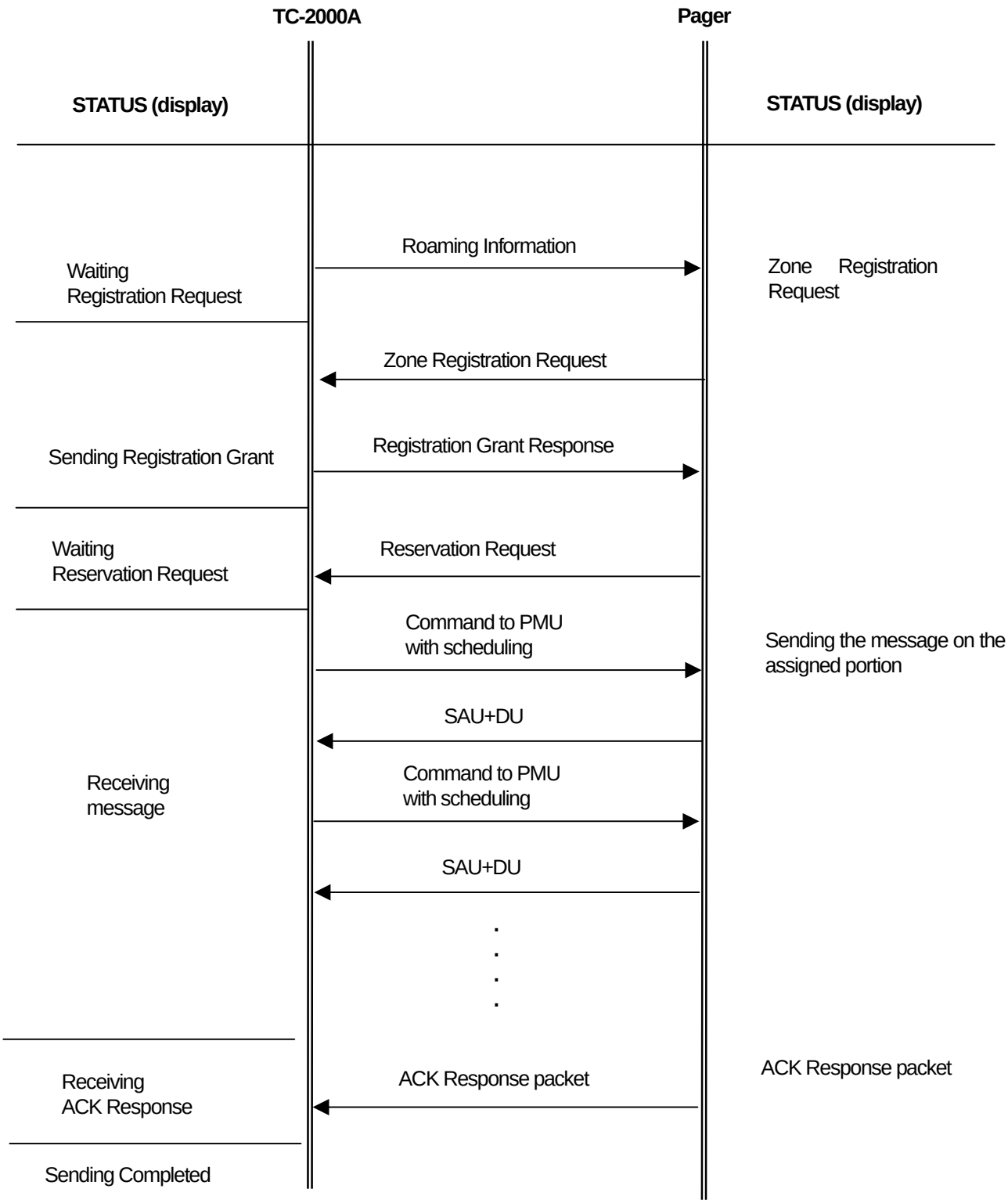
ReFLEX 25 < SCENARIO # 0 : IDLE FRAME >



ReFLEX 25 < SCENARIO # 1 : Outbound MSG Test >



ReFLEX 25 < SCENARIO # 2 : Inbound MSG Test >



ReFLEX 50

This manual does not include protocol details. Unless operator is proficient with the protocol and has specific use, not altering the default value is highly recommended.

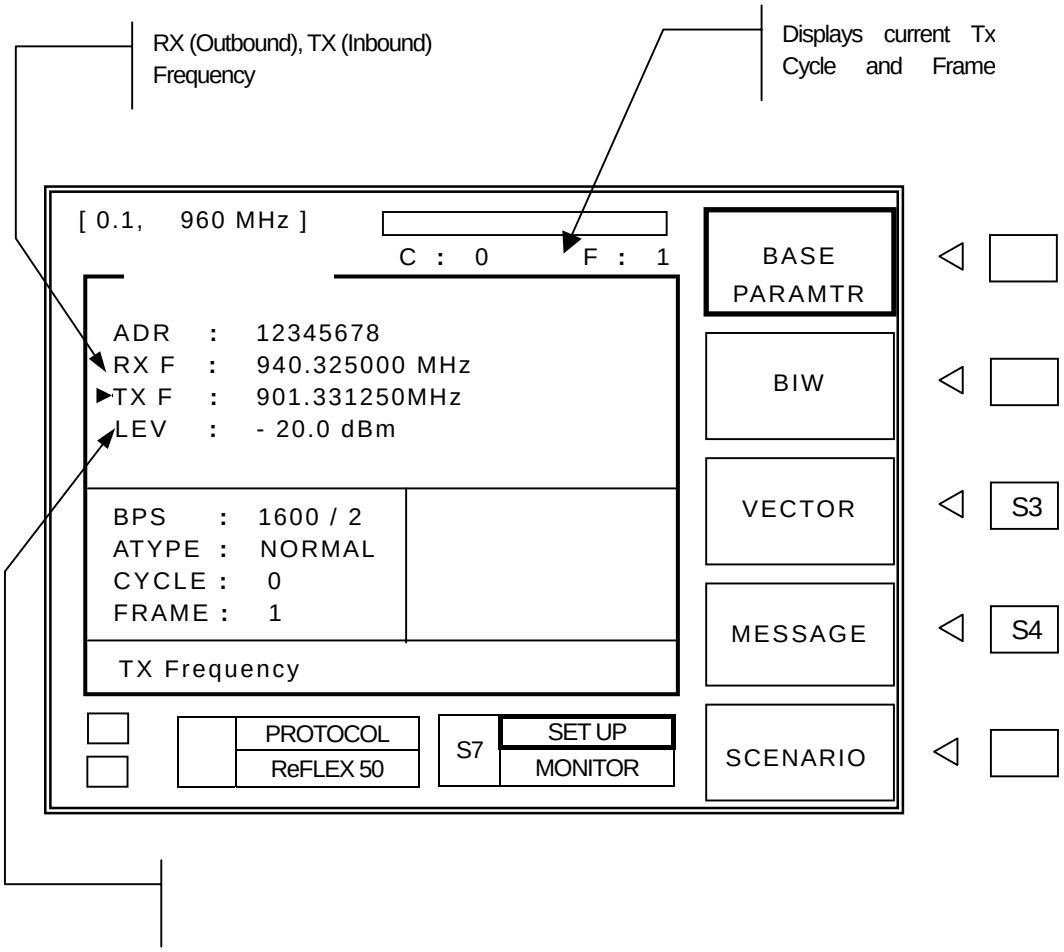
Parameters not specified in the protocol documents but supported in TC-2000A are in gray on this operating manual.

To select ReFLEX 50 screen, press [FCN] + [S4], choose it from pop-up menu and press [ENT].

Refer to 3-1 for the operation, choosing menu, moving cursor, data input, etc.

BASE PARAMT

Press [S1] to select base test parameter settings.



ADR : Address setting. Press [ADR] key or move cursor to "ADR" and press [ENT] and then input the pager address,

- Range : 0 ~ 1073741823

RX F : Outbound channel (Rx) frequency.

Press [FRQ] key or move cursor to "RX F" and press [ENT] , then input frequency. Frequency value can be changed while TC-2000A is transmitting.

- Range : 100KHz ~ 50MHz or 130MHz ~ 960MHz
- Resolution : 6.25KHz or 5KHz

TX F : Inbound channel (Rx) frequency.

Press [FRQ] key or move cursor to "TX F" and press [ENT] , then input frequency. Frequency value can be changed while TC-2000A is transmitting.

Range : 455kHz ~ 960MHz

- Resolution : 6.25kHz, 5KHz

LEV : RF output level.

Press [LEV] key or move cursor to "LEV" and press [ENT] , then input frequency. Level value can be changed while TC-2000A is transmitting.

Frequently used value can be conveniently stored and recalled(☞ Refer to 3-7).

- Range : -20dBm to -120dBm
- Level Step : 0.1dB

BPS : Data Baud Rate.

Range of ReFLEX 50 is 1600/2, 3200/2, 3200/4, 6400/4 BPS.

ATYPE : Address Type .

Move arrow to "ATYPE" then choose NORMAL or INFOR (Information) by pressing [ENT] for the correct Address Type. When "INFOR" (Information Address Type) is selected, Address range becomes 0 to 65534, and "SUBA" (Subaddress Parameter) appears on screen.

SUBA : Information Subaddress (0 ~ 14)

See "ATYPE" above.

CYCLE : Starting cycle number of transmission (0 ~ 14)

Move cursor to "CYCLE" and press [ENT] , then input the start cycle number.

FRAME : Starting frame number of transmission (0 ~ 127)

Move cursor to "FRAME" and press [ENT] , then input the start frame number.

POLRT : FSK Modulation Polarity.

Toggles between "NOR" and "INV".

FSK Modulation (2 LEVEL)

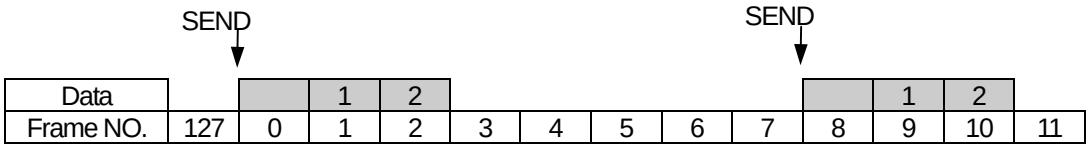
NOR (Normal polarity)	INV (Inverse polarity)
"1" : Carrier **+** 2.4 kHz "0" : Carrier **–** 2.4 kHz	"1" : Carrier **–** 2.4 kHz "0" : Carrier **+** 2.4 kHz

FSK Modulation (4 LEVEL)

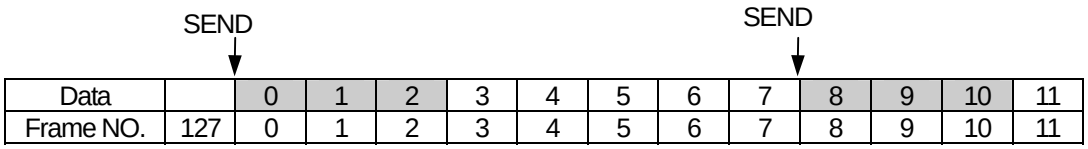
NOR (Normal polarity)	INV (Inverse polarity)
"10" : Carrier **+** 2.4 kHz "11" : Carrier **+** 0.8 kHz "01" : Carrier – 0.8 kHz "00" : Carrier – 2.4 kHz	"10" : Carrier – 2.4 kHz "11" : Carrier – 0.8 kHz "01" : Carrier **+** 0.8 kHz "00" : Carrier **+** 2.4 kHz

SYNC : Synchronous Transmit ON / OFF.

SYNC OFF : "SEND" key initiates transmission with Frame=0. During no transmission, unmodulated CW signal is output



SYCN ON : "SEND" key initiates transmission at the next frame using the frame number of the internal reference. During non-transmission, IDLE Frame is repeated to allow synchronization of the pager under test.

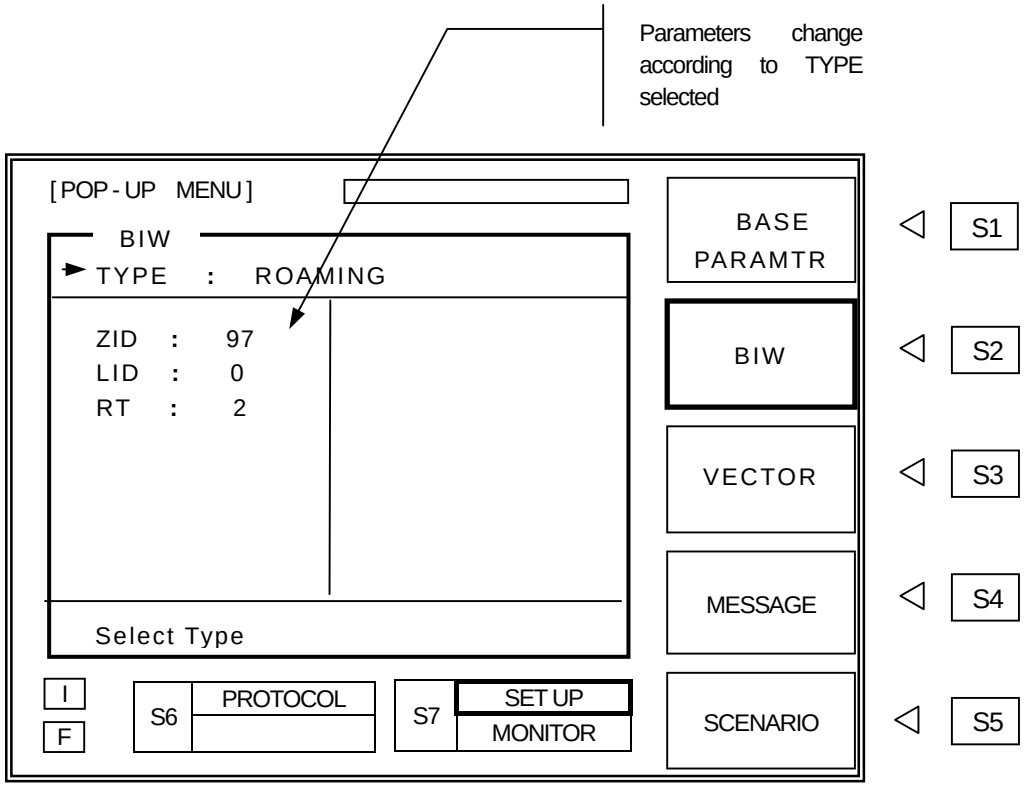


TXPOW : Expected TX Power (-30dBm ~ 15dBm)

To receive TX signal correctly, an expected Tx Power value should be entered. Power value can be changed while TC-2000A is transmitting.

B I W (Block Information Word)

Press S2 to select [BIW] parameter settings.



TYPE **: BASIC / REVERSE / ROAMING / TIME**

BIW (Block Information Word) Parameter Group Select.

Move cursor to TYPE and press ENT . Select test function from pop up menu and press ENT. Test parameters related to test function selected will appear on screen.

Following chart shows various parameters available in TC-2000A depending on Parameter Group selected.

Group	Description	Parameter
BASIC	Basic Information Parameter	RD, LE, COLL, CLAI
REVERSE	Reverse Channel Parameter	BOUND, RCS, TOP, ALOH
ROAMING	Roaming Parameter	ZID, LID, RT
TIME	Time Information Parameter	YEAR, MONT, DAY, WEEK, HOUR, MIN, CS, DS, TZ

■ **BASIC : Basic BIW**

RD : Registration Denied (0, 1)

LE : Registration Acknowledgment (0, 1)

COLL : Collapse Mask for Personal Address (0, 7)

CLAI : Collapse Mask for Information Service (0 ~ 7)

■ **REVERSE CHANNEL**

ReFLEX 50 has two types of Reverse Channel, FDD and TDD. However TC-2000A only supports FDD.

BOUND : Boundary between Scheduled and Unscheduled (ALOHA) (0 ~ 127)

RCS : Reverse Channel Speed (800, 1600, 6400, 9600)

TOP : ALOHA Time-Out (0 ~ 2047)

A : ALOHA Allowed (0, 1)

■ **ROAMING**

ZID : Forward channel zone number (0 ~ 8191)

LID : Local channel ID (0 ~ 8191)

RT : Registration Threshold (0 ~ 127)

■ **TIME**

YEAR : Year (1994 ~ 2025)

MONT : Month (1 ~ 12)

DAY : Date (1 ~ 31)

WEEK : Day of the week (1 ~ 7 : Sun ~ Sat)

HOUR : Hour (0, 23)

MIN : Minute (0 ~ 59)

CS : Correction second (0 ~ 63)

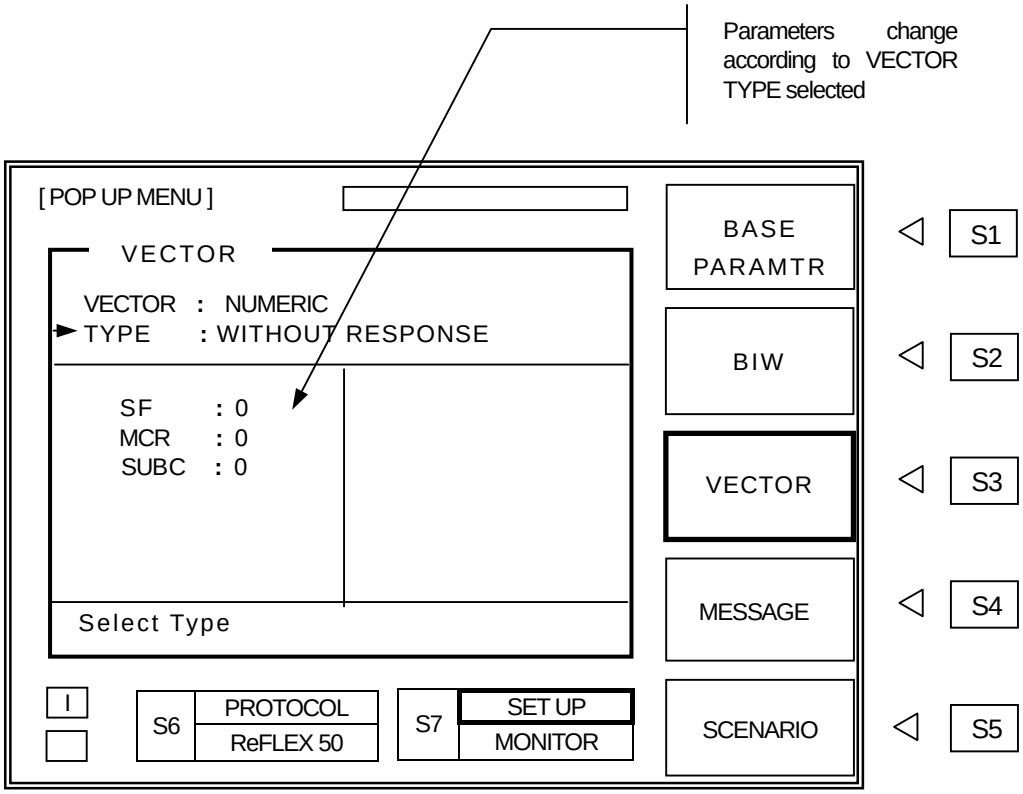
DS : Daylight Saving (0, 1)

TZ : Time Zone Index (0 ~ 31)

VECTOR

VECTOR menu contains parameters related to Vector type.

Press [S3] to select [VECTOR] menu.



VECTOR Choosing VECTOR Type

Move cursor to VECTOR, press [ENT] , select desired vector type from pop up menu and press [ENT] . Parameters change according to VECTOR TYPE selected.

.

■ **SHORT : Short Message Vector**

Move cursor to "TYPE", press [ENT] , select desired Short Message Type from pop up menu and press [ENT] .

TYPE	Description
0	7 Numeric Characters
1	6 Char + 16 Sources
2	4 characters + 16 Sources + MSN

■ **NUMERIC : Numeric Vector**

Move cursor to "TYPE", press [ENT] , select desired Numeric Vector Type from pop up menu and press [ENT] . Parameters change according to TYPE selected. Details of selected Short Message Types are shown on tables below.

WITHOUT RESPONSE

Parameter	Range	Description
SF	0, 1	Special Format
MCR	0, 1	Multiple Choice Response Flag
SUBC	0 ~ 3	Subchannel Assignment Number
AMI	ON/OFF	Automatic-Numbering Message

WITH RESPONSE

Parameter	Range	Description
SF	0, 1	Message Sequence Number
MCR	0,1	Multiple Choice Response Flag
SUBC	0 ~ 3	Subchannel Assignment Number
MSN	0 ~ 99	Message Sequence Number (Signature)
FRAME	0 ~ 63	Scheduling information for response (Relative Frame Number)
RS	0 ~115	Scheduling information for response (Response Packet Slot)
PACK	0 ~ 7	Scheduling information for response (Position Pointer within ACK)
RT		Response Type (ALOHA or SCHEDULED)
ARL	2 ~ 63	ALOHA Response Time Limit
AMI	ON/OFF	Automatic-Numbering Message

■ **HEX / BIN : HEX /Binary Vector**

TC-2000A supports Single Subchannel only.

Parameter	Range	Description
MSN	0 ~ 99	Message Sequence Number (Signature)
FRAME	0 ~ 63	Scheduling information for response (Relative Frame Number)
RS	0 ~115	Scheduling information for response (Response Packet Slot)

PACK	0 ~ 7	Scheduling information for response (Position Pointer within ACK)
RT		Response Type(ALOHA or SCHEDULED)
ENCY	0, 1	Encryption flag
CMF	0, 1	Compress Message flag
MCR	0 ~ 99	Message Sequence Number (Signature)
MAIL	0, 1	Mail drop flag
SUBC	0 ~ 3	Subchannel Assignment Number
LENG	0 ~ 15	Blocking Length
ARL	2 ~ 63	ALOHA Response Time Limit

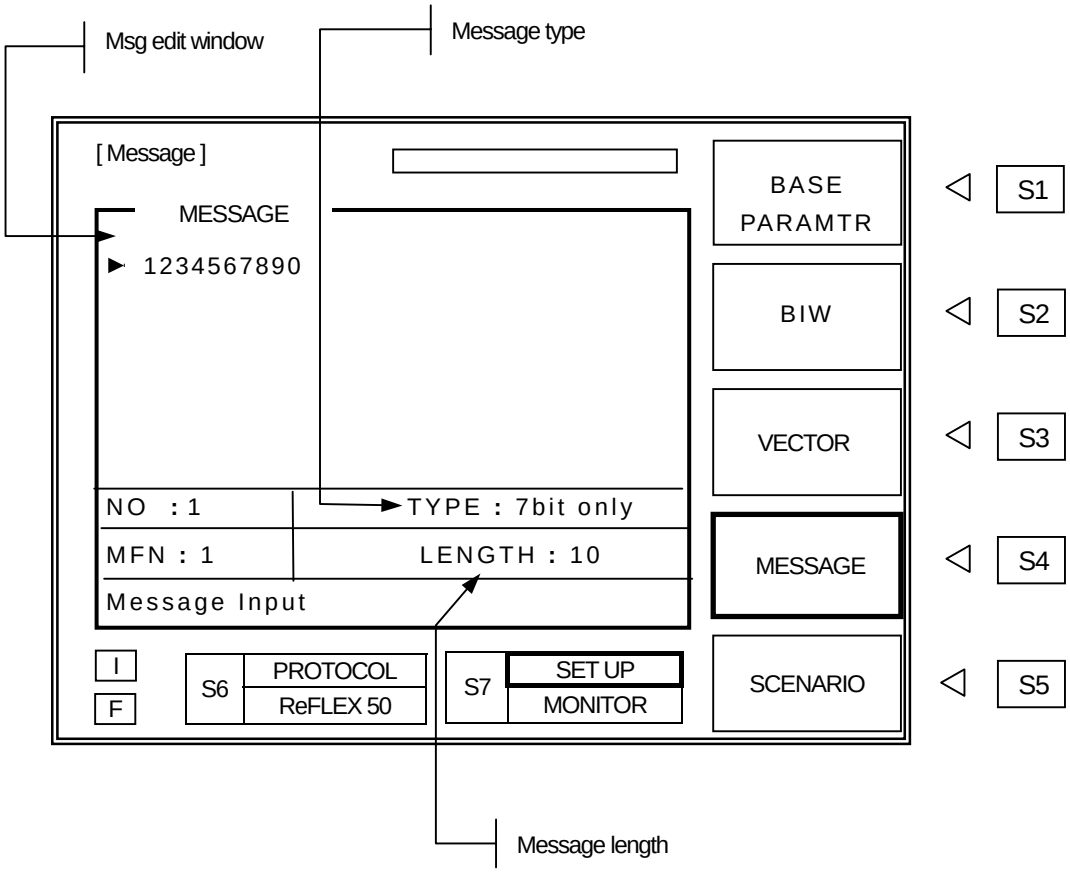
■ **ALPHA : Alphanumeric Vector**

TC-2000A supports Single Subchannel only.

Parameter	Range	Description
MSN	0 ~ 99	Message Sequence Number (Signature)
FRAME	0 ~ 63	Scheduling information for response (Relative Frame Number)
RS	0 ~115	Scheduling information for response (Response Packet Slot)
PACK	0 ~ 7	Scheduling information for response (Position Pointer within ACK)
RT		Response Type (ALOHA or SCHEDULED)
ENCY	0, 1	Encryption flag
CMF	0, 1	Compress Message flag
MCR	0 ~ 99	Message Sequence Number (Signature)
MAIL	0, 1	Mail drop flag
SUBC	0 ~ 3	Subchannel Assignment Number
AMI	ON/OFF	Automatic-Numbering Message
ARL	2 ~ 63	ALOHA Response Time Limit

MESSAGE

Press [S4] to select [MESSAGE] menu. Messages for transmission can be edited on this screen.



MESSAGE Display Window : Message content and editing.

Messages either can be directly entered on screen or recalled the stored messages. Numeric messages can be enter by front panel keypad. To enter Alphanumeric messages, use Rotary Knob and [⇦] [⇨] key and choose characters. Messages also can be entered by PC via RS-232C interface. Stored messages are not editable on screen.

TYPE : Select Character Code Type (7 bit, KSC-5601, GB 2312 or CNS).

Move cursor to "TYPE" , press ENT , select Character Code type from pop-up menu and press ENT. This is only possible when "ALPHA" on "VECTOR" is selected. When "TONE" or "NUMERIC" is selected, only "TYPE" is displayed.

NO : Select the stored messages.

Move cursor to "NO" and press ENT . Enter stored message number and press ENT . TC-2000A has 40 stored messages of Arabic numbers, ASCII, Korean (KS-S601), Chinese Characters (GB-2312-80) for testing various types of pagers. Stored messages are in following table.

TC-2000A Stored Message List

Message Type	Number / Length	Size of Buffer	Message
Numeric (4bit)	No : 1	100	1234567890
	No : 2	100	3456789012
	No : 3	100	5678901234
	No : 4	100	7890123456
	No : 5	100	9012345678
Alphanumeric (7bit only)	No : 1 (10 Char.)	100	1234567890
	No : 2 (26 Char.)	100	ABCDEFGHIJKLMNOPQRSTUVWXYZ
	No : 3 (36 Char.)	100	Abcdefghijklmnopqrstuvwxyz1234567890
	No : 4 (100 Char.)	100	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2
	No : 5 (1000 Char.)	1000	1A 1B 1C 1D 1E 1F 1G 1H 1I 1J 1K 1L 1M 1N 1O 1P 1Q 1R 1S 1T 1U 1V 1W 1X 1Y 1Z 2A 2B 2C 2D 2E 2F 2G 2H 2I 2J 2K 2L 2M 2N 2O 2P 2Q 2R 2S 2T 2U 2V 2W 2X 2Y 2Z 3A 3B 3C 3D 3E 3F 3G 3H 3I 3J 3K 3L 3M 3N 3O 3P 3Q 3R 3S 3T 3U 3V 3W 3X 3Y 3Z 4A 4B 4C 4D 4E 4F 4G 4H 4I 4J 4K 4L 4M 4N 4O 4P 4Q 4R 4S 4T 4U 4V 4W 4X 4Y 4Z 5A 5B 5C 5D 5E 5F 5G 5H 5I 5J 5K 5L 5M 5N 5O 5P 5Q 5R 5S 5T 5U 5V 5W 5X 5Y 5Z 6A 6B 6C 6D 6E 6F 6G 6H 6I 6J 6K 6L 6M 6N 6O 6P 6Q 6R 6S 6T 6U 6V 6W 6X 6Y 6Z 7A 7B 7C 7D 7E 7F 7G 7H 7I 7J 7K 7L 7M 7N 7O 7P 7Q 7R 7S 7T 7U 7V 7W 7X 7Y 7Z 8A 8B 8C 8D 8F 8G 8H 8I 8J 8K 8L 8M 8N 8O 8P 8Q 8R 8S 8T 8U 8V 8W 8X 8Y 8Z 9A 9B 9C 9D 9E 9F 9G 9H 9I 9J 9K 9L 9M 9N 9O 9P 9Q 9R 9S 9T 9U 9V 9W 9X 9Y 9Z 0A 0B 0C 0D 0E 0F 0G 0H 0I 0J 0K 0L 0M 0N 0O 0P 0Q 0 R0S 0T 0U 0V 0W 0X 0Y 0Z 1a 1b 1c 1d 1e 1f 1g 1h 1i 1j 1k 1l 1m 1n 1o 1p 1q 1r 1s 1t 1u 1v 1w 1x 1y 1z 2a 2b 2c 2d 2e 2f 2g 2h 2i 2j 2k 2l 2m 2n 2o 2p 2q 2r 2s 2t 2u 2v 2w 2x 2y 2z 3a 3b 3c 3d 3e 3f 3g 3h 3I 3j 3k 3l 3m 3n 3o 3p 3q 3r 3s 3t 3u 3v 3

Message Type	Number / Length	Size of Buffer	Message
Alphanumeric (KSC-5601)	No : 1 (26 Char)	100	한글문자 Pager 시험.
	No : 2 (28 Char)	100	무궁화 꽃이 피었습니다.
	No : 3 (41 Char)	100	무궁화 꽃이 피었습니다. 123456789012
	No : 4 (54 Char)	100	무궁화 꽃이 피었습니다. Pager Test 123456789012
	No : 5 (32 Char)	1000	테스콤 Pager Tester 世界第一
Alphanumeric (GB 2312-80)	No : 1 (13 Char)	100	中文傳呼測試
	No : 2 (40 Char)	100	TESCOM 傳呼機測試儀器, 品質第一
	No : 3 (41 Char)	100	祝 生意興隆, 萬事如意, 財源滾滾
	No : 4 (41 Char)	100	緊急事件, 太太我 , 速回電家裏
	No : 5 (35 Char)	1000	交通阻塞, 約會改爲 1630 金
Alphanumeric (CNS)	No : 1, 2, 3, 4 (70 Char)	100	CNS CODE MESSAGE : TESCOM 祝 各 用 戶 業 務 蒸 蒸 日 上
	No : 5 (284 Char)	1000	FLEX和POCSAG碼制的區別:FLEX是用GPS的絶對時鍾作爲標準的全同步傳輸方式,尋呼機在指定的時間內打開接收電路,接收信息,這樣就比POCSAG碼尋呼機省電好幾倍以上;同時,FLEX采用的4電平FSK調制而代替POCSAG制式的2電平FSK,因而 FLEX的傳輸容量能增加幾倍.
HEX / BIN	No : 1, 2, 3, 4, 5	100 (No 5:1000)	123456789ABCDEF

MFN : Message Fragment Number..

HEX/BIN and Alphanumeric message can be transmitted in fragmented form. The fragmentation range is dependant with message length.

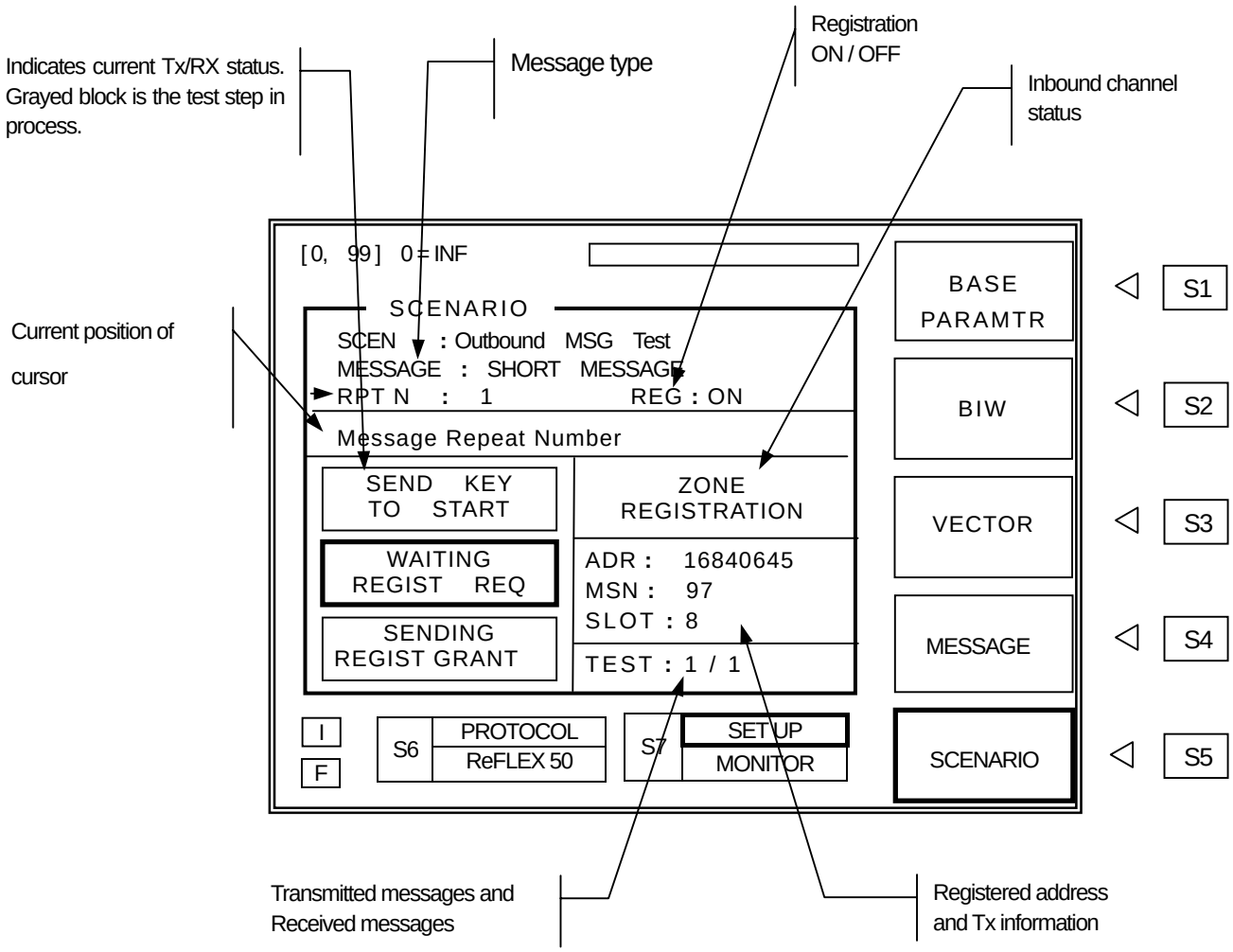
LENGTH : Indicates current message length.

SCENARIO

The 2-Way pager communication is not as simple as 1-Way pager, network send messages and pager receive it. It proceeds roaming information, zone registration request, registration grant, inbound request, inbound message command, acknowledge message receipt, etc. TC-2000A has several built-in test scenario automatically executes steps required for 2-Way pager testing. Each step including signal transmitted from the pager under test can be monitored on TC-2000A screen.

To select SCENARIO screen, press [S5] . Select appropriate SCENARIO, then press [SEND] key.

After the test completion, inbound signal information can be viewed on screen by pressing [FCN] + [1] or [FCN] + [S5], and pressing [S1] thru [S5], (☞ Refer to 3-2-5).



SCEN : Select SCENARIO

. Move cursor to SCEN, press [ENT] , and select SCENARIO number from pop up menu.

Details of scenarios are as following.

Number	SCEN	Description
0	IDLE FRAME	Transmits the Idle cord word continuously
1	Outbound MSG Test	Transmits test messages and detects inbound ACK.
2	Inbound MSG Test	Tests received inbound message.

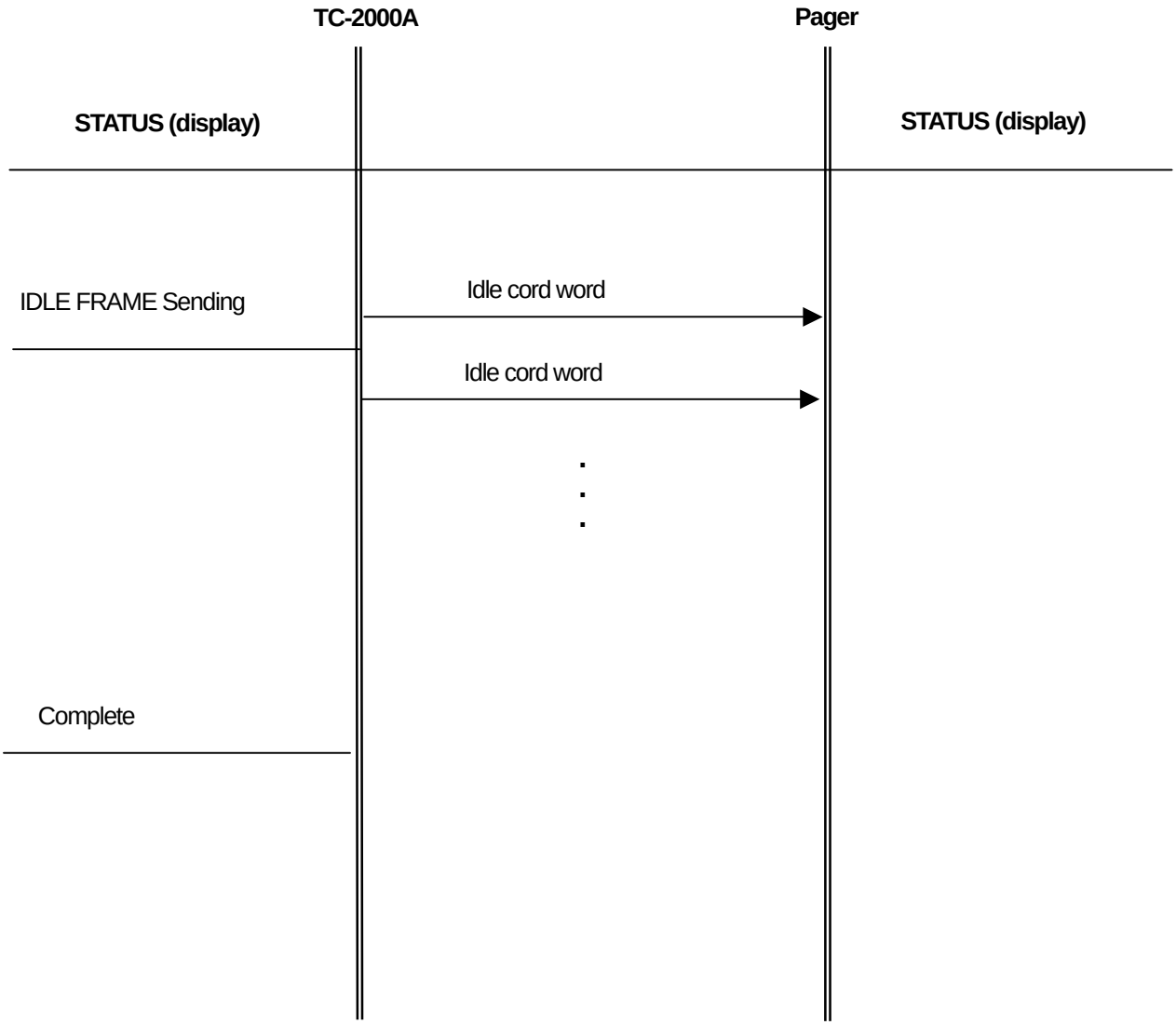
RPT N : Repeat Number.

Choose number of messages to be sent.

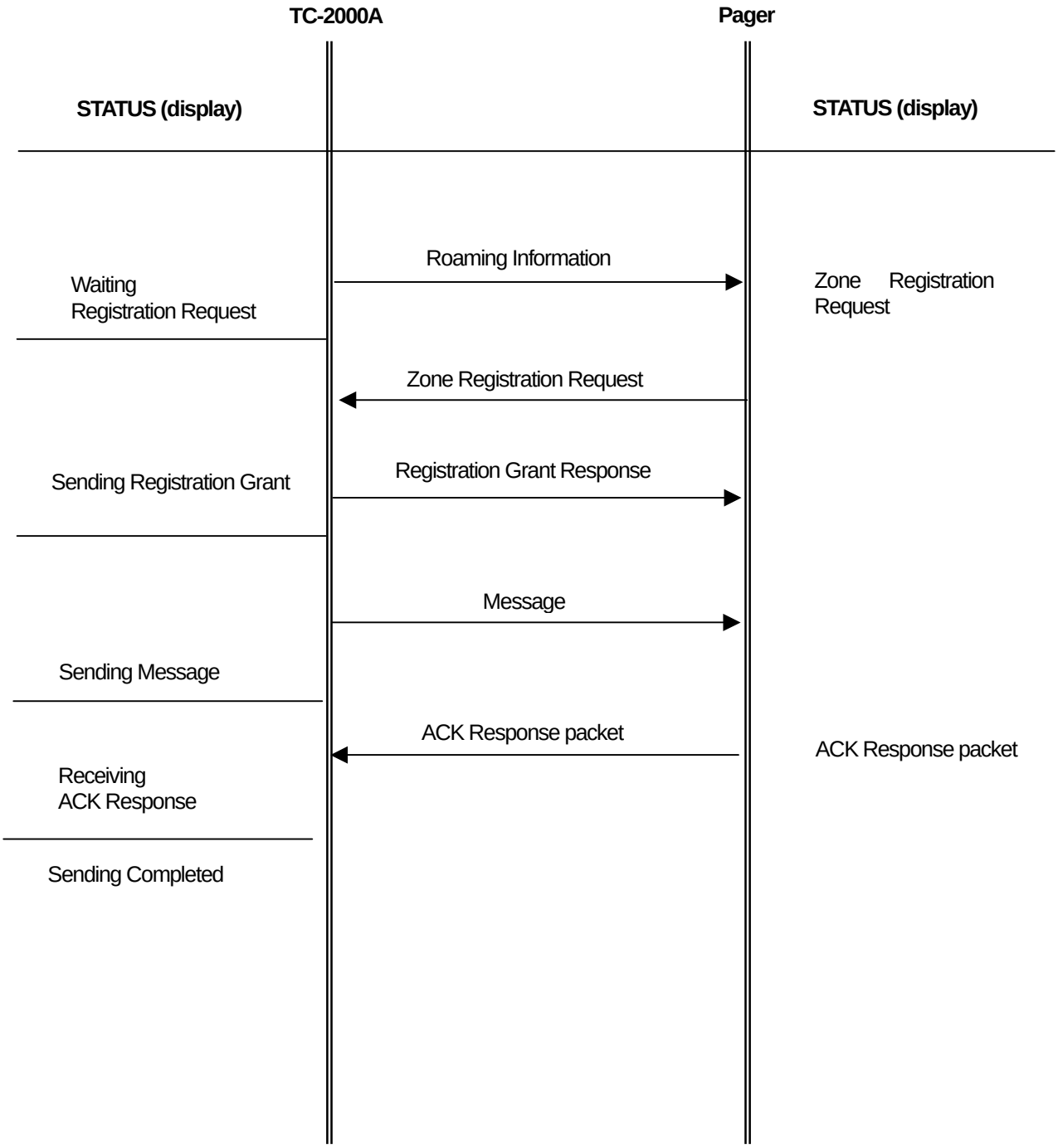
TC-2000A does not repeat SCENARIO. It only repeats message. Message repeat range is 0 to 99. “0” is continuous repeat until [SEND] is pressed again.

REG : When it is off, it will skip registration process during the SCINARIO test.

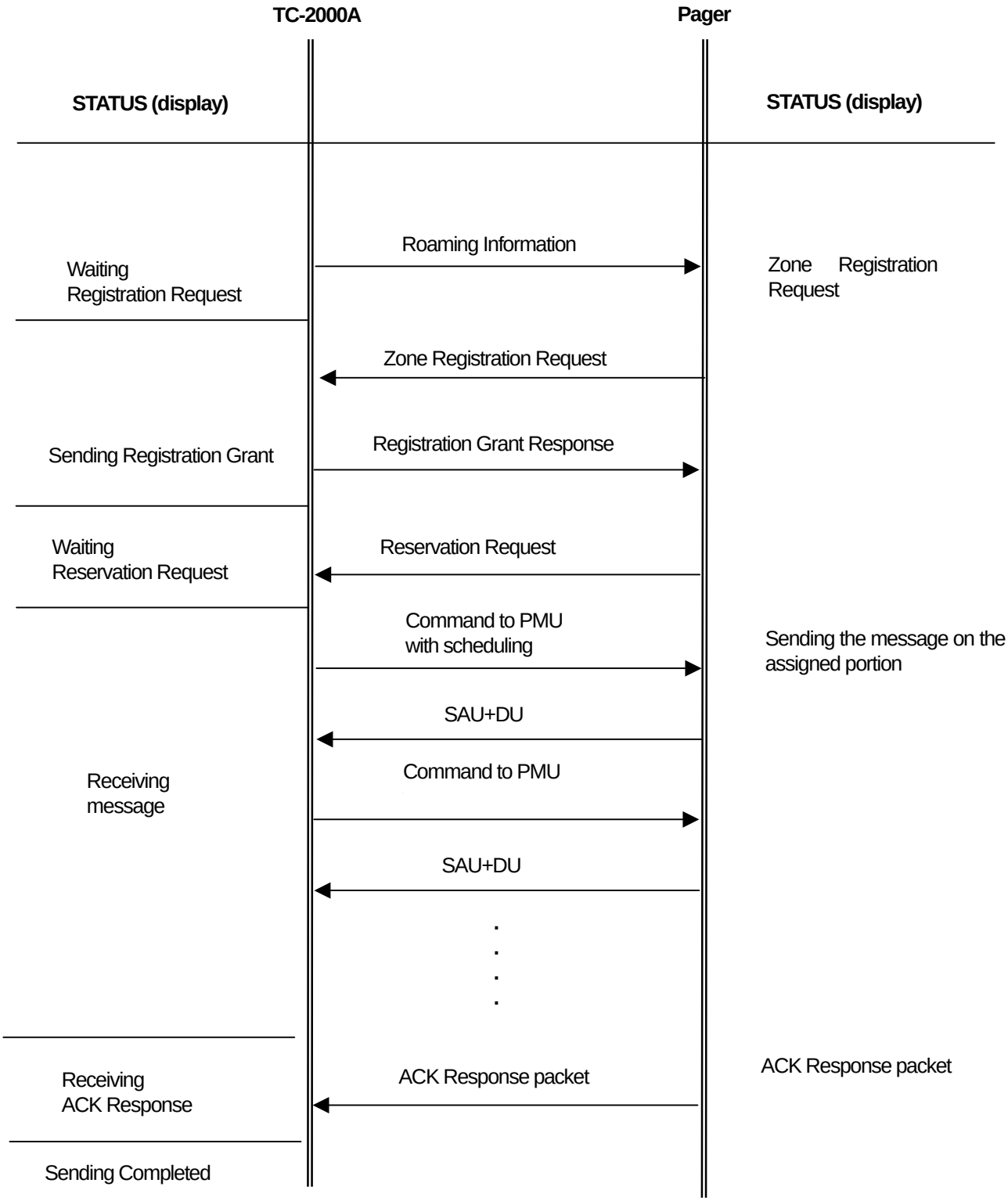
ReFLEX 50 < SCENARIO # 0 : IDLE FRAME >



ReFLEX 50 < SCENARIO # 1 Outbound MSG Test >



ReFLEX 50 < SCENARIO # 2 Inbound MSG Test >



Operator’s Verification

This section contains information for keeping the instrument in good working order and checking its overall performance.

V

Principles of Operation

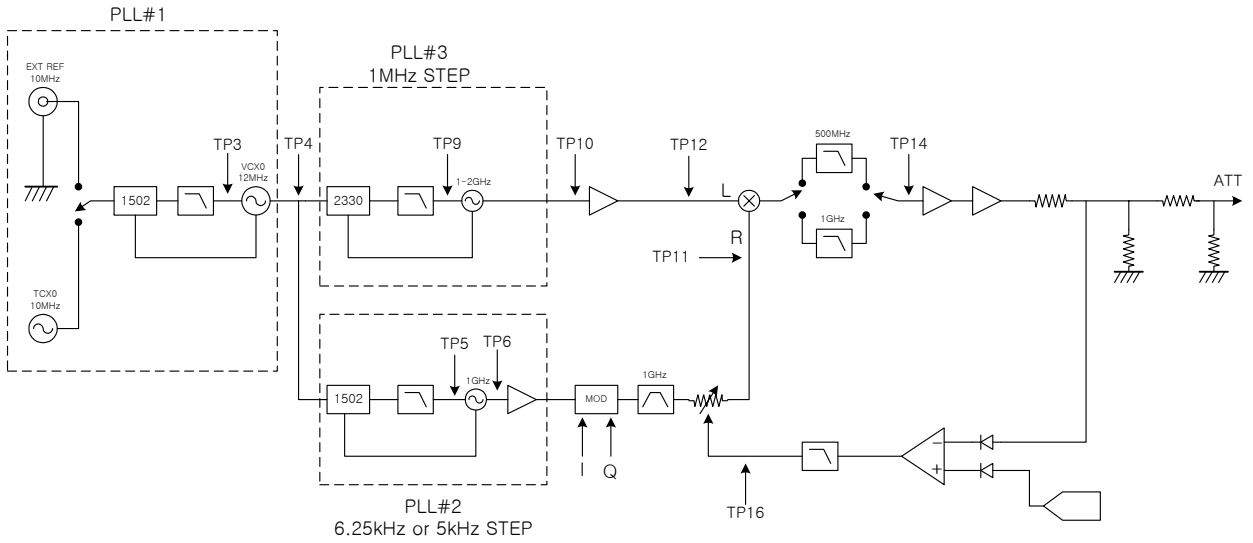
Use the simplified block diagrams and the circuit descriptions in this section to understand the instrument's operation

.

RF Signal Source Board (TX Board)

The wideband RF output frequency of TC-2000A is obtained by mixing a narrowband 1GHz RF (PLL#2 , for modulation and fine frequency steps) with the wideband 1~2GHz LO (PLL#3, 1MHz steps). Two separate output ports are used for convenience; the unleveled low frequency IF band, 0.1MHz ~ 50MHz (-10dBm @ typical) and the main RF band 130MHz ~960MHz (-20~-120dBm). The primary frequency resolution is 5KHz or 6.25KHz automatically selected, but frequency is settable in 10Hz resolution with reduced noise performance. The heart of the system is I/Q modulator that digitally produces high accuracy FSK modulation for pagers as well as general-purpose narrowband modulation.

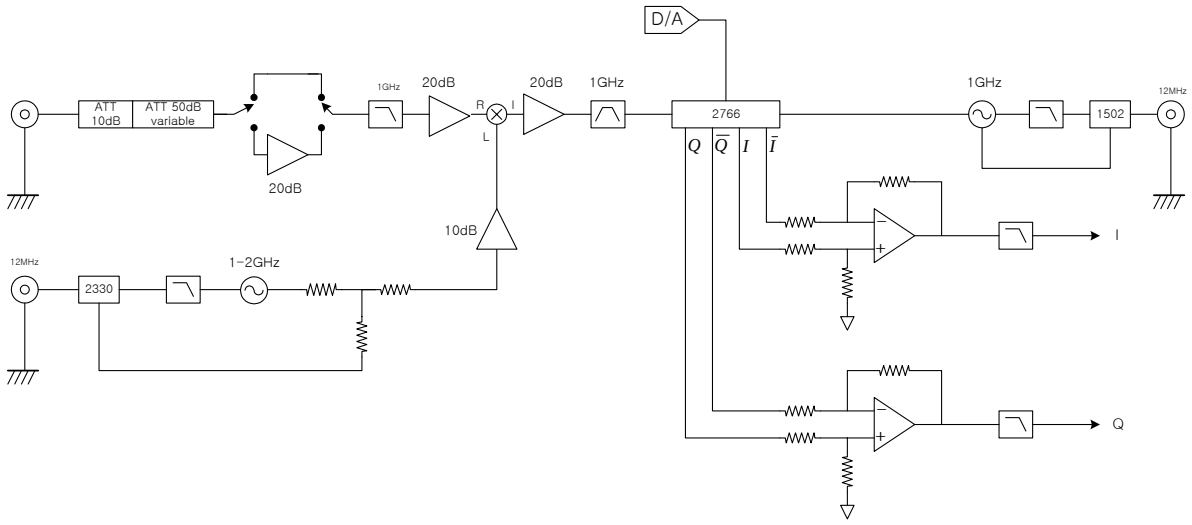
TC-2000A Tx Board Block Diagram



RF Monitor and Analysis Board (RX Board)

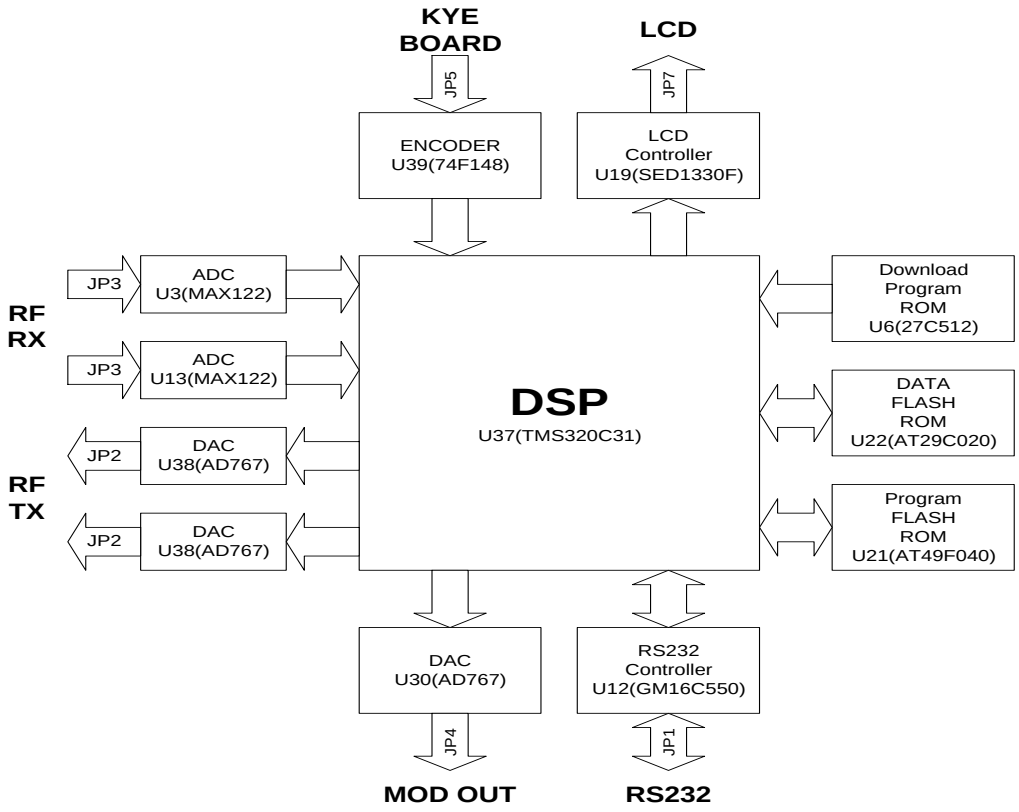
TC-2000A is a combined heterodyne and homodyne receiver that converts the input signal, 0.455MHz ~ 960MHz (20dBm ~ -70dBm) to 1GHz IF with the 1st LO (1~2GHz, PLL#3). The 1GHz IF is then directly down-converted to the I-Q base band signals with 1GHz 2nd LO. This demodulation method provides an excellent stability for narrowband digital communication signals. The input frequency can be set in 5KHz or 6.25KHz steps.

TC-2000A Rx Board Block Diagram



DSP Board

The brain of TC2000A lies in DSP board. All DSP operation and User Interface Control are performed in this board. The main DSP interface with RF boards is through ADC (AD Converter) and DAC (DA Converter). This raw data is processed for further information such as FM Demodulation, Power measurement, Frequency offset measurement, FFT, and so on. User Interface also includes LCD Control, Key Interface, and RS232 remote Interface.



Performance Test

The procedure in this chapter allows the verification of the electrical performance of TC-2000A. These tests do not require access to the interior of the instrument.

Recommended test equipment

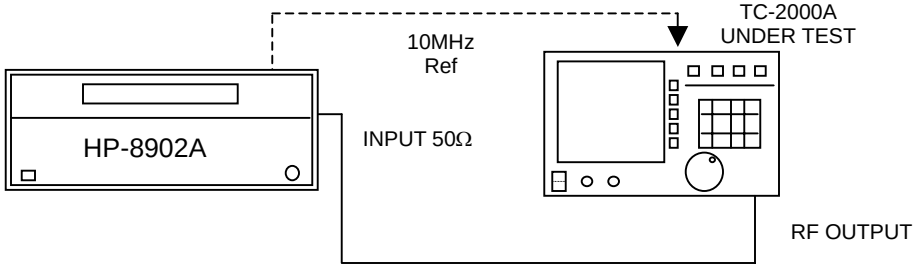
Description	Minimum specification	Model
Power meter	+/- 0.2dB, -60 to -20dBm, 100 KHz to 1 GHz	HP-436A/8481D
Spectrum analyzer	100 KHz to 3 GHz, up to –120 dBm	HP-8591E
Measuring receiver	0.2 to 1300 MHz, 0 to –125dBm, Freq Counter	HP-8902A
Oscilloscope	DC to 100 MHz, 5 mV to 1 V/div, Rise Time capability	TEK TDS360
Signal source	130 to 960 MHz, FSK modulation	TC-2000A
Function Generator	+/- 0.1 dB, 0 ~ 20kHz, > 1V	HP-33120A
Signal Generator	100kHz ~ 1GHz, +/- 0.5dB, +20 ~ -120dBm	HP-8648C
Frequency Counter	+/- 0.1 ppm, 10Hz ~ 1GHz, 9 digit	HP-53181A

1. Signal Generator

1.1. Frequency Accuracy

Range: 130 to 960 MHz
Stability: Same as reference oscillator accuracy. Internal 0.5ppm 0 to 50degC

1. Test Setup



Carrier frequency accuracy test

2. HP-8902A : auto tuning, frequency display

3. TC-2000A:

1). Reset
2). Press [FCN] [S4] , select SERVICE, [S1] for Signal Generator mode
3). LEV: -20 dBm
4). MOD: OFF

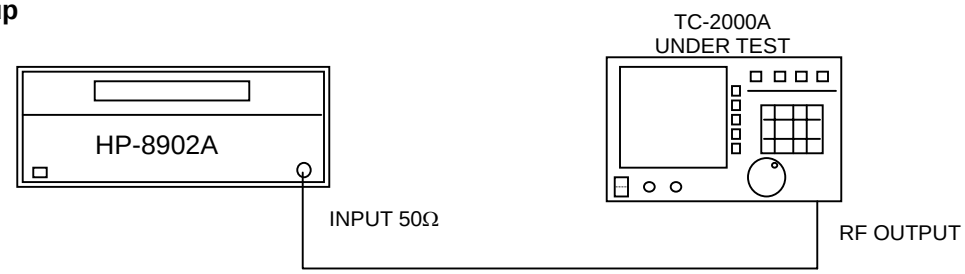
4. Set TC-2000A output Freq to 900MHz and read the frequency. Repeat after removing the 10MHz EXT reference.

TC-2000A FREQ	Lower	Actual	Upper	Remark
900MHz	900MHz –50Hz		900MHz +50Hz	8902 Reference
900MHz	900MHz-200Hz		900MHz+200Hz	0.2ppm at RT

1.2. RF Output Level Accuracy

RF level range : -120dBm to –20dBm
Accuracy : +/- 1 dB

1. Test Setup



2. HP-8902A: Auto-tuning, RF Power

3. TC-2000A ;

1). Reset
2). Press [FCN] [S4] , select SERVICE, [S1] for Signal Generator mode
3). FREQ: 140MHz
4). MOD: OFF

4. Set TC-2000A Level and read power level in dBm.

5. Change the DUT Frequency to 240, 260, 490, 510, 740, 760, 950 MHz and repeat the steps

Table: TC-2000A Signal Generator Level Accuracy

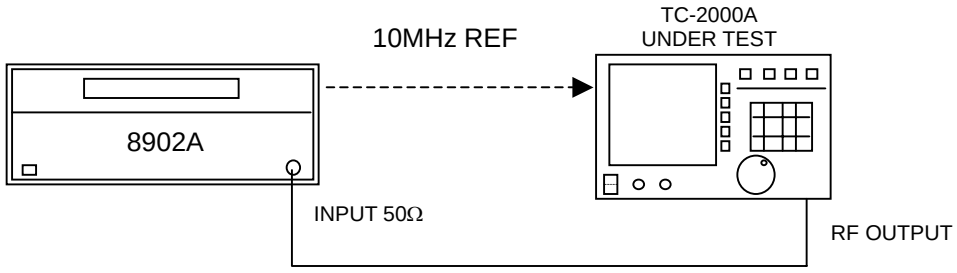
Level	TC-2000A Output Frequency (MHz)								
dBm	140	240	260	490	510	740	760	950	Remark
-20									
-36									
-52									
-61.1									
-80.2									
-100.3									
-110									
-120									

1.3. Spectral Purity

1.3.1. Residual FM Noise

RMS Noise : <30 Hz Typ. 50Hz~3KHz @ Fout= Nx5KHz or 6.25KHz
<80Hz Typ. 50Hz~3KHz elsewhere

1. Test Setup.



Residual FM test

2. HP 8902A: FM, RMS, Filter BW 50Hz~3KHz

3. TC 2000A:

1). Reset
2). Press [FCN] [S4] ,select SERVICE, [S1] for Signal Generator mode
3). LEV: -20 dBm
4). MOD: OFF

4. Set TC 2000A Frequency and read RMS noise.

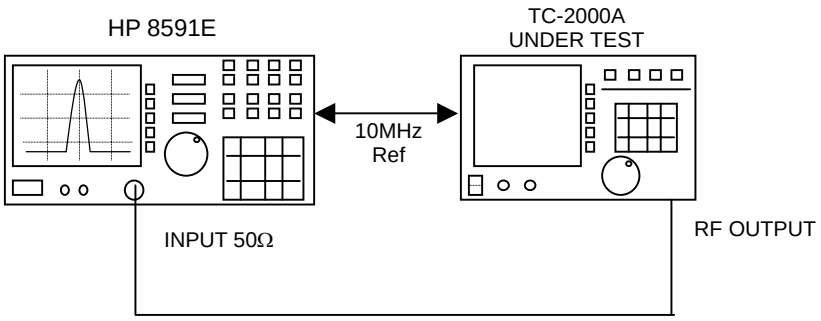
Table: TC-2000A Signal Generator Residual FM
(Demodulation BW=50Hz~3KHz)

Freq (MHz)	RMS Noise(Hz)	Limit (Hz)	Remark	Source
140		30Hz		PLL
140.001		80Hz		IQ DDS
140.002		80Hz		IQ DDS
140.003		80Hz		IQ DDS
140.004		80Hz		IQ DDS
140.005		30Hz		PLL
400		30Hz		PLL
700		30Hz		PLL
950		30Hz		PLL

1.3.2. Harmonic Spurious:

Harmonic Level at 2xFout: <-35dBc

1. Test Setup.



Harmonics test

2. HP 8591E: **Span= 500 KHz, RBW= 10 KHz, VBW=30 KHz.**

3. TC-2000A:

1). Reset
2). Press FCN S4 ,select SERVICE, S1 for Signal Generator mode
3). LEV: -20dBm
4). MOD: OFF

4. Set DUT frequency and read the harmonic level on the spectrum analyzer.

Table: TC2000A Signal Generator Harmonic Spurious

Fout (MHz)	Spurious(MHz)	Level (dBm)	Upper Limit	Remark
130	260		-55dBm	
200	400		-55dBm	
450	900		-55dBm	
960	1920		-55dBm	

1.3.3. Non-harmonic spurious:

LO Leakage and Mixer Spurious: *<-35dBc*

1. **Test Setup: the same as Harmonics test**
2. **Set Fout and level. Measure the spurious signal on Spectrum Analyzer.**

Table TC-2000A Non-harmonic Spurious

RF Level=- 20dBm

Fout(MHz)	Spurious Freq.	Level (dBm)	Limit (dBm)	Remark
130	1130		-55dBm	Fout+1GHz LO
130	1000		-55dBm	1GHz LO
450	550		-55dBm	Mixer IMD
498	504		-55dBm	Mixer IMD
510	490		-55dBm	Mixer IMD
900	1000		-55dBm	1GHz LO

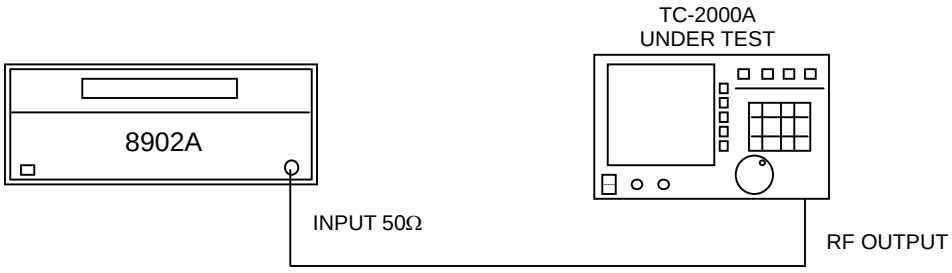
1.4. Modulation

1.4.1. FM (Internal Sine wave)

Range: DEV=0.1 KHz to 7 KHz, Fm=20~4000Hz

Accuracy: 100Hz

1. Test Setup.



FM Deviation Test

2. HP 8902A: Auto tuning; FM, [(+)Peak+(-)peak]/2, Filter 50Hz~3KHz

3. TC-2000A:

1). Reset
2). Press [FCN] [S4], select SERVICE, [S1] for Signal Generator mode
3). LEV: -20dBm
4). FREQ= 900MHz
5). MOD: ON, TYPE: FM (SIN), F=1KHz

4. Set TC-2000A DEV value as follows. Read FM Peak DEV on HP 8902A.

*** Error is due to noise and distortion of IQ Modulator**

Table TC-2000A Signal Generator FM DEV Accuracy at Fm=1KHz

DEV(Hz)	lower	8902 Reading	Upper	Remark
1000	900		1100	
2000	1900		2100	
3000	2900		3100	
5000	4900		5100	
7000	6900		7100	

5. Set DEV=5KHz. Change HP8902A Filter to 50Hz~15KHz.
Read FM DEV vs. modulation frequency..

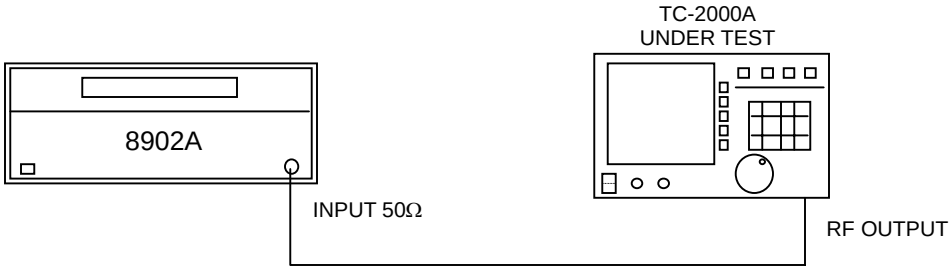
Table TC-2000A Signal Generator FM DEV Vs. Modulation Frequency
* Accuracy limitation is due to noise.

Fm (Hz)	lower	8902 Reading	Upper	Remark
500	4800		5200	
1000				
2000				
3000				
4000				

1.4.2. AM (Internal Sine wave)

Range: 1~100%, Fm=20Hz~4000Hz
Accuracy 5%+10% of peak value

1. Test Setup.



AM depth

2. HP 8902A: Auto tuning; AM, [(+)Peak+(-)peak]/2, Filter 50Hz~3KHz

3. TC-2000A:
1). Reset
2). Press [FCN] [S4], select SERVICE, [S1] for Signal Generator mode

3). LEV: -20dBm
4). FREQ= 900MHz
5). MOD= ON, TYPE= AM (SIN), F(MOD)=1KHz

4. Read AM Depth on HP 8902A.

Table. AM Accuracy @Fm=1KHz

AM Setting(%)	Lower	8902A Reading	Upper	Remark
10	4		16	
30	22		38	
90	76		100	

5. Change 8902A Filter to 50Hz to15KHz.

Table. AM Accuracy Vs Modulation Frequency
@ AM Depth =30%, 50Hz~15KHz Filter

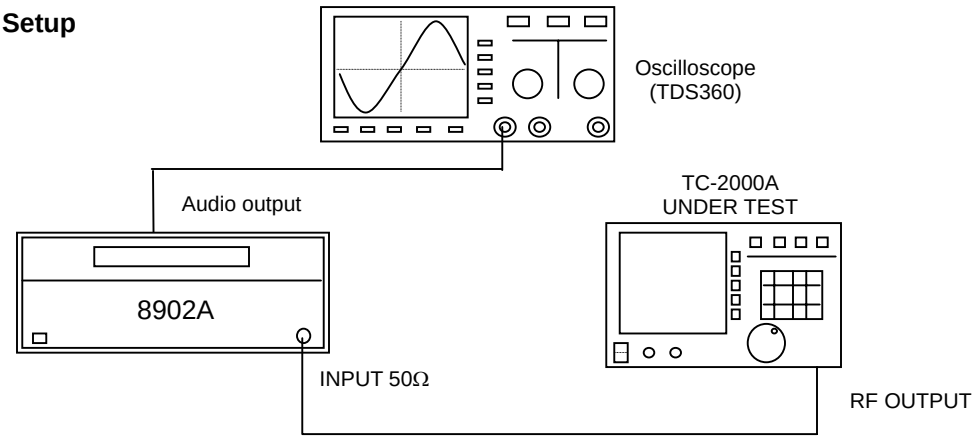
FMOD Setting	Lower	8902A Reading	Upper	Remark
1.0KHz				
2.0KHz				
3.0KHz				
4.0KHz				

1.4.3. FM(RECT) (Internal FSK Test Patterns)

Deviation Accuracy

Range: 0.1KHz~7KHz,
Accuracy 100Hz @5KHz

1. Test Setup



SK Deviation and Noise Test

2. Equipment

HP-8902A: FM, RMS, HPF=OFF, LPF=15KHz

TDS360: 250us/div, 500mV/div Average : 16

3. TC-2000A

1). Reset

2). Press [FCN] [S4], select SERVICE, [S1] for Signal Generator mode

3). FREQ= 900MHz, LEV= -20dBm

4). MOD= ON, TYPE= FM (RECT), BPS= 512/2, DEV= 5.0 KHz

4. Read FM Deviation in RMS.

DEV(TC-2000A)	Limit
5.0KHz	4.9KHz+-100Hz

.* Note: *HP8902A can not measure FSK deviation directly. Use RMS reading with theoretical correction. Assuming the built-in 3.9KHz Bessel filter, expected RMS reading is approximately 4.9KHz in case of DEV=5KHz. We use this correction factor. TC-2000A can measure the deviation directly, but not used for calibration.*

Table: FSK Deviation Accuracy @ 512/2 BPS

Item	Lower	Actual	Upper	Remark
Deviation (RMS)	4800		5000	

1.4.4. FSK Base Band Filter Accuracy

Rise and Fall Time: 88us +-5us

* *This may be measured at the front panel in base band.*

Use the same test setup as above. Change setting; BPS=1600/2 and DEV=5.0KHz.
Measure the rise and fall time of the FSK waveform with Oscilloscope Tr and Tf measurement function.

Rise and Fall Time	Limit
88us+	-5us

Table: Base Band Filter Accuracy Test

Item	Lower	Actual	Upper	Remark
Rise Time	83us		93us	
Fall Time	83us		93us	

1.4.5. FSK Noise and Ripple

Peak-peak Deviation: <300Hz @15KHz demodulation BW

1. Use the same test setup

2. HP 8902A: FM, HPF=Off, LPF=15KHz.

3.TC-2000: BPS=512/2 and DEV=1.0KHz.

4. Display the demodulated waveform on the Oscilloscope and measure the peak-peak noise excursion on top of the FSK waveform using horizontal cursors. Refer to figure below.

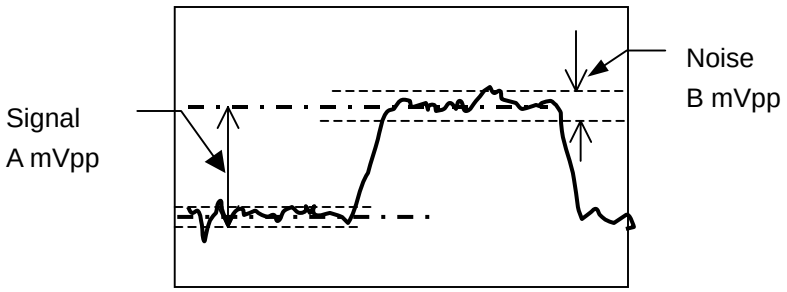


Fig: FSK Noise and Ripple

5. TDS360 : 500us/div, 500mV/div, Average = 1 (sample)

Table: FSK Noise and Distortion at DEV=1KHz
8902A Demodulation BW (15KHz)

FSK : A(mVPP)	Noise : B(mVPP)	B/A(%)	Spec	Remark
			<15%	

2. Test Receiver

2.1. Power Measurement

Linearity and Frequency Response

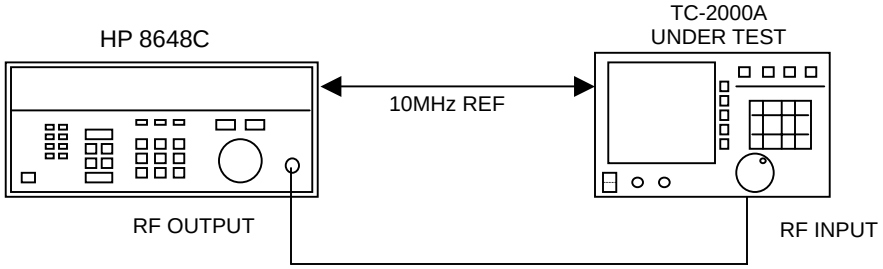
Input Range: -70 to +15 dBm

Freq Range: 455KHz~960MHz

Accuracy: 1.5dB

***** *TC*-2000A measures all the power within input BW regardless of waveform.

1. Test Setup:



2. Equipment: HP-8648C: Modulation Off

3. TC-2000A

1). Reset: press [FCN], [ESC], [PRESET]

2). Press [FCN] [S4], select SERVICE, Select TX Test and Spectrum Analyzer mode

3. Record the power reading according to the table below.

Table: TC-2000A Power Measurement Accuracy (dBm)

Input Level	Offset Freq(KHz) Fin=Fsig gen=900MHz			Max Error	Remark
dBm	-15KHz	0	+15KHz	dBm	
+10					
0					
-10					
-20					
-30					
-40					
-50					
-60					
-70					
-80					

5. Set 8648C Level to –20dBm. Record the power level accuracy at other frequencies.

Table : Power Measurement Frequency response. Input Level = -20 dBm

Frequency (MHz)	Limits(dBm)		
	Lower	Measured	Upper
1	-21.5dBm		-18.5dBm
10			
50			
100			
130			
190			
210			
250			
300			
350			
450			
600			
650			
710			
730			
800			
850			
910			
950			

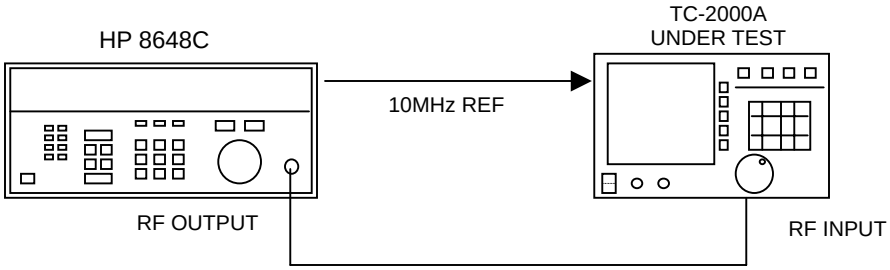
2.2. Frequency Offset (Frequency meter)

Input Range: -60dBm~+15dBm, 150KHz~960MHz

Accuracy: 50Hz

This test measures the static accuracy of the FM demodulator

1. Test Setup



2. Equipment:

HP8648C : F=900MHz, MOD=OFF

3. TC-2000A

: 1). Reset: press [FCN] [ESC], [PRESET]

2). Select SERVICE: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). FM DEMOD..: LPF=3KHz

4. Test: Record the frequency offset reading at different offset frequencies..

Table . FM Demodulation Accuracy Fin=900MHz, -60dBm

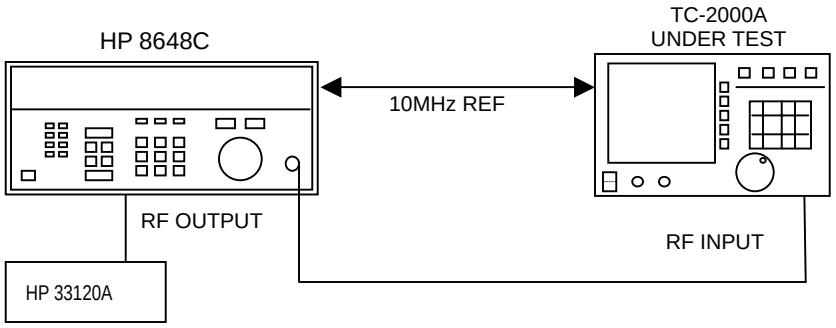
TC-2000A RF Input Frequency	SIGNAL GENERATOR Offset (KHz)	Limits(Hz) 50Hz	
		Measured	Error(Hz)
900MHz	-15		
	-10		
	-5.0		
	-1.0		
	0		
	+1.0		
	+5.0		
	+10		
	+15		

2.3. FM Demodulation

2.3.1. Linearity and Frequency response

Linearity: <100Hz @500Hz~ 10KHz, <200Hz @500Hz ~20KHz
Frequency Response: 63 Tap FIR Filter
F(3dB) >20KHz, No Filter
3dB +/-0.5dB @ F(3dB) for 3KHz and 15KHz LPF.
**This test measures the frequency response of the FM demodulator*

1. Test Setup



2. Equipment:

HP8648C : F=900MHz, LEV=-20dBm, FM-INT(400Hz)/ FM-EXT AC .
HP33120A : Sine Wave, 500Hz~20KHz, 1V

3. TC-2000A

: 1). Reset ; press [FCN], [ESC], [PRESET]
2). Select SERVICE: [FCN] [S5]
3).TX TEST mode; [FCN] , [1]
4). Display Mode : FM DEMOD

4. Linearity Test:

With HP8648 FM INT(400)=ON, change FM DEV 500Hz to 20KHz and read DEV on TC-2000A**.**

5. Frequency Response Test:

With HP8648 EXT FM=ON and DEV=5KHz, change the modulation frequency with function generator and read DEV on TC-2000A.

Table FM Demodulation Linearity (LPF=3KHz)

TC-2000A Input Freq.(MHz)	HP8648C FM-INT DEV(KHz)	TC 2000A FM DEV (KHz)		
900MHz	FMOD=400Hz	Min	Actual	Max
	0.5	0.4		0.6
	1.0	0.9		1.1
	2.0	1.9		2.1
	3.0	2.9		3.1
	4.0	3.9		4.1
	5.0	4.9		5.1
	10.0	9.9		10.1
	15.0	14.8		15.2

Table FM Demodulation Frequency response

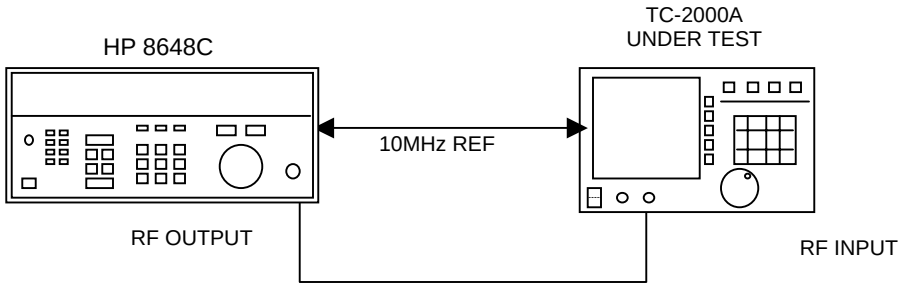
Fm(Hz)	LPF=OFF		LPF=15KHz		LPF=3KHz		LPF=1KHz	
	DEV	dB	DEV	dB	DEV	dB	DEV	dB
400								
1000								
1500								
2000								
2500								
3000								
3500								
4000								
5000								
6000								
7000								
8000								
9000								
10000								
12500								
15000								
17500								

2.3.2. Noise and Ripple

Specification: <50Hz @LPF=3KHz

** Measures the system noise floor of the receiver due to the effects of LO noise and I-Q demodulator imperfection.*

1. Test Setup



2. Equipment:

HP 8648C: CW, -20dBm

3. TC-2000A

: 1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE mode: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). Display Mode : FM DEMOD, LPF=3KHz

4. Record VAR(RMS Noise) reading from TC-2000A at different RF input frequencies. Reduce the input power to –65dBm and confirm if VAR does not increase visibly.

Table : Receiver FM Noise and Ripple (Pin=-20dBm)

TC-2000A RF Input (MHz)	SIG. GEN. Offset Freq(KHz)	FM Noise and Ripple(Hz)		
		LPF=3KHz	LPF=15KHz	Spec(3KHz)
900	-5.0			<50Hz
	-4.0			
	-3.0			
	-2.0			
	-1.0			
	-0.5			
	0			
	+0.5			
	+1.0			
	+2.0			
	+3.0			
	+4.0			
	+5.0			

2.4. AM Demodulation

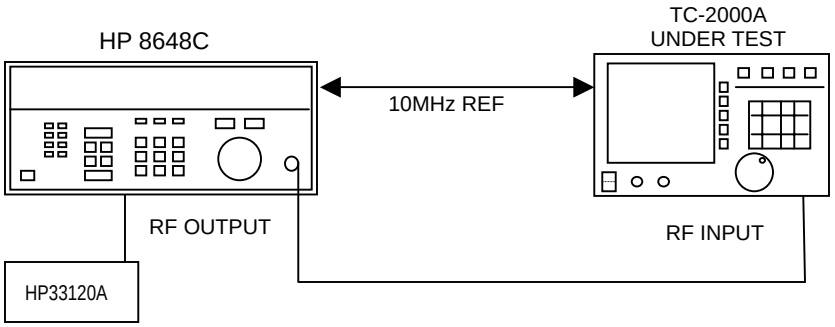
Input Range –60~+15dBm, 455KHz~960MHz

Linearity and Frequency Response

Linearity: 1%+4% of actual, for 5 to 95% AM depth @Fmod=400Hz

Frequency Response: the same as FM

1. Test Setup



2. Equipment:

HP 8648C: 1MHz, -20dBm,

Linearity: AM INT(400Hz)

Frequency Response: AM EXT, set to 30%, Function generator

3. TC-2000A

: 1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE mode: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). Display Mode: AM DEMOD, LPF=3KHz

4. Linearity: Record % AM reading from TC-2000A changing AM depth of HP8648A.

5. Frequency Response: Record % AM Depth with respect to the function generator frequency.

Table: AM Demodulation Linearity (Fmod=400Hz)

TC-2000A RF Input (MHz)	SIG. GEN. AM Depth(%) 400Hz	AM Depth Reading LPF=3KHz		
		Min	Reading	Max
1	95	90		100
	90	85		95
	80	76		84
	70	67		73
	60	57		63
	50	47		53
	40	38		42
	30	28		32
	20	18		22
	10	8		12
	5	4		6
	1%	0		2

Table AM Demodulation Frequency response (AM=30%)

Fm(Hz)	LPF=OFF		LPF=15KHz		LPF=3KHz		LPF=1KHz	
	Depth(%)	dB	Depth(%)	dB	Depth(%)	dB	Depth(%)	dB
400								
1000								
1500								
2000								
2500								
3000								
3500								
4000								
5000								
6000								
7000								
8000								
9000								
10000								
12500								
15000								
17500								

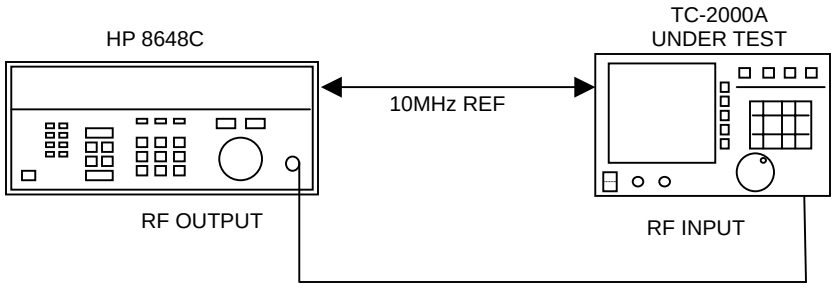
2.5. Spectrum Analyzer

Item	***Power Reading***	***Freq Offset Reading***	***Maximum Sensitivity***	***3dB Span Bandwidth***	***Gain Roll-Off***
Condition	*Freq: within 20KHz from the center. Level:-80dBm ~+20dBm*	*Freq: within 20KHz from the center. Level: -60dBm ~+20dBm*	*Lowest detectable signal level*	*3dB gain drop relative to center frequency*	*Gain drop at Fc+/-20KHz*
Spec. or Accuracy	*1.5dB*	*20Hz, LPF=3KHz*	*<-90dBm at the center <-110dBm elsewhere*	*Fc+/-32KHz typical*	*1dB typical*
Item	***LO Leakage***	***I-Q Image Rejection***	***Aliening Rejection***	***Resolution Bandwidth***	***Refresh Time***
Condition	*LO leakage at the center*	*Fc+/-20KHz*	*Fc+/-500KHz*	*fixed*	*1 display refresh*
Spec. or Accuracy	*<-100dBm typical. No signal <35dBc with signal*	*<40dBc typical*	*>40dB typical*	*Approx. 200Hz*	*Approx. 1 sec.*

2.5.1. Linearity

Linearity: 1.5dB –70dBm to +15dBm

1. Test Setup



2. Equipment:

HP 8648C: CW, 455KHz~960MHz, -80dBm~+10dBm

3. TC-2000A

: 1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE mode: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). Display Mode: SPECTRUM

4. Linearity: Record the level of HP-8648C at different level and frequencies. .

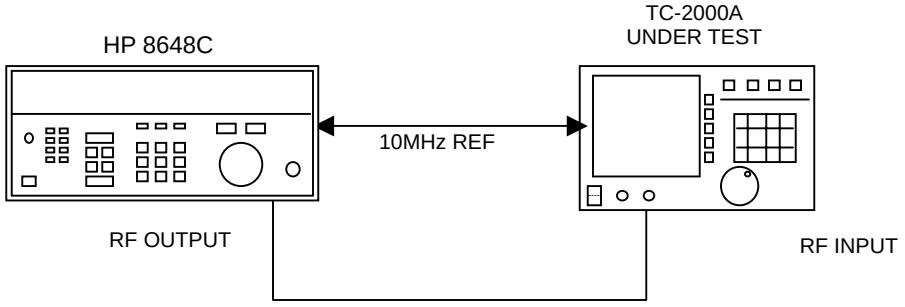
Table: Spectrum Linearity (@10KHz offset)

TC-2000A RF Input (MHz)	SIG. GEN. Level (dBm)	Spectrum Reading (Visual)		
		Min	Reading	Max
140	10	8.5		11.5
	0	-1.5		+1.5
	-10	-11.5		-8.5
	-20	-21.5		-18.5
	-30	-31.5		-28.5
	-40	-41.5		-38.5
	-50	-51.5		-48.5
	-60	-61.5		-58.5
	-70	-71.7		-68.5
	-80	-81.5		-78.5
	-90	-91.5		-88.5
	-100	-101.5		-98.5

2.5.2. Spurious (I-Q Demodulation)

**TC-2000A uses I-Q Demodulator for excellent stability necessary for digital demodulation. But this method also creates unique signal-dependent spurious.*

1. Test Setup



2. Equipment:

HP 8648C: CW, -20dBm

3. TC-2000A

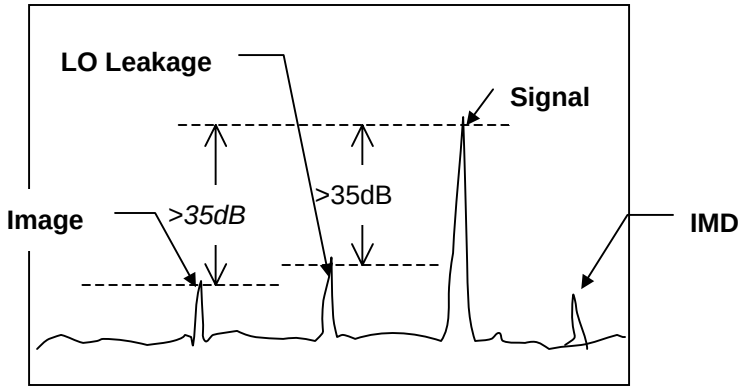
1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). Display Mode : Spectrum Analyzer,

4. Set TC-2000A and Signal Generator frequencies and record the spurious signal levels at each frequency.



Typical signal dependent Spurious in Spectrum mode

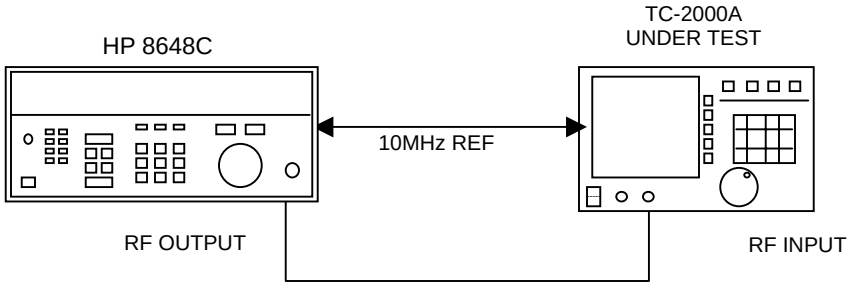
Table Spectrum Analyzer Spurious

TC-2000A	Sig. Gen.		TC-2000A			
TX Freq (MHz)	Input Freq. Offset(KHz)	Level	Spurious Location Offset(KHz)	Level	Limits	Remark
900	N/A	OFF	0		<-100dBm	LO Leak
	+10KHz	-20dBm	0		<-35dBc	LO Leak
	+10KHz	-20dBm	-10KHz		<-35dBc	Image
	+10KHz	-20dBm	+20KHz		<-35dBc	IMD
	-10KHz	-20dBm	0		<-35dBc	LO Leak
	-10KHz	-20dBm	+10KHz		<-35dBc	Image
	-10KHz	-20dBm	+20KHz		<-35dBc	IMD
140	N/A	OFF	0		<-100dBm	LO Leak
	+10KHz	-20dBm	0		<-35dBc	LO Leak
	+10KHz	-20dBm	-10KHz		<-35dBc	Image
	+10KHz	-20dBm	+20KHz		<-35dBc	IMD
	-10KHz	-20dBm	0		<-35dBc	LO Leak
	-10KHz	-20dBm	+10KHz		<-35dBc	Image
	-10KHz	-20dBm	+20KHz		<-35dBc	IMD

2.5.3. Maximum Sensitivity

Noise Level: <-110dBm except at the center of the display.

1. Test Setup



2. Equipment:

HP 8648C: CW, -110dBm

3. TC-2000A

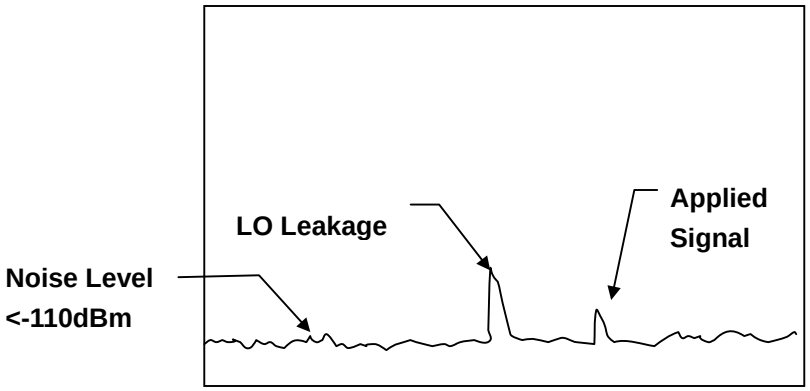
1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE: [FCN] [S5]

3).TX TEST mode ; [FCN], [1]

4). Display Mode : Spectrum Analyzer,

4. Set TC-2000A and HP8648C frequency at 900MHz. Offset HP8648C frequency by 10KHz. Reduce the level to until the signal disappears in the noise.



TC-2000A Spectrum Analyzer Noise Floor

Table Maximum Sensitivity of TC-2000A Spectrum Analysis mode

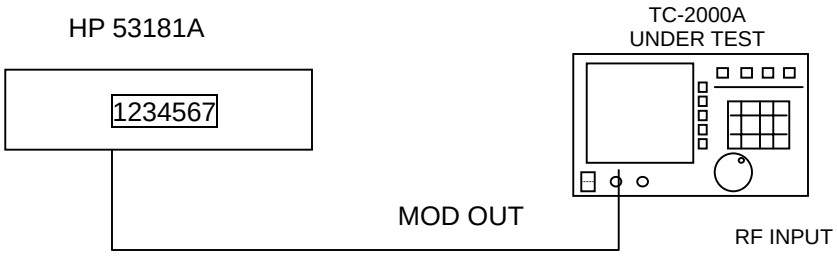
Fin/Offset	140MHz/10KHz	280MHz/10KHz	450MHz/10KHz	900MHz/10KHz
Minimum Detectable Level				
Spec	<-110dBm	<-110dBm	<-110dBm	<-110dBm

3. Miscellaneous Functions

3.1. Encoder Time Base Accuracy

Specification: 4 ppm

1. Test Setup



2. Equipment:

Frequency Counter HP53181A or equivalent

3. TC-2000A

: 1). Reset ; press [FCN], [ESC], [PRESET]

2). Select SERVICE mode: [FCN] [S5]

3).RX TEST mode ; [FCN], [2]

4). Display Mode: SIG GEN:FM(RECT), MOD=ON, BPS=3200/2

4. Frequency counter reading should be 1600Hz within 4ppm. Repeat for 6250/4 (ERMES).

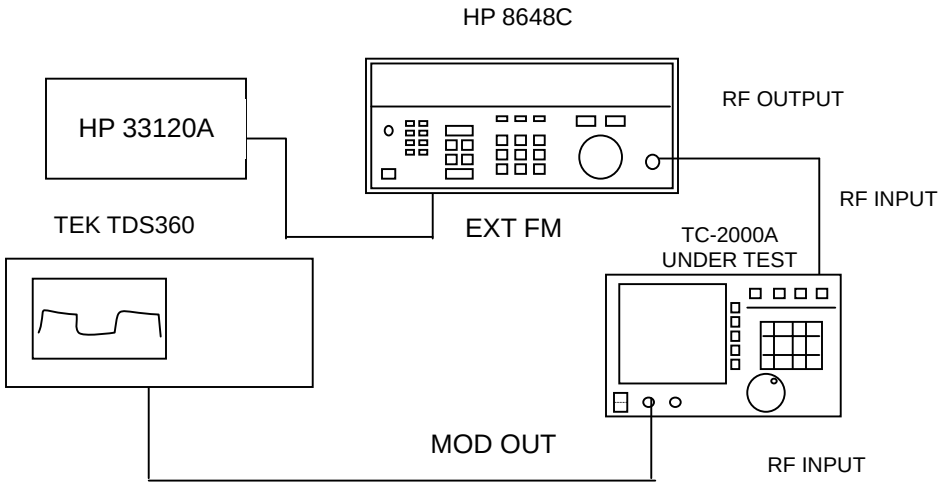
Table: Encoder Time base Accuracy

Rate	Lower	Actual	Upper	Remark
3200/2	1599.9936		1600.0064	4ppm

3.2. FSK Receiver

This is a receiver-only mode that provides continuously demodulated analog output from the received FSK signal (front panel MOD OUT port) as well the digital output in HEX form (into RS-232C interface).

1. Test setup



FSK Receiver Test Setup

2. Equipment:

TDS360 Oscilloscope
8648C Signal Generator
HP 33120A Function Generator

3. TC-2000A:

1). Reset ; press [FCN], [ESC], [PRESET]
2). Select FSK Receiver mode: in [FCN] [S5]
3).FSK SETUP mode ; [FCN], [2]
4). Set FSK parameters: SPS=1600, Level=2, DEV=4.8KHz, FREQ=140MHz
Output: +DEV=1, -DEV=0

4.. Use Function Generator and HP8648C signal generator FM to create 2-level FSK test signal with 4.8KHz deviation and 1600/2 BPS. Apply the signal to TC-2000A RF input. Observe the demodulated signal with Oscilloscope at the front panel MOD OUT port.

Vp(Actual) = Vp(set at MOD OUT Window) x(incoming FSK DEV)/(DEV value set at FSK Setup window)

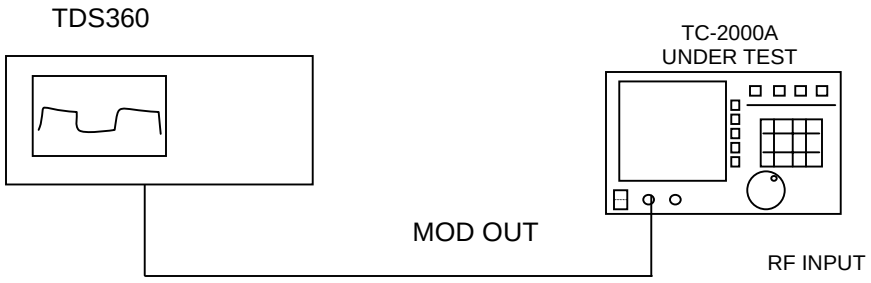
Table: Demodulated Output Voltage (Front Panel BNC) Accuracy.
Incoming FSK, DEV 4.8KHz,1600/2
MOD OUT SET: Vp=1V
FSK SETUP: DEV=4.8KHz, SPS=1600, 2 LEVEL

MOD OUT Setting	Lower	P-P Amplitude (V)	Upper	Remark
1.0V Peak; Unipolar	1.900		2.100	Into OPEN
1.0V Peak; Bipolar	3.800		4.200	Into OPEN

3.3. Encoder Output Voltage

Output Range: 0~2Vmax (Uni-polar), 0~2V Vpeak (Bipolar) into 600 ohm
Source Resistance: 600 ohm
Amplitude Voltage Accuracy: 5%
***Note**: EXT output waveform is already filtered by 3.9KHz 10th order Bessel filter. The rise and fall times can be verified using Oscilloscope. Refer to FM(RECT) modulation.

1. Test setup



2. Equipment: TDS360 Oscilloscope

3. TC-2000A:

1). Reset ; press [FCN], [ESC], [PRESET]
2). Select SERVICE mode: [FCN] [S5]
3).RX TEST mode ; [FCN], [2]
4). Display Mode: SIG GEN:FM(RECT), MOD=ON, BPS=512/2
5). Select **MOD OUT SETUP** from Menu.

4. Set TC-2000A MOD OUT Voltage to 1.0V Peak (600Ohm) or 2V Peak (Open Circuit). Measure the peak to peak amplitude of the waveform using AMPLITUDE function of TDS360.

***Note: Peak to Peak Voltage reading gives higher error than actual due to noise.**

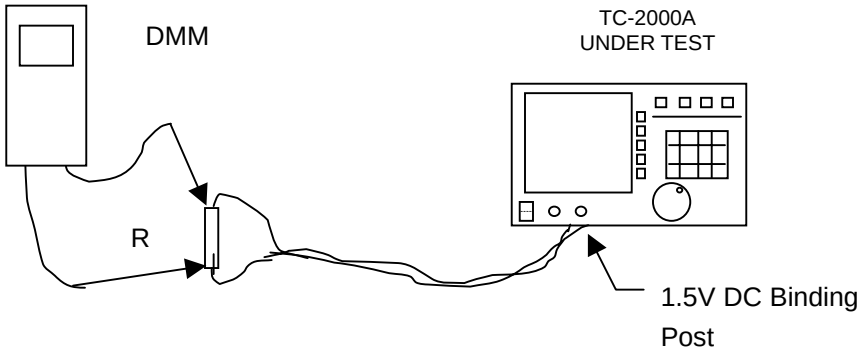
Table: Modulation Output Voltage (Front Panel BNC)

Output Setting	Lower	P-P Amplitude (V)	Upper	Remark
1.0V Peak; Unipolar	1.900		2.100	Into OPEN
1.0V Peak; Bipolar	3.800		4.200	Into OPEN

3.4. DC Power

Specification: 1.5V +/- 100mV @0~150mA
Short circuit current: 300mA

1. Test Setup



2. Equipment: DMM, Resistor (1/2Watt) 100, 10, 5 ohm

3. Measure DC voltage drops with different resistor values as below.

Table: TC-2000A 1.5V supply DC Voltage –Current Characteristics.

1.5V	Open	R=100	R=10	R=5
DC Voltage				
Current				
Remark				

3.5. RF Output Leakage

Specification: <-107dBm or < 1uV on instrument surface

1. Test Setup: Connect the 1" Test Loop to Spectrum Analyzer input with an RF cable.

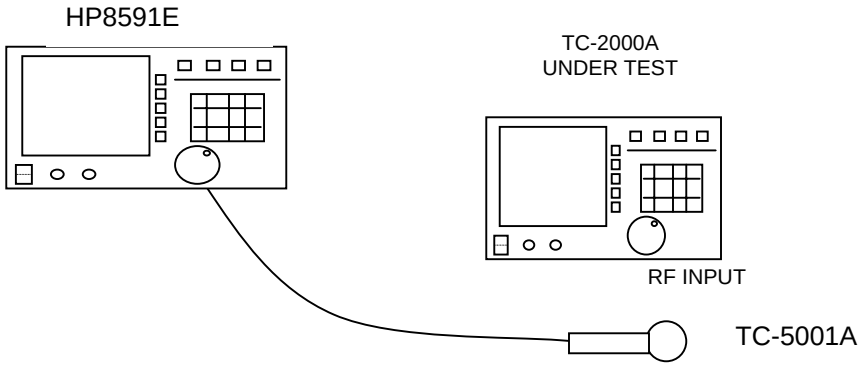


Fig: RF Leakage Test Setup

2. Equipment

HP-8591E: ATT=0dB, Minimum RBW and SPAN for maximum sensitivity
Tescom Test Loop (TC-5001A): 1" diameter, 150MHz ~ 1GHz

3. TC-2000A

1). Reset
2). Press [FCN] [S4], select SERVICE, [S1] for Signal Generator mode
3). FREQ= 130MHz, LEV= -100dBm
4). MOD= OFF, RF=ON

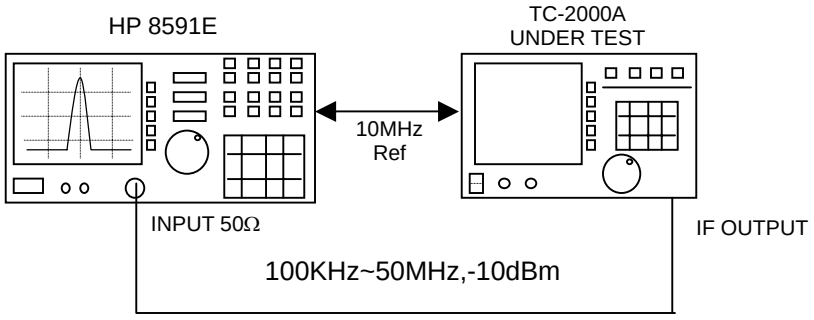
4. Confirm the spectrum analyzer is set correctly to read –110dBm signal by direct connection to TC-2000A output. Replace the TC-2000A with the probe and feel the surface of the instrument for leakage. Record the worst case leakage.

Fout	Worst Leakage	Limit	Remark
150MHz		-107dBm	
300MHz		-107dBm	
500MHz		-107dBm	
900MHz		-107dBm	

3.6. IF Output

Measures power level at the IF output port
Specification: -15dBm Typical

1. Test Setup



2. Equipment:

HP8591E

3. TC-2000A:

1). Reset ; press [FCN], [ESC], [PRESET]
2). Select SERVICE mode: [FCN] [S5]
3).RX TEST mode; [FCN], [2]
4). Display Mode: SIG GEN:: FREQ: 50MHz

4. Observe the signal level and harmonics on Spectrum Analyzer.

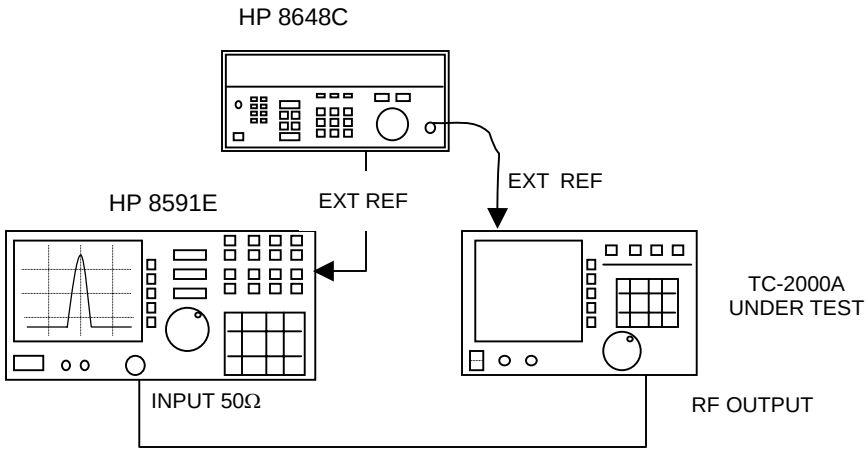
Table TC-2000A IF Output Level and Spurious

IF Freq.	Level	Limit	Harmonics	Limit
140KHz				<20dBc
455KHz				
1MHz				
10MHz				
15MHz				
20MHz				
30MHz				
40MHz				
50MHz				
Remark				

3.7. External Reference

Operating Input Level: Guaranteed Turn-Off <-18dBm
Guaranteed Turn-On >-12dBm

1. Test Setup



2. Equipment: HP8591E Spectrum Analyzer: 900MHz, SPAN 20KHz
HP8648C Signal Generator: 10.0001MHz, -15dBm

3. TC-2000A:

1). Reset ; press [FCN], [ESC], [PRESET]
2). Select SERVICE mode: [FCN] [S5]
3).RX TEST mode ; [FCN], [2]
4). Display Mode: SIG GEN:: FREQ: 900MHz, -20dBm

4. When TC-2000A locks to EXT Reference, the frequency would hop 9KHz.
By increasing and decreasing the signal generator output level,
TC-2000A frequency reference can be switched between Internal and external.

Fout= 900MHz ->INT Reference
Fout= 900MHz +9KHz ->EXT Reference

EXT REF Input(dBm)	TC-2000A Freq (Level Increase from Internal)	TC-2000A Freq (Level Decrease from External)	Remark
-20			
-18			
-16			
-14			
-12			
-10			

Checking List for Common Problems

This section provides a brief check lists of common failures. Before troubleshooting or repairing the TC-2000A, make sure the failure is in the instrument rather than any external connections. Also make sure that the instrument is accurately calibrated.

Unit is inoperative

1. **Verify that the AC power cord is connected to the TC-2000A**
   Make sure that the power cord is firmly plugged into the power module on the rear panel. You should also make sure that the power source you plugged the TC-2000A into is energized.
2. **Verify that the front-panel power switch is depressed.**
   Verify that the TC-2000A's power switch is in the "I" position.
3. **Verify line voltage.**
   The available line voltage is 100 ~ 240 VAC

Failure of testing

1. **Check primary parameters.**
   2-Way : ADR (Address), TX F (TX Frequency), RX F (RX Frequency),
   SPID (Service Provider Identification), POLA (FM Deviation Polarity)
   BPS, VECTOR (Vector Type), TX POW (Estimated TX Power)

   1-Way : ADR (Address), FRQ (Frequency), POLA (FM Deviation Polarity)
   BPS, VECTOR (Vector Type)

2. **Check Level.**
   If the RF level is lower than the receiver sensitivity allows, the pager may not respond.

3. **Check the resynchronization of the pager.**
   The receiver testing in TC-2000A is asynchronous testing. the pager under test must be unsynchronized before re-acquiring synchronization during the test Turn off and on the pager before each test.

Programming Guide

PC may control TC-2000A remotely through RS-232C interface using a comprehensive set of commands. This section provides the necessary information to operate TC-2000A under RS-232C control..

VI

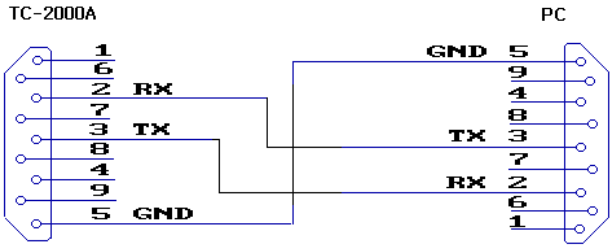
Introduction

TC-2000A supports high speed RS-232C serial Interface for remote operation under PC control. Standard 9-pin RS-232C connector is located at the rear panel. Any communication program (e.g., WINDOW 95/98 Hyper Terminal) may be used for simple tasks such as programming an alphanumeric message in a different local language. Complex tasks may be automated using PC program. Custom visual interface on PC screen (using Visual Basic program) could be designed to greatly enhance the user interface with TC-2000A.

RS-232C Interface

Connection

TC-2000A uses 9-pin RS-232C cable. To make connection to 25-pin RS-232C connector, use 9-pin to 25-pin adapter. The cable pin configuration is shown below.



Using Windows 95/98 Hyper Terminal

With the cable connected between TC-2000A and PC serial port,

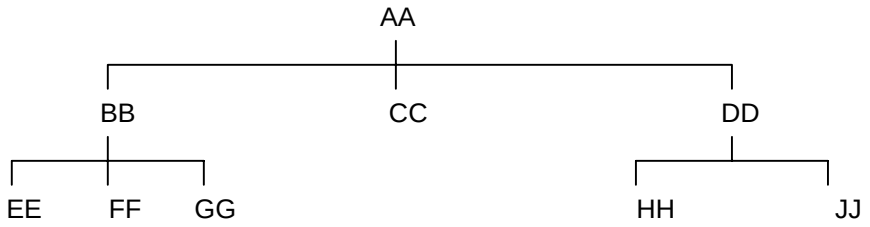
- Open Hyper Terminal: Start->Program->Accessories->HyperTerminal
- Modem Selection-> Select Direct Connection to Port (e.g., COM1).
- Enter the following parameters in Property Window.

Data Rate	38400 BPS
Data Bit	8 bit
Parity Bit	None
Stop Bit	1 bit
Flow Control	None

- In ASCII setup-> ASCII SEND, check "Display before send"
- Type in a TC-2000A RS-232C Command followed by Enter key.
- TC-2000A returns "OK" when the command has been executed successfully.

RS-232C Commands

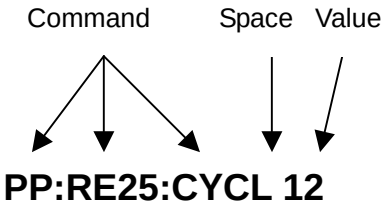
Command Structure



AA:BB

AA:BB:GG

- You must follow a particular path to reach lower level subcommands. For example, if you wish to access the GG command, you must follow the path AA to BB to GG (AA:BB:GG).
- Commands consist of *set commands* and *query commands* (usually simply called commands and queries). Set commands change instrument settings or perform a specific action. Queries cause TC-2000A to return data and information about its status. Most commands have both set form and query form. The query form of the command is the same as the set form except that it ends with a question mark. For example, the set command **PP:RE25:ADR** has a query form **PP:RE25:ADR?**. Not all commands have both set and query form; some commands are for set only and some are for query only.
- When a *colon* is placed between two commands mnemonics, it moves the current path down one level in the command tree.
- *Space* is used to separate parameters from commands. AA:BB:FF 20
- Query is used to return parameter value from TC-2000A to PC.



- Every command must be followed by CR (Carriage Return Chr(13)).

Command Parameter Types

- Integer Parameter

  PP:FLEX:CYCL <Value> <CR>
- Discrete Parameter

  PP:FLEX:BPS {1600/2|3200/2|3200/4|6400/4}<CR>
- Boolean Parameter

  SERV:SG:RF {ON|OFF}<CR>
- String Parameter

  PP:FLEX:MSG1:NUME <String><CR>

**String parameters must be surrounded by apostrophe (') as 'String'.*

Responses to Query

All return responses (data or messages) have data plus ending consisting of CR(Carriage Return, Chr(13)) and LF (Line Feed, Chr(10)).

- Integer: Return an integer value, e.g. 0, 100, 256, -230.
- Discrete: Return a selection.
- String: Return a string. e.g. '12345678, 'Hi! TESCOM'.
- "OK": Command accepted
- "ERR10": Syntax error
- "ERR20": Out of range error

Sample Responses

Command & Query	Response
PP:RE50:CYCL 112	OK
PP:RE50:CYCL?	112
PP:RE50:BPS 6400/4	OK
PP:RE50:BPS?	6400/4

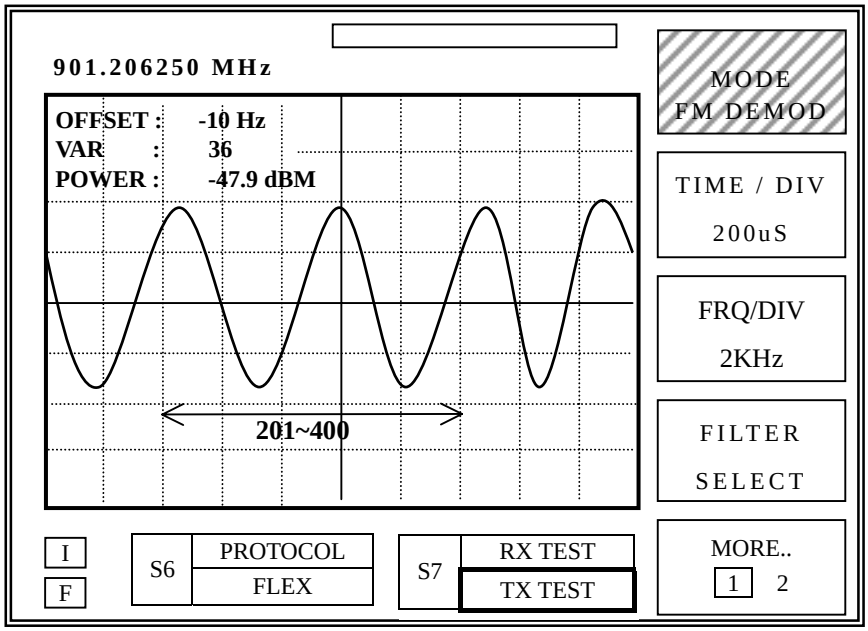
- "ACK": *TC-2000A sends a response, "ACK", after successful reception of 2-way pager transmission indicating the test data is ready for query*.

Retrieving Graphical Data

TX TEST Mode

Each waveform data in TX TEST consists of 2000 points except for spectrum (spectrum waveform consists of 512 points). All or part of 2000 points can be downloaded.

Example 1: Read FM demodulation waveform from the 201st point to the 400th point.



Query : **TXST:GRAP:FMDE:201:400?** <CR>

Response : **1708, 1754, 1808, 1912, 1931,2004, …, 1096, 1108**<CR><LF>

(Response consists of 200 points value and <CR>,<LF>)

Example 2: Reading full 2000 points in the previous example,

Query : **TXST:GRAP:FMDE:1:2000?**<CR>

Response : **-1708,-1754,-1808,-1912,-1931,-2004,-2004, …,-2096,-2108**<CR><LF>

(Response consists of 2000 points value and <CR>,<LF>)

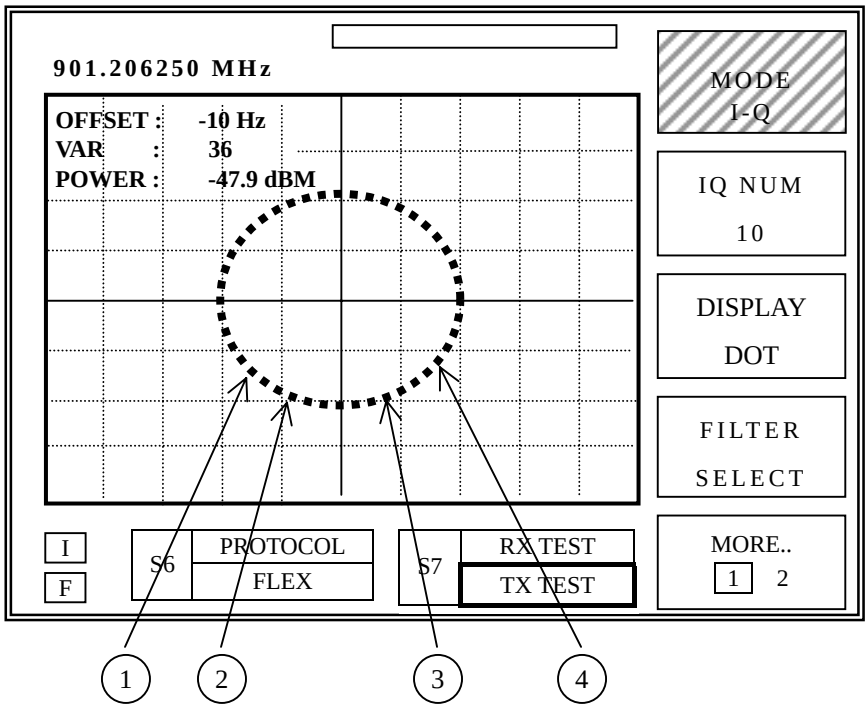
Example 3: Reading AM demodulation waveform from 1st point to 100th point.

Query : **TXST:GRAP:AMDE:1:100?**<CR>

Response : **25.0,24.8,24.4,23.8,23.2,22.6,…… ,25.2,24.7**<CR><LF>

(Response consists of 100 points value and <CR>,<LF>)

Example 4: Reading 10 data points from an IQ diagram



Each data point on IQ graph is made up of 2 data values (X, Y).

The response to an IQ waveform query takes a form,

Response: X1,Y1,X2,Y2,X3,Y3,……..<CR><LF>

In the example

Query : **TXST:GRAP:IQ:1:20?**<CR>

Response : **-61.4,-50.0, -36.5,-54.6,10.2,-58.2,23.9,-50.8,17.4,-62.8,11.5,-64.3**
,6.0,-65.0,0.9,-65.2,-3.4,-65.1,-7.2,-64.4<CR><LF>

① X1 = -61.4, Y1 = -50.0

② X2 = -36.5, Y2 = -54.6

③ X3 = 10.2, Y3 = -58.2

④ X4 = 23.9, Y4 = -50.8

.

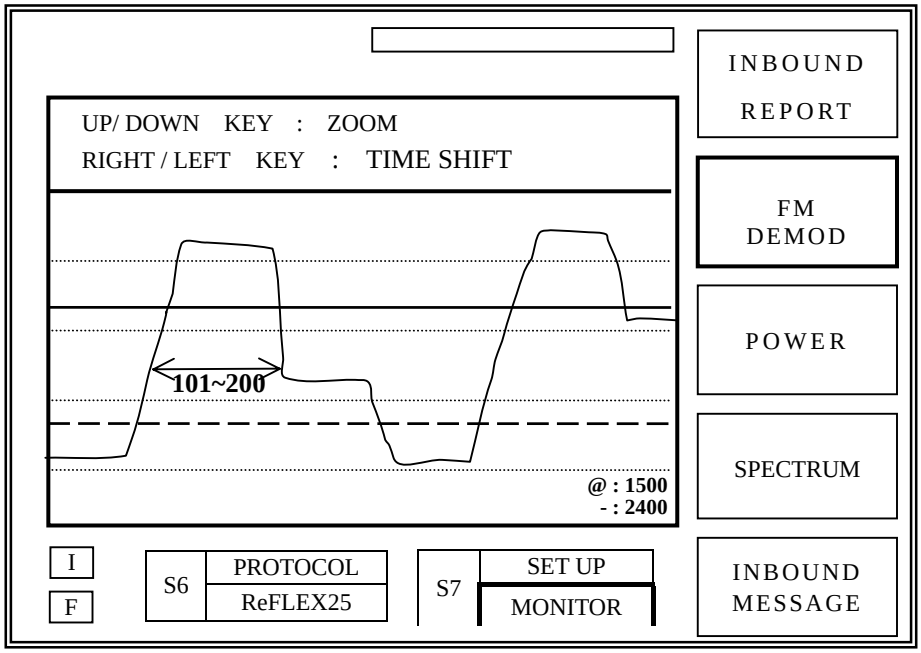
.

⑩ X10 = -7.2, Y10 = -64.4

MONITOR Mode (2-way Pager Reverse Channel Test Mode)

In 2-way Pager test mode, TC-2000A analyzes the reverse channel *Acknowledgement signal*. Each waveform in MONITOR mode consists of 1000 points except for spectrum display (spectrum waveform consists of 512 points). All or part of 1000 points may be downloaded.

Example 1: Reading FM demodulation waveform from 101st point to 200th point.



Query : **MONI:GRAP:FMDE:101:200?** <CR>

Response : **-2827,-2895,-1495,152,208,269,……..,-1736,-1854**<CR><LF>

(Response consists of 100 points value and <CR>,<LF>)

Example 2: Reading POWER waveform from 201st to 255th point.

Query : **MONI:GRAP:POW:201:255?**<CR>

Response : **-12.1,-13.3,-12.1,-12.6,…….,-11.1,-12.1**<CR><LF>

(Response consists of 55 points value and <CR>,<LF>)

Example 3: Reading SPECTRUM waveform from 201st to 300th point.

MONI:GRAP:SPEC:201:300?<CR>

Response : **-90.0,-92.2,-93.8,-94.4,-92.5,……..,-87.5,-88.3**<CR><LF>

(Response consists of 100 points value and <CR>,<LF>)

System Commands (No query form)

SYST:STAT REMOTE

TC-2000A can operate only remotely through RS-232C.

SYST:STAT LOCAL

TC-2000A can operate from the front panel or through RS-232C.

SYST:HEAD {ON|OFF}

Query	Head off Response	Head on Response
PP:RE50:ADR?	1234	PP:RE50:ADR 1234
PP:RE50:POLA?	NOR	PP:RE50:POLA NOR

SYST:STOR {1|2|3|4|5|6|7|8|9}

Save the current system setting in one of nine memory locations

SYST:STOR MESSAGE

Save all the current messages to the message memory.

SYST:RCL {1|2|3|4|5|6|7|8|9}

Recall the instrumentation setup data from one of nine memory locations.

SYST:RESE {PRESET|MESSAGE}

Initialize all instrument parameters or all messages to default values.

SYST:VER? (Query Only)

Read the program version.

SYST:DATE?(Query Only)

Read the system date

Frequently used RS-232C Commands

The followings are the list of most likely used commands for typical applications.

Common Commands

PP:SEND (No query form)

Start or stop the code transmission.

Syntax

PP:SEND {START|STOP}

Example

PP:SEND START

Starts the code transmission.

PP:TYPE

Sets or queries the current protocol.

Syntax

PP:TYPE {POCS|FLEX|ERME|INFL|RE25|RE50}

PP:TYPE?

Example

PP:TYPE RE25

sets the protocol type to ReFLEX25

FLEX

PP:FLEX:ADR

Sets or queries the address.

Syntax

PP:FLEX:ADR <value>

PP:FLEX:ADR?

Example

PP:FLEX:ADR 123456

sets the address to 123456

PP:FLEX:FRQ

Sets or queries the RF output frequency.

Syntax

PP:FLEX:FRQ <value>

PP:FLEX:FRQ?

Example

PP:FLEX:FRQ 901.20625

sets the RF output frequency to 901.20625MHz

PP:FLEX:LEV

Sets or queries RF output power level.

Syntax

PP:FLEX:LEV <value>

PP:FLEX:LEV?

Example

PP:FLEX:LEV –20.2

sets RF output power level to –20.2dBm

PP:FLEX:RPTN

Sets or queries the repeat number of messages to transmit.

Syntax

PP:FLEX:RPTN <value>

PP:FLEX:RPTN?

Example

PP:FLEX:RPTN 10

Sets the message repeat number to 10.

PP:FLEX:VECT:TYPE

Sets or queries the vector type.

Syntax

PP:FLEX:VECT:TYPE {NSTD|NSPE|NNUM|SMSG|HEX|ALPH|SECU|SINS}

PP:FLEX:VECT:TYPE?

Example

PP:FLEX:VECT:TYPE NNUM

sets the vector type to numeric numbered.

PP:FLEX:MSG1:NUME

Sets or queries the numeric message in message buffer number 1.

Syntax

PP:FLEX:MSG1:NUME 'String'

PP:FLEX:MSG1:NUME?

Example

PP:FLEX:MSG1:NUME '823449051316'

sets the message to transmit 823449051316.

POCSAG

PP:POCS:ADR

Sets or queries the address.

Syntax

PP:POCS:ADR <value>

PP:POCS:ADR?

Example

PP:POCS:ADR 654321

sets the address to 654321.

PP:POCS:FRQ

Sets or queries the RF output frequency.

Syntax

PP:POCS:FRQ <value>

PP:POCS:FRQ?

Example

PP:POCS:FRQ 902.0145

sets RF frequency to 902.0145MHz.

PP:POCS:LEV

Sets or queries the RF output power level.

Syntax

PP:POCS:LEV <value>

PP:POCS:LEV?

Example

PP:POCS:LEV –21.5

sets RF output power level to –21.5dBm.

PP:POCS:MSG

Sets or queries the message type.

Syntax

PP:POCS:MSG {TONE|NUME|ALPH}

PP:POCS:MSG?

Example

PP:POCS:MSG ALPH

sets the message type to alphanumeric.

PP:POCS:MSG1:NUME

Sets or queries the numeric message in memory 1.

Syntax

PP:POCS:MSG1:NUME 'String'

PP:POCS:MSG1:NUME?

Example

PP:POCS:MSG1:NUME '823449051316'

sets the message to transmit 823449051316.

ReFLEX25

PP:RE25:RXF

Sets or queries the RX(RF Output) frequency.

Syntax

PP:RE25:RXF <value>

PP:RE25:RXF?

Example

PP:RE25:RXF 270.5

sets the RX(RF Output) frequency to 270.5MHz.

PP:RE25:TXF

Sets or queries the TX(RF Input) frequency.

Syntax

PP:RE25:TXF <value>

PP:RE25:TXF?

Example

PP:RE25:TXF 950.6

sets the RF input frequency to 950.6MHz.

PP:RE25:LEV

Sets or queries the RF output power level.

Syntax

PP:RE25:LEV <value>

PP:RE25:LEV?

Example

PP:RE25:LEV –50.2

sets the RF output power level to –50.2dBm.

PP:RE25:ATT

Sets or queries the RF input attenuation value.

Syntax

PP:RE25:ATT <value>

PP:RE25:ATT?

Example

PP:RE25:ATT 35.9

sets the RF input attenuation value to 35.9dB.

PP:RE25:SPID

Sets or queries the service provider ID.

Syntax

PP:RE25:SPID <value>

PP:RE25:SPID?

Example

PP:RE25:SPID 16383

sets the service provider ID to 16383.

PP:RE25:VECT:TYPE

Sets or queries the vector type.

Syntax

PP:RE25:VECT:TYPE {SHOR|NUME|ALPH|BIN|SECU|WRU|COMM}

PP:RE25:VECT:TYPE?

Example

PP:RE25:VECT:TYPE BIN

sets the vector type to binary.

PP:RE25:MSG4:NUME

Sets or queries the numeric message in memory 4.

Syntax

PP:RE25:MSG4:NUME 'String'

PP:RE25:MSG4:NUME?

Example

PP:RE25:MSG4:NUME '823449051316'

sets the message to 823449051316.

PP:RE25:SCEN:SCEN

Sets or queries the test scenario type.

Syntax

PP:RE25:SCEN:SCEN <value>

PP:RE25:SCEN:SCEN?

Example

PP:RE25:SCEN:SCEN 3

sets scenario type to 3.

PP:RE25:SCEN:RPTN

Sets or queries the message repeat number.

Syntax

PP:RE25:SCEN:RPTN <value>

PP:RE25:SCEN:RPTN?

Example

PP:RE25:SCEN:RPTN 10

sets message the repeat number to 10.

PP:RE25:SCEN:MSG

Sets or queries the transmit message type.

Syntax

PP:RE25:SCEN:MSG {SHOR|NUME|ALPH|BIN|SECU|WRU|COMM}

PP:RE25:SCEN:MSG?

Example

PP:RE25:SCEN:MSG WRU

sets transmit message type to Where aRe yoU.

ReFLEX50

PP:RE50:ADR

Sets or queries the address.

Syntax

PP:RE50:ADR <value>

PP:RE50:ADR?

Example

PP:RE50:ADR 1073741823

sets the address to 1073741823.

PP:RE50:RXF

Sets or queries the RX(forward) frequency.

Syntax

PP:RE50:RXF <value>

PP:RE50:RXF?

Example

PP:RE50:RXF 270.5

sets Rx(forward) frequency to 270.5MHz.

PP:RE50:TXF

Sets or queries the TX(reverse) frequency.

Syntax

PP:RE50:TXF <value>

PP:RE50:TXF?

Example

PP:RE50:TXF 270.5

sets Tx(reverse) frequency to 270.5MHz.

PP:RE50:LEV

Sets or queries the RF output power level.

Syntax

PP:RE50:LEV <value>

PP:RE50:LEV?

Example

PP:RE50:LEV –50.2

sets RF output power level to –50.2dBm.

PP:RE50:ATT

Sets or queries the RF input attenuation value.

Syntax

PP:RE50:ATT <value>

PP:RE50:ATT?

Example

PP:RE50:ATT 35.9

sets the RF input attenuation value to 35.9dB.

PP:RE50:VECT:TYPE

Sets or queries the vector type.

Syntax

PP:RE50:VECT:TYPE {SHOR|NUME| HEX|ALPH}

PP:RE50:VECT:TYPE?

Example

PP:RE50:VECT:TYPE SHOR

sets vector type to short message.

PP:RE50:SCEN:SCEN

Sets or queries the scenario type.

Syntax

PP:RE50:SCEN:SCEN <value>

PP:RE50:SCEN:SCEN?

Example

PP:RE50:SCEN:SCEN 3

sets the scenario type to 3.

PP:RE50:SCEN:RPTN

Sets or queries the message repeat number.

Syntax

PP:RE50:SCEN:RPTN <value>

PP:RE50:SCEN:RPTN?

Example

PP:RE25:SCEN:RPTN 10

sets the message repeat number to 10.

PP:RE50:SCEN:MSG

Sets or queries the transmit message type.

Syntax

PP:RE50:SCEN:MSG {SHOR|NUME|ALPH|HEX}

PP:RE50:SCEN:MSG?

Example

PP:RE25:SCEN:MSG HEX

sets transmit message type to HEX/BINary.

PP:RE50:MSG3:NUME

Sets or queries the numeric message in memory 3.

Syntax

PP:RE50:MSG3:NUME 'String'

PP:RE50:MSG3:NUME?

Example

PP:RE50:MSG4:NUME '823449051316'

sets the message to transmit 823449051316.

SERVICE

SERV:SG:FRQ

Sets or queries the signal generator output frequency.

Syntax

SERV:SG:FRQ <value>

SERV:SG:FRQ?

Example

SERV:SG:FRQ 857.324

sets forward frequency to 857.324MHz.

SERV:SG:LEV

Sets or queries the RF output power level.

Syntax

SERV:SG:LEV <value>

SERV:SG:LEV?

Example

SERV:SG:LEV –50.2

sets RF output power level to –50.2dBm.

SERV:SG:RF

Sets or queries the RF ON/ OFF condition at the RF OUTPUT.

Syntax

SERV:SG:RF {ON|OFF}

SERV:SG:RF?

Example

SERV:SG:RF ON

sets the RF signal to ON.

SERV:SG:MOD

Sets or queries the modulation signal ON/ OFF condition.

Syntax

SERV:SG:MOD {ON|OFF}

SERV:SG:MOD?

Example

SERV:SG:MOD OFF

sets the modulation signal to OFF.

SERV:SG:TYPE

Sets or queries the modulation type.

Syntax

SERV:SG:TYPE {AM|FMSI|FMRE}

SERV:SG:TYPE?

Example

SERV:SG:TYPE AM

sets the modulation type to AM.

SERV:SG:AM:FRQ

Sets or queries the internal AM frequency.

Syntax

SERV:SG:AM:FRQ <value>

SERV:SG:AM:FRQ?

Example

SERV:SG:AM:FRQ 400

sets the internal AM frequency to 400Hz.

SERV:SG:AM:DEPT

Sets or queries the amplitude modulation depth in percent.

Syntax

SERV:SG:AM:DEPT <value>

SERV:SG:AM:DEPT?

Example

SERV:SG:AM:DEPT 50

sets the amplitude modulation depth to 50 percent.

SERV:SG:FMSI:FRQ

Set or queries the FM modulation frequency when internal sine waveform is used..

Syntax

SERV:SG:FMSI:FRQ <value>

SERV:SG:FMSI:FRQ?

Example

SERV:SG:FMSI:FRQ 1000

sets the internal FM frequency to 1000Hz.

SERV:SG:FMSI:DEV

Sets or queries the FM deviation when internal waveform is sine.

Syntax

SERV:SG:FMSI:DEV <value>

SERV:SG:FMSI:DEV?

Example

SERV:SG:FMSI:DEV 4.8

sets the FM deviation to 4.8KHz.

SERV:SG:FMRE:BPS

Sets or queries the BPS of the internal rectangular modulation(FSK).

Syntax

SERV:SG:FMRE:BPS {512/2|1200/2|1600/2|2400/2|3200/2|3200/4|6250/4|6400/4}

SERV:SG:FMRE:BPS?

Example

SERV:SG:FMRE:BPS 1600/2

sets the internal FM BPS to 1600/2.

SERV:SG:FMRE:DEV

Sets or queries the frequency deviation of the rectangular (FSK) waveform.

Syntax

SERV:SG:FMRE:DEV <value>

SERV:SG:FMRE:DEV?

Example

SERV:SG:FMRE:DEV 3.5

sets the FM deviation to 3.5KHz.

Reverse Channel Monitor Commands(Query Only)

MONI:FMDE:AVER:P24?

Queries the average deviation of one of 4-level FSK levels corresponding to +2400Hz

MONI:FMDE:AVER:N24?

Queries the average deviation of one of 4-level FSK levels corresponding to -2400Hz

MONI:FMDE:AVER:P08?

Queries the average deviation of one of 4-level FSK levels corresponding to +800Hz

MONI:FMDE:AVER:N08?

Queries the average deviation of one of 4-level FSK levels corresponding to -800Hz

MONI:FMDE:NUMB:P24?

Queries the number of symbols that falls onto a specific deviation +2400Hz out of the decoded 4 level FSK inbound signal.

MONI:FMDE:NUMB:N24?

Queries the number of symbols that falls onto a specific deviation -2400Hz out of the decoded 4 level FSK inbound signal

MONI:FMDE:NUMB:P08?

Queries the number of symbols that falls onto a specific deviation +800Hz out of the decoded 4 level FSK inbound signal

MONI:FMDE:NUMB:N08?

Queries the number of symbols that falls onto a specific deviation -800Hz out of the decoded 4 level FSK inbound signal

MONI:FMDE:MAX:P24?

Queries the maximum deviation value of the signals that falls onto a specific level +2400Hz out of the 4-level FSK inbound signal

MONI:FMDE:MAX:N24?

Queries the maximum deviation value of the signals that falls onto a specific level -2400Hz out of the 4-level FSK inbound signal

MONI:FMDE:MAX:P08?

Queries the maximum deviation value of the signals that falls onto a specific level +800Hz out of the 4-level FSK inbound signal

MONI:FMDE:MAX:N08?

Queries the maximum deviation value of the signals that falls onto a specific level -800Hz out of the 4-level FSK inbound signal

MONI:FMDE:MIN:P24?

Queries the minimum deviation value of the signals that falls onto a specific level +2400Hz out of the 4-level FSK inbound signal

MONI:FMDE:MIN:N24?

Queries the minimum deviation value of the signals that falls onto a specific level -2400Hz out of the 4-level FSK inbound signal

MONI:FMDE:MIN:P08?

Queries the minimum deviation value of the signals that falls onto a specific level +800Hz out of the 4-level FSK inbound signal

MONI:FMDE:MIN:N08?

Queries the minimum deviation value of the signals that falls onto a specific level -800Hz out of the 4-level FSK inbound signal

MONI:INFO?

Queries the Information bits of reverse channel packet

MONI:ADR?

Queries the address of the pager

MONI:MSN?

Queries the Message Sequence Number of reverse channel packet

MONI:SLOT?

Queries the slot number of reverse channel packet

MONI:TEST?

Queries the test results

MONI:LOBE?

Queries the side lobe of reverse channel signal

MONI:POW?

Queries the power of reverse channel signal

MONI:OFFS?

Queries the slot time offset of reverse channel packet

MONI:CFRQ?

Queries the center frequency offset of reverse channel

MONI:INBO:MSG?

Queries the message of reverse channel

MONI:GRAP:FMDE:start:end?

See page 6-7

MONI:GRAP:POW:start:end?

See page 6-7

MONI:GRAP:SPEC:start:end?

See page 6- 7

Programming in Windows 95/98

Procedure Overview

- Port select (COM1-COM4)
- Set-up Baud Rate(38400 bps), Parity Bit(None), Data Bit(8 bit), Stop Bit(1 bit)
- Open COM Port (COM1-COM4).
- Send RS-232C Command string to the COM Port..
- Wait until the confirmation string "OK" is received. (*note)
- When confirmed, send the next command

*Note: another simple option is to program sufficient wait time between commands

Programming Hints

- TC-2000A returns "OK" after certain delay time that varies with specific command..
- In case of error, TC-2000A returns "ERR10" or ”ERR20”
- Use upper case only for commands.
- Commands use colon (not semi-colon) as separator.
- Commands does not allow spaces except for parameter values
- Every command must be followed by CR (Carriage Return, Chr(13)).

Programming Examples (Visual Basic 5.0/6.0)

```
Private Sub Form Load()
    MSComm1.CommPort = 1                ' select COM1
    MSComm1.Settings = "38400, N, 8, 1"   ' Baud Rate, Parity Bit, Data Bit, Stop Bit
    MSComm1.Rthreshold=1
    MSComm1.PortOpen = True             ' Open Com Port.
End Sub
Private Sub Form_QueryUnload(Cancel As Integer, UnloadMode As Integer)
    MSComm1.PortOpen = False            ' Close Com Port.
    End                                 ' Quit the program
End Sub
Private Sub RFON_Click()                    ‘ Turn on RF.
    MSComm1.Output = "SERV:SG:RF ON" + Chr(13)   ` send command .
End Sub
Private Sub Response_Click()   ‘Check if "OK" is received in RS-232C input buffer
    Text1.Text = MSComm1.Input   ‘ read the input string and check later if it is “OK”
End Sub
```

Commands Table

TX_TEST : IQ,FM Demodulation, AM Demodulation, Spectrum

RS-232C Command	Range	Description
TXST:TYPE {IQ|FMDE|AMDE|SPEC|HIST}		Tx_Test Selection IQ : IQ diagram FMDE : FM demodulation AMDE : AM demodulation SPEC : Spectrum HIST : Histogram
:FRQ <value>	0.455-960	Reverse Frequency(MHz)
TXST:IQ:NUMB <value>	10-1000	IQ Point Number
:DISP {LINE|DOT}		Type of Display
:LPF {1KHz|3KHz|15KHz|OFF}		Low Pass Filter Selection
:TRIG {AUTO|NORMAL| SINGLE}		Trigger Selection
:POW <value>	(-80) - 10	Power Trigger
:AVER <value>	1-16	Average
TXST:FMDE:TDIV {1000uS|500uS|200uS|100uS}		Time /Division
:FDIV {5KHz|2KHz|1KHz|500Hz|200Hz|100Hz}		Frequency /Division
:LPF {1KHz|3KHz|15KHz|OFF}		Low Pass Filter Selection
:TRIG {NORMAL|AUTO|SINGLE}		Trigger Selection
:POW <value>	(-80) - 10	Power Trigger
:AVER <value>	1-16	Average
TXST:AMDE:TDIV {1000uS|500uS|200uS|100uS}		Time Division
:LPF {1KHz|3KHz|15KHz|OFF}		Low Pass Filter Selection
:POW <value>	(-80) - 10	Power Trigger
:TRIG {NORMAL|AUTO|SINGLE}		Trigger Selection
TXST:SPEC:SPAN <value>	1-95	Span (KHz)
:REF <value>	(-90)-50	Reference (dBm)
:AVER <value>	1-16	Average
:POW <value>	(-80) - 10	Power Trigger
:TRIG {NORMAL|AUTO|SINGLE}		Trigger
TXST:HIST:SPAN <value>	1-40	Span (KHz)
:LPF {1KHz|3KHz|15KHz|OFF}		Low Pass Filter Selection
:TRIG {NORMAL|AUTO|SINGLE}		Trigger Selection
:POW <value>	(-80) - 10	Power Trigger
:AVER <value>	1-16	Average
:DEV?	Query Only	FM Deviation
TXST:OFFS?	Query Only	Offset
:VAR?	Query Only	Variance
:POW?	Query Only	Power
:DEPT?	Query Only	AM Depth
:DEV?	Query Only	FM Deviation
:GRAP:IQ: Start point : End point?	1(min):2000(max)	IQ Display
:GRAP:FMDE: Start point : End point?	1(min):2000(max)	FM Demod. Waveform
:GRAP:AMDE: Start point : End point?	1(min):2000(max)	AM Demod. Waveform
:GRAP:SPEC: Start point : End point?	1(min):512(max)	Spectrum Display
:GRAP:HIST: Start point : End point?	1(min):2000(max)	FM Histogram Display

2-Way Reverse Channel Monitor Command (Query Only)

RS-232C Command	Range	Description
MONI:FMDE:AVER:P24?		Average Value of +2400
:AVER:N24?		Average Value of –2400
:AVER:P08?		Average Value of +800
:AVER:N08?		Average Value of –800
:NUMB:P24?		Number of +2400
:NUMB:N24?		Number of –2400
:NUMB:P08?		Number of +800
:NUMB:N08?		Number of –800
:MAX:P24?		Maximum of +2400
:MAX:N24?		Maximum of –2400
:MAX:P08?		Maximum of +800
:MAX:N08?		Maximum of –800
:MIN:P24?		Minimum of +2400
:MIN:N24?		Minimum of –2400
:MIN:P08?		Minimum of +800
:MIN:N08?		Minimum of –800
MONI:INFO?		Information Number
:ADR?		2-Way Pager Address
:MSN?		Message Sequence Number
:SLOT?		Slot Number
:TEST?		Test Result
:LOBE?		Side Lobe
:POW?		Power
:OFFS?		Slot Offset
:CFRQ?		Center Frequency
:INBO:MSG?		Inbound Message
MONI:GRAP:FMDE: start point : end point?	1(min):1000(max)	FM Demodulation Waveform
:POW: start point : end point?	1(min):1000(max)	Power Waveform
:SPEC: start point : end point?	1(min):512(max)	Spectrum Waveform
MONI:SPEC:CUR<value>		Line Cursor position

Pager Protocol Commands

RS-232C Command	Range	Description
PP:SEND {START|STOP}		Protocol Send or Stop
PP:TYPE {POCS|FLEX|ERME|INFL|RE25|RE50}		POCS : POCSAG FLEX : FLEX ERME : ERMES INFL : InFLEXION RE25 : ReFLEX25 RE50 : ReFLEX50
PP:MSG:NO:NUME <value> :HEX <value> :ALPH <value> PP:MSG:MFN <value> :ALPH {7BIT|KSC|GB|CNS}	1-5 1-5 1-5 1-8	Message Number of Numeric Message Number of HEX/BIN Message Number of ALPHA Numeric Message Fragment Number ALPHA Numeric Message Type

Pager Protocol (PP) : FLEX

RS-232C Command	Range	Description
● Base Parameter		
PP:FLEX:ADR <value>	1-427068542	Address
:FRQ <value>	0.1-50, 130-960	Forward Frequency (MHz)
:LEV <value>	(-120)-(-20)	Output Level (dBm)
:BPS {1600/2|3200/2|3200/4|6400/4}		Bit Per Second
:CYCL <value>	0-14	Start Cycle Number
:FRAM <value>	0-127	Base Frame
:PHAS {A|B|C|D}		Base Phase
:COLL <value>	0-7	System Collapse Value
:RPTN <value>	0-999	Message Repeat Number
:HEAD {ON|OFF}	ON/OFF	Header Frame Transmit
:RESY {ON|OFF}	ON/OFF	Resync Pattern
:POLA {NOR|INV}	NOR/INV	FM Deviation Polarity
:DUMM {ON|OFF}	ON/OFF	Dummy Call ON/OFF
● BIW		
PP:FLEX:BIW:TYPE {SSID|NID||TIME}		BIW Type Selection
:SSID:SERV {ON|OFF}	ON/OFF	SSID Roaming
:NID:SERV {ON|OFF}	ON/OFF	NID Roaming
:TIME:SERV {ON|OFF}	ON/OFF	Time Service
PP:FLEX:BIW:SSID:LID <value>	0-511	Local ID
:CZ <value>	0-31	Coverage Zone
:CC <value>	0-999	Country Code
:TMF <value>	0-15	Traffic Management Flags
:MCO <value>	0-3	Maximum Carry On
:FOS <value>	0-63	Frame Offset
PP:FLEX:BIW:NID:NA <value>	0-4095	Network Address(NA+2025472)
:SA <value>	0-31	Service Area
:MULT <value>	0-7	Multiplier
:TMF <value>	0-15	Traffic Management Flags
:MCO <value>	0-3	Maximum Carry On
:FOS <value>	0-63	Frame Offset
PP:FLEX:BIW:TIME:MONT <value>	1-12	Month
:DAY <value>	1-31	Day
:YEAR <value>	1994-2025	Year
:HOUR <value>	0-23	Hour
:MIN <value>	0-59	Minute
:CS <value>	0-63	Second Adjustment(15/16sec)
:DLS {0|1}	0/1	Daylight Saving
:LTZ <value>	0-31	Time Zone Index
● VECTOR		
PP:FLEX:VECT:TYPE {NSTD|NSPE|NNUM|SMSG|HEX|ALPH|SECU|SINS|SEAL}		Vector Type Selection NSTD : Numeric Standard NSPE : Numeric Special NNUM : Numeric Numbered SMSG : Short Message HEX : HEX/BIN ALPH : Alpha Numeric

		SECU : Secure SINS : Short Instruction SEAL : Secure Alphanumeric
PP:FLEX:VECT:NSTD:AMI{ON|OFF}		Automatic-Numbering Message Function
PP:FLEX:VECT:NSPE:AMI{ON|OFF}		Automatic-Numbering Message Function
PP:FLEX:VECT:NNUM:MSN <value>	0-63	Message Sequence Number
:IOMF {0|1}	0/1	In Order Message Flag
:SF {0|1}	0/1	Special Format
AMI{ON|OFF}		Automatic-Numbering Message Function
PP:FLEX:VECT:SMSG:TYPE {0|1|2}	0-2	Short Message Type Selection
PP:FLEX:VECT:SMSG:TYP1:SOUR <value>	0-7	Source Value
PP:FLEX:VECT:SMSG:TYP2:SOUR <value>	0-7	Source Value
:MSN <value>	0-63	Message Sequence Number
:IOMF {0|1}	0/1	In Order Message Flag
PP:FLEX:VECT:HEX:MSN <value>	0-63	Message Sequence Number
:IOMF {0|1}	0/1	In Order Message Flag
:LENG <value>	0-15	Blocking Length
:MAIL {0|1}	0/1	Mail drop flag
:HEAD {0|1}	0/1	Header Message
:SIF {0|1}	0/1	Status Information Field
PP:FLEX:VECT:ALPH:MSN <value>	0-63	Message Sequence Number
:IOMF {0|1}	0/1	In Order Message Flag
:MAIL {0|1}	0/1	Mail drop flag
:AMI{ON|OFF}		Automatic-Numbering Message Function
PP:FLEX:VECT:SECU:MSN <value>	0-63	Message Sequence Number
:NSR <value>	1-7	Number of Sequential Registration
:SN <value>	1-7	Sequential Number
:ST <value>	0-524287	Start Time (x 1Minute)
PP:FLEX:VECT:SECU:RT1 {SSID|NID}	SSID/NID	Registration Type of NSR=1
:RT2 {SSID|NID}		Registration Type of NSR=2
:RT3 {SSID|NID}		Registration Type of NSR=3
:RT4 {SSID|NID}		Registration Type of NSR=4
:RT5 {SSID|NID}		Registration Type of NSR=5
:RT6 {SSID|NID}		Registration Type of NSR=6
:RT7 {SSID|NID}		Registration Type of NSR=7
PP:FLEX:VECT:SECU:DT1 <value>	0-524287	Duration Time of NSR=1
:DT2 <value>		Duration Time of NSR=2
:DT3 <value>		Duration Time of NSR=3
:DT4 <value>		Duration Time of NSR=4
:DT5 <value>		Duration Time of NSR=5
:DT6 <value>		Duration Time of NSR=6
:DT7 <value>		Duration Time of NSR=7
PP:FLEX:VECT:SECU:OT1 <value>	0-127	Overlap Time of NSR=1
:OT2 <value>		Overlap Time of NSR=2
:OT3 <value>		Overlap Time of NSR=3
:OT4 <value>		Overlap Time of NSR=4
:OT5 <value>		Overlap Time of NSR=5
:OT6 <value>		Overlap Time of NSR=6
:OT7 <value>		Overlap Time of NSR=7

PP:FLEX:VECT:SECU:FRQ1 <value>	0-2097151	Frequency of NSR=1
:FRQ2 <value>		Frequency of NSR=2
:FRQ3 <value>		Frequency of NSR=3
:FRQ4 <value>		Frequency of NSR=4
:FRQ5 <value>		Frequency of NSR=5
:FRQ6 <value>		Frequency of NSR=6
:FRQ7 <value>		Frequency of NSR=7
PP:FLEX:VECT:SECU:MAS1 <value>	0-7	CZ/SA Wildcard Mask of NSR=1
:MAS2 <value>		CZ/SA Wildcard Mask of NSR=2
:MAS3 <value>		CZ/SA Wildcard Mask of NSR=3
:MAS4 <value>		CZ/SA Wildcard Mask of NSR=4
:MAS5 <value>		CZ/SA Wildcard Mask of NSR=5
:MAS6 <value>		CZ/SA Wildcard Mask of NSR=6
:MAS7 <value>		CZ/SA Wildcard Mask of NSR=7
PP:FLEX:VECT:SECU:CC1 <value>	0-1023	Country Code of NSR=1
:CC2 <value>		Country Code of NSR=2
:CC3 <value>		Country Code of NSR=3
:CC4 <value>		Country Code of NSR=4
:CC5 <value>		Country Code of NSR=5
:CC6 <value>		Country Code of NSR=6
:CC7 <value>		Country Code of NSR=7
PP:FLEX:VECT:SECU:LID1 <value>	0-511	Local ID of NSR=1
:LID2 <value>		Local ID of NSR=2
:LID3 <value>		Local ID of NSR=3
:LID4 <value>		Local ID of NSR=4
:LID5 <value>		Local ID of NSR=5
:LID6 <value>		Local ID of NSR=6
:LID7 <value>		Local ID of NSR=7
PP:FLEX:VECT:SECU:CZ1 <value>	0-31	Coverage Zone of NSR=1
:CZ2 <value>		Coverage Zone of NSR=2
:CZ3 <value>		Coverage Zone of NSR=3
:CZ4 <value>		Coverage Zone of NSR=4
:CZ5 <value>		Coverage Zone of NSR=5
:CZ6 <value>		Coverage Zone of NSR=6
:CZ7 <value>		Coverage Zone of NSR=7
PP:FLEX:VECT:SINS:TYPE {0|1|2}	0-2	Short Instruction Type selection
PP:FLEX:VECT:SINS:TYP0:MSG {NUME|HEX|ALPH}		Transmit Message Type Select
:ADR <value>	0-15	Temporary ADR(ADR+2029568)
:FRAM <value>	1-120	Relative Frame Number
PP:FLEX:VECT:SINS:TYP1:MSG {NUME|HEX|ALPH}		Transmit Message Type Select
:EVEN <value>	0-2047	System Event Notification
PP:FLEX:VECT:SINS:TYP2:MSG {NUME|HEX|ALPH}		Transmit Message Type Select
:ADR <value>	0-15	Temporary ADR(ADR+2029568)
:FRAM <value>	1-120	Relative Frame Number
:MSN <value>	0-63	Message Sequence Number
PP:FLEX:VECT:SEAL:MSN<value>	0-63	Message Sequence Number

● Message	
PP:FLEX:{MSG1|MSG2|MSG3|MSG4|MSG5}:NUME 'String'	String = Numeric
:SMSG 'String'	String = Short Message
:HEX 'String'	String = HEX/BIN
:ALPH:7BIT 'String'	String = ALPH 7BIT
:ALPH:KSC 'String'	String = ALPH KSC
:ALPH:GB 'String'	String = ALPH GB
:ALPH:CNS 'String'	String = ALPH CNS
:SINS:NUME 'String'	String = Short Instruction Numeric
:SINS:HEX 'String'	String = Short Instruction HEX/BIN
:SINS:ALPH:7BIT 'String'	String = Short Instruction ALPH(7BIT)
:SINS:ALPH:KSC 'String'	String = Short Instruction ALPH(KSC)
:SINS:ALPH:GB 'String'	String = Short Instruction ALPH(GB)
:SINS:ALPH:CNS 'String'	String = Short Instruction ALPH(CNS)
:SEAL:'String'	String= Secure Alphanumeric(7BIT)
	*MSG1 : Message Buffer Number 1
	*MSG2 : Message Buffer Number 2
	*MSG3 : Message Buffer Number 3
	*MSG4 : Message Buffer Number 4
	*MSG5 : Message Buffer Number 5

Pager Protocol : POCSAG

RS-232C Command	Range	Description
● **Base Parameter**		
PP:POCS:ADR <value>	8-2097151	Address
:FRQ <value>	0.1-50, 130-960	Forward Frequency(MHz)
:LEV <value>	(-120)-(-20)	Output Level(dBm)
:MSG {TONE|NUME|ALPH}		MSG Type Selection
:BPS {512/2|1200/2|2400/2}		Bit Per Second
:FUN {A|B|C|D}		Function Bit
:RPTN <value>	0-999	Message Repeat Number
:INTV <value>	0-99	Transmit Interval
:RF {ON|OFF}	ON/OFF	RF Level ON/OFF
:POLA {NOR|INV}	NOR/INV	FM Deviation Polarity
:PRC {ON|OFF}	ON/OFF	People's Republic of China
:AMI{ON|OFF}		Automatic-Numbering Message function
● **Message**		
PP:POCS:{MSG1|MSG2|MSG3|MSG4|MSG5}:NUME 'String'		String = Numeric
:ALPH:7BIT 'String'		String = ALPH 7BIT
:ALPH:KSC 'String'		String = ALPH KSC
:ALPH:GB 'String'		String = ALPH GB
:ALPH:CNS 'String'		String = ALPH CNS
		*MSG1 : Message Buffer Number 1
		*MSG2 : Message Buffer Number 2
		*MSG3 : Message Buffer Number 3
		*MSG4 : Message Buffer Number 4
		*MSG5 : Message Buffer Number 5

Pager Protocol : ERMES

RS-232C Command	Range	Description
● **Base Parameter**		
PP:ERME:IA <value>	0-262143	Initial Address
:FRQ <value>	0.1-50, 130-960	Forward Frequency(MHz)
:LEV <value>	(-120)-(-20)	Output Level(dBm)
:CHAN <value>	0-15	Channel Number
:BT <value>	0-15	Pager Batch Type
:CYCL <value>	0-59	Start Cycle Number
:SSN <value>	0-4	Start Subsequence Number
:BATC <value>	0-15	Start Batch Number
:RPTN <value>	0-999	Message Repeat Number
:POLA {NOR|INV}	NOR/INV	FM Deviation Polarity
● **SYSTEM Information**		
PP:ERME:INFO:TYPE {ROAM|TIME}	ROAM/TIME	System Information Type Selection
PP:ERME:INFO:ROAM:ZID <value>	2-7	Zone ID
:CC <value>	0-99	Country Code
:OC <value>	0-7	Operator Code
:PA <value>	0-63	Paging Area Code
:FSI <value>	0-30	Frequency Subset Indicator
:VER {1.01|2.01}	1.01/2.01	Protocol Version Number
PP:ERME:INFO:TIME:YEAR <value>	1990-2117	Year
:MONT<value>	1-12	Month
:DAY <value>	1-31	Day
:WEEK <value>	1-7	Day of the week
:HOUR <value>	0-23	Hour
● **HEADER**		
PP:ERME:HEAD:TYPE {TONE|NUME|ALPH|TRAN|LONG|OTAP|CTAP}		Vector Type Selection TONE : Tone Only NUME : Numeric ALPH : Alpha Numeric TRAN : Transparent LONG : Long Message OTAP : Remote Program CTAP : Common Temporary Address
PP:ERME:HEAD:TONE:MSN <value>	0-31	Message Sequence Number
:UMI {0|1}	0/1	Urgent Message Indicator
:ALRT <value>	0-7	Alert Type
PP:ERME:HEAD:NUME:MSN <value>	0-31	Message Sequence Number
:UMI {0|1}	0/1	Urgent Message Indicator
:ALRT <value>	0-7	Alert Type
PP:ERME:HEAD:ALPH:MSN <value>	0-31	Message Sequence Number
:UMI {0|1}	0/1	Urgent Message Indicator
:ALRT <value>	0-7	Alert Type
PP:ERME:HEAD:TRAN:MSN <value>	0-31	Message Sequence Number
:UMI {0|1}	0/1	Urgent Message Indicator
:ALRT <value>	0-7	Alert Type

PP:ERME:HEAD:LONG:NUME:MSN <value>	0-31	Message Sequence Number
:NUME:UMI {0|1}	0/1	Urgent Message Indicator
:NUME:ALRT <value>	0-7	Alert Type
:ALPH:MSN <value>	0-31	Message Sequence Number
:ALPH:UMI {0|1}	0/1	Urgent Message Indicator
:ALPH:ALRT <value>	0-7	Alert Type
:TRAN:MSN <value>	0-31	Message Sequence Number
:TRAN:UMI {0|1}	0/1	Urgent Message Indicator
:TRAN:ALRT <value>	0-7	Alert Type
PP:ERME:HEAD:OTAP:TYPE {IA|PA|OPID|INH|OUTH}		Remote Program Type Selection
PP:ERME:HEAD:OTAP:IA:FUN		Initial Address Function Bit Selection
{REPLACE|REMOVE|RESTORE}		
:ZID <value>	2-7	Zone ID
:CC <value>	0-99	Country Code
:OC <value>	0-7	Operator Code
:IA <value>	0-262143	Initial Address
PP:ERME:HEAD:OTAP:PA:FUN		Paging Area Function Bit Selection
{REPLACE|REMOVE|RESTORE}		
:ZID <value>	2-7	Zone ID
:CC <value>	0-99	Country Code
:OC <value>	0-7	Operator Code
:PA <value>	0-63	Paging Area Code
PP:ERME:HEAD:OTAP:OPID:FUN		Operator Identity Func. Bit Selection
{REPLACE|REMOVE|RESTORE}		
:ZID <value>	2-7	Zone ID
:CC <value>	0-99	Country Code
:OC <value>	0-7	Operator Code
PP:ERME:HEAD:OTAP:INH:FUN		In Home Function Bit Selection
{REPLACE|REMOVE|RESTORE}		
:SM <value>	0-31	Subsequence Mask
:HNL <value>	0-7	Subset of the Sixty Cycles
PP:ERME:HEAD:OTAP:OUTH:FUN		Outside Home Function Bit
{REPLACE|REMOVE|RESTORE}		
:SM <value>	0-31	Subsequence Mask
:ENL <value>	0-7	Subset of the Sixty Cycles
PP:ERME:HEAD:CTAP:CTAP <value>	0-15	Common Temporary Address
:MSG {TONE|NUME|ALPH|TRAN}		CTAP Message

● Message	
PP:ERME:{MSG1|MSG2|MSG3|MSG4|MSG5}:NUME ‘String’	String = Numeric
:TRAN ‘String’	String = Transparent
PP:ERME:{MSG1|MSG2|MSG3|MSG4|MSG5}:ALPH:7BIT ‘String’	String = ALPH 7BIT
:KSC ‘String’	String = ALPH KSC
:GB ‘String’	String = ALPH GB
:CNS ‘String’	String = ALPH CNS
PP:ERME:{MSG1|MSG2|MSG3|MSG4|MSG5}:LMSG:NUME ‘String’	String = Long MSG Numeric
:TRAN ‘String’	String = Long MSG Transparent
:ALPH:7BIT ‘String’	String = Long MSG ALPH 7BIT
:ALPH:KSC ‘String’	String = Long MSG ALPH KSC
:ALPH:GB ‘String’	String = Long MSG ALPH GB
:ALPH:CNS ‘String’	String = Long MSG ALPH CNS
PP:ERME:{MSG1|MSG2|MSG3|MSG4|MSG5}:CTAP:NUME ‘String’	String = CTAP Numeric
:TRAN ‘String’	String = CTAP Transparent
:ALPH:7BIT ‘String’	String = CTAP ALPH 7BIT
:ALPH:KSC ‘String’	String = CTAP ALPH KSC
:ALPH:GB ‘String’	String = CTAP ALPH GB
:ALPH:CNS ‘String’	String = CTAP ALPH CNS
	*MSG1 : Message Buffer Number 1 *MSG2 : Message Buffer Number 2 *MSG3 : Message Buffer Number 3 *MSG4 : Message Buffer Number 4 *MSG5 : Message Buffer Number 5

Pager Protocol : ReFLEX25

RS-232C Command	Range	Description
● BASE PARAMETER		
PP:RE25:ADR <value>	16777216-1073741823	Address
:RXF <value>	0.1-50, 130-960	Forward Frequency(MHz)
:TXF <value>		Reverse Frequency(MHz)
:LEV <value>	0.455-960	Output Level(dBm)
:BPS {1600/2|3200/2|3200/4|6400/4}	30-90	Bit Per Second
:ATYP {NORMAL|INFOR}	0-14	Address Type
:CYCL <value>	0-127	Start Cycle Number
:FRAM <value>	0-127	Start Frame Number
:COLO <value>	NOR/INV	Color Code Value
:POLA {NOR|INV}	1-16383	FM Deviation Polarity
:SPID <value>		Service Provider ID
:ADRI{ON|OFF}		Auto-setting of the address
:SYNC{ON|OFF}		Synchronous Transmit ON | OFF
:TXPO<value>		Estimated TX Power
● BIW		
PP:RE25:BIW:TYPE {ROAM|TXSC|RXSC|CHFR|TIME|VER}		BIW TYPE Selection ROAM : Roaming TXSC : Tx Schedule RXSC : Rx Schedule CHFR : Channel Freqency TIME : Time VER : Protocol Version Number
PP:RE25:BIW:ROAM:ZID <value>	1-16383	Zone ID
:SH <value>	0,1	Subzone Handoff flag
:SZID <value>	1-127	Subzone ID
:SD <value>	0-15	Subzone Notification Delay
:NM <value>	0-7	Subzone Validation Number
:L {0|1}	0/1	Leading SPID Flag
:RP <value>	0-15	Registration Interval
:SE {0|1}	0/1	Subzone Notification Control
:IN <value>	0-255	Incommunication Delay
:S<value>	0,1	Surrogate SPID Flag
:ZT<value>	0,1	Zone Time-sharing flag
:ST<value>	0,1	Subaone Time-sharing flag
:OW<value>	0,1	One-way zone flag
:OK<value>	0,1	Other Kind flag
:PC<value>	0,1	Partial inbound flag
PP:RE25:BIW:TXSC:SC <value>	0-5	SCI Collapse Mask
:SF <value>	8-24	SCI Base Frame
:IC <value>	0-7	IS Collapse Mask
:IF <value>	0-126	IS Base Frame
:AL {0|1}	0/1	PMU must decode the IS Frame
:PF <value>	0-127	First Base Frame
:PN <value>	0-127	Number of Families
:PS <value>	0-63	Spacing between Base Frames
:CN <value>	0-63	Number of Control Frames
:CS <value>	0-7	Spacing between Control

:PC <value>	0-7	Spacing between Clusters
:SP<value>	0,1	SCI Frame Pair flag
:EC<value>	0,7	Extended Collapse Value
PP:RE25:BIW:RXSC:CC <value>	0-7	Cluster Collapse Value
:RS <value>	0-127	First Base Frame
:RN <value>	0-63	Number of Families
:AA {0|1}	0/1	ALOHA Allowed
:AB <value>	0-127	ALOHA Boundary
:RI <value>	0-7	ALOHA Randomization interval
:AT <value>	1-255	ALOHA Time-out
:RT <value>	0-7	Number of ALOHA Retries, RT X 2
:LR <value>	0-3	Maximum Inbound MSG. Length
:LL <value>	0-511	Maximum Inbound MSG. Length
:AN<value>	0-31	Number of Measurement Frame
:LT<value>	0,1	Linear randomization flag
:IA<value>	1,0	Implied ACK flag
PP:RE25:BIW:CHFR:S <VALUE>	0 – 2047	Forward Channel Assignment
:FBF <VALUE>	0 – 8191	Forward Base Frequency * 1MHz
:FDF{ON|OFF}	ON/OFF	Forward Default Set ON/OFF
:CS{ON|OFF}	ON/OFF	Channel Spacing Indicator
:C <VALUE>	0 – 2047	Reverse Channel Assignment
:RBF <VALUE>	0 – 8191	Reverse Base Frequency * 1MHz
:RDF{ON|OFF}	ON/OFF	Reverse Default Set ON/OFF
:SD <VALUE>	800–9600	Reverse Channel Speed
PP:RE25:BIW:TIME:YEAR <value>	1994-2025	Year
: MONT <value>	1-12	Month
: DAY <value>	1-31	Day
:WEEK <value>	1-7	Week
:HOUR <value>	0-23	Hour
:MIN <value>	0-59	Minute
:SEC <value>	0-59	Second
:DS {0|1}	0/1	Daylight Saving
:TZ <value>	0-31	Time Zone Index
:MT {0|1}	0/1	Multiple Time Zones
PP:RE25:BIW:LOCA:HL <VALUE>	0 – 63	Increment for MSST
:DL <VALUE>	0 – 63	Signal strength difference
:UL <VALUE>	0 – 63	Increment for Lower Signal
:E <VALUE>	0 – 127	Registration Threshold
:NC <VALUE>	0 – 9	Number of Local Scan List
:CN <VALUE>	0 – 15	Local Scan Channel Number
:S0 <VALUE>	0 – 2047	Forward Channel Assignment
:CS0 <VALUE>	0,1	Channel Spacing Indicator
:SC0 <VALUE>	0 – 5	SCI Collapse Mask
:SF0 <VALUE>	0 – 31	SCI Base Frame
.		
.		
:S15 <VALUE>		
:CS15 <VALUE>		
:SC15 <VALUE>		
:SF15 <VALUE>		
:LN<value>	0-15	Number of Measurement Frame
:MC<value>	0-7	Measurement Frame Collapse

:PR0<value>	0,1	SCI Pair Indicator 0
:PR1<value>	0,1	SCI Pair Indicator 1
:PR2<value>	0,1	SCI Pair Indicator 2
:PR3<value>	0,1	SCI Pair Indicator 3
:PR4<value>	0,1	SCI Pair Indicator 4
:PR5<value>	0,1	SCI Pair Indicator 5
:PR6<value>	0,1	SCI Pair Indicator 6
:PR7<value>	0,1	SCI Pair Indicator 7
:PR8<value>	0,1	SCI Pair Indicator 8
:PR9<value>	0,1	SCI Pair Indicator 9
:PR10<value>	0,1	SCI Pair Indicator 10
:PR11<value>	0,1	SCI Pair Indicator 11
:PR12<value>	0,1	SCI Pair Indicator 12
:PR13<value>	0,1	SCI Pair Indicator 13
:PR14<value>	0,1	SCI Pair Indicator 14
:PR15<value>	0,1	SCI Pair Indicator 15
PP:RE25:BIW:VER <value>	0-255	Protocol Version Number
● Vector		
PP:RE25:VECT:TYPE {SHOR|NUME|ALPH|BIN|SECU|WRU|COMM}		Vector Type Selection SHOR : Short Message NUME : Numeric ALPH : Alphanumeric BIN : Binary Message SECU : Secure Message SIMC : Schedule Inbound WRU : Where Are You COMM : Command Vector
PP:RE25:VECT:SHOR:TYPE {NUME|SPEC|TEST}		NUME : Numeric SPEC : Special TEST : Test Mode
PP:RE25:VECT:SHOR:NUME:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:AMI{ON|OFF}		Automatic-Numbering Message Function
:FT<value>	0,1	First Time flag
PP:RE25:VECT:SHOR:SPEC:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:AMI{ON|OFF}		Automatic-Numbering Message Function
:FT<value>	0,1	First Time flag
PP:RE25:VECT:SHOR:TEST:MSN <value>	0-127	Message Sequence Number
:TM {0|1}	0/1	Test Mode
:RR {0|1}	0/1	Response Required Flag
:WT {0|1}	0/1	Word Error Rate Test
:BT {0|1}	0/1	BER Measurement
:FF <value>	1-127	Relative Test Frame
:NF <value>	0-255	Number of Test Frame

:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:FT<value>	0,1	First Time flag
PP:RE25:VECT:NUME:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:AMI{ON|OFF}		Automatic-Numbering Message Function
PP:RE25:VECT:ALPH:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:MC {0|1}	0/1	Multiple Choice Response
:AMI{ON|OFF}		Automatic-Numbering Message Function
:FT<value>	0/1	First Time flag
PP:RE25:VECT:BIN:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
:RD <value>	0,1	Response Disable Flag
:FT<value>	0/1	First Time flag
PP:RE25:VECT:SECU:PSWD <value>	0-127	Home Index Value Password
:HVAL <value>	0-115	Home Index Value
:MSN <value>	0,1	Message Sequence Number
:RR {0|1}	0-115	Response Required Flag
:MR {0|1}	0/1	Message Read Flag
:RS <value>	0/1	Response Packet Slot
:FRAM <value>		Relative Frame Number
:RD		Response Disable Flag
:FT<value>	0/1	First Time flag
PP:RE25:VECT:WRU:MSN <value>	0-127	Message Sequence Number
:LR <value>	0-3	Maximum Amount of Memory
:LL <value>	0-15	Maximum Amount of Memory
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
		Command Vector Type Selection
PP:RE25:VECT:COMM:TYPE {REGI|SUBZ		REGI : Change Registration
|MEMO|HOME|TRAN|ADVA|RELE|TONE|PEND|ABOR}		SUBZ : Subzone Query
		MEMO : Memory Status
		HOME : Home Index
		TRAN : Transaction Status
		ADVA : Advance MSN
		RELE : Release MSN
		TONE : Tone Only
		ABOR : Abort TX
PP:RE25:VECT:COMM:REGI:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag

:G {DENIED|GRANT|WAIT}		Type of Registration Change
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:SUBZ:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:MEMO:MSN <value>	0-127	Message Sequence Number
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:HOME:QI {0|1}	0/1	0:Middle 11bit, 1:MSB 11bit
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:TRAN:MSN <value>	0-127	Message Sequence Number
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:ADVA:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:RELE:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:TONE:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:PEND:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:MP {0|1}	0/1	Message Pending flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
PP:RE25:VECT:COMM:ABOR:MSN <value>	0-127	Message Sequence Number
:RR {0|1}	0/1	Response Required Flag
:RS <value>	0-115	Response Packet Slot
:FRAM <value>	0-127	Relative Frame Number
● SCENARIO		The Number of Scenario
PP:RE25:SCEN:SCEN <value>	0-5	0. IDLE FRAME 1. Outbound MSG Test 2. Inbound MSG Test 3. ALOHA MSG Test 4. Multiple Choice 5. Read Notification
:RPTN <value>	0-99	Message Repeat Number
:MSG {SHOR|NUME|ALPH|BIN|SECU|WRU|COMM}		Transmit Message Type Select
:REG {ON|OFF}	ON/OFF	Registration

● Message	
PP:RE25:{MSG1|MSG2|MSG3|MSG4|MSG5}:NUME 'String' :SHOR:NUME 'String' :SHOR:SPEC 'String' :BIN 'String' :ALPH:7BIT 'String' :ALPH:KSC 'String' :ALPH:GB 'String' :ALPH:CNS 'String'	String = Numeric String = Short Numeric String = Special Numeric String = Binary String = ALPH 7BIT String = ALPH KSC String = ALPH GB String = ALPH CNS *MSG1 : Message Buffer Number 1 *MSG2 : Message Buffer Number 2 *MSG3 : Message Buffer Number 3 *MSG4 : Message Buffer Number 4 *MSG5 : Message Buffer Number 5

Pager Protocol : ReFLEX50

RS-232C Command	Range	Description
● Base Parameter		
PP:RE50:ADR <value>	0-1073741823	Address
:RXF <value>	0.1-50, 130-960	Forward Frequency(MHz)
:TXF <value>	0.455-960	Reverse Frequency(MHz)
:LEV <value>	30-90	Output Level(dBm)
:BPS {1600/2|3200/2|3200/4|6400/4}		Bit Per Second
:ATYP {NORMAL|INFOR}	NORMAL/INFOR	Address Type
:CYCL <value>	0-14	Start Cycle Number
:FRAM <value>	0-127	Start Frame Number
:POLA {NOR|INV}	NOR/INV	FM Deviation Polarity
:SUBA <value>	0-31	Information Sub-address
:SYNC{ON|OFF}		Synchronous Transmit ON | OFF
:TXPO<value>		Estimated TX Power
● BIW		
PP:RE50:BIW:TYPE {BASI|REVE|ROAM|TIME}		BIW Type Selection BASI : Basic BIW REVE : Reverse Channel ROAM : Roaming TIME : Time
PP:RE50:BIW:BASI:RD {0|1}	0/1	Registration Denied
:LE {0|1}	0/1	Registration Acknowledgement
:COLL <value>	0-7	Collapse Mask for Personal
:CLAI <value>	0-7	Collapse Mask for Information
PP:RE50:BIW:REVE:BOUN <value>	0-127	ALOHA Boundary
:RCS {800|1600|6400|9600}		Reverse Channel Speed
:TOP <value>	0-2047	ALOHA Time-out
:ALOH {0|1}	0/1	ALOHA Allowed
PP:RE50:BIW:ROAM:ZID <value>	0-8191	Zone ID
:LID <value>	0-8191	Local ID
:RT <value>	0-127	Registration Threshold
PP:RE50:BIW:TIME:WEEK <value>	1-7	Day of the Week
:DAY <value>	1-31	Day
:YEAR <value>	1994-2025	Year
:MONT <value>	1-12	Month
:HOUR <value>	0-23	Hour
:MIN <value>	0-59	Minute
:CS <value>	0-63	Second Adjustment(15/16sec)
:DS {0|1}	0/1	Daylight Saving
:TZ <value>	0-31	Time Zone Index
● Vector		
PP:RE50:VECT:TYPE {SHOR|NUME| HEX|ALPH}		Vector Type Selection SHOR : Short Message NUME : Numeric HEX : Hex/Bin ALPH : Alphanumeric
PAGE:RE50:VECT:SHOR:TYP {0|1|2}	0-2	Short Message Type Selection

:TYP0:AMI{ON|OFF}		Automatic-Numbering Message Function
:TYP1:SOUR <value>	0-15	Source Value
:TYP1:AMI{ON|OFF}		Automatic-Numbering Message Function
:TYP2:SOUR <value>	0-15	Source Value
:TYP2:MSN <value>	8-99	Message Sequence Number
:TYP2:AMI{ON|OFF}		Automatic-Numbering Message Function
PP:RE50:VECT:NUME:TYPE {WITH|WOUT}	WITH/WOUT	Numeric Type Selection
:WOUT:SF {0|1}	0/1	Special Format
:WOUT:MCR {0|1}	0/1	Multiple Choice Response
:WOUT:SUBC <value>	0-3	Subchannel Assignment Number
:WONT:AMI{ON|OFF}		Automatic-Numbering Message Function
:WITH:SF {0|1}	0/1	Special Format
:WTH:MCR {0|1}	0/1	Multiple Choice Response
:WITH:SUBC <value>	0-3	Subchannel Assignment Number
:WITH:MSN <value>	8-99	Message Sequence Number
:WITH:FRAM <value>	0-63	Relative Frame Number
:WITH:RS <value>	0-115	Response Packet Slot
:WITH:PACK <value>	0-7	Position Pointer within ACK
:WITH:RT <value>	ALOHA or SCH.	Response Type
:WITH:AMI{ON|OFF}		Automatic-Numbering Message Function
:WITH:ARL<value>	2-63	ALOHA Response Time Limit
PP:RE50:VECT:HEX:MSN <value>	8-99	Message Sequence Number
:FRAM <value>	0-63	Relative Frame Number
:RS <value>	0-115	Response Packet Slot
:PACK <value>	0-7	Position Pointer within ACK
:RT <value>	ALOHA or SCH.	Response Type
:ENCY {0|1}	0/1	Encryption flag
:CMF {0|1}	0/1	Compressed Message flag
:MCR {0|1}	0/1	Multiple Choice Response
:MAIL {0|1}	0/1	Maildrop flag
:SUBC <value>	0-3	Subchannel Assignment Number
:LENG <value>	0-15	Blocking Length
:ARL<value>	2-63	ALOHA Response Time Limit
PP:RE50:VECT:ALPH:MSN <value>	8-99	Message Sequence Number
:FRAM <value>	0-63	Relative Frame Number
:RS <value>	0-115	Response Packet Slot
:PACK <value>	0-7	Position Pointer within ACK
:RT <value>	ALOHA or SCH.	Response Type
:ENCY {0|1}	0/1	Encryption flag
:CMF {0|1}	0/1	Compressed Message flag
:MCR {0|1}	0/1	Multiple Choice Response
:MAIL {0|1}	0/1	Maildrop flag
:SUBC <value>	0-3	Subchannel Assignment Number
:AMI{ON|OFF}		Automatic-Numbering Message Function
:ARL<value>	2-63	ALOHA Response Time Limit
● SCENARIO		The Number of Scenario
PP:RE50:SCEN:SCEN <value>		0. IDLE FRAME
	0-2	1. Outbound MSG Test
		2. Inbound MSG Test
:RPTN <value>	0-99	Message Repeat Number
:MSG {SHOR|NUME|ALPH|HEX}		Transmit Message Type Select
:REG {ON|OFF}	ON/OFF	Registration ON/OFF

● Message	
PP:RE50:{MSG1|MSG2|MSG3|MSG4|MSG5}:NUME 'String'	String = Numeric
:SHOR 'String'	String = Short Numeric
:HEX 'String'	String = HEX/BIN
:ALPH:7BIT 'String'	String = ALPH 7BIT
:ALPH:KSC 'String'	String = ALPH KSC
:ALPH:GB 'String'	String = ALPH GB
:ALPH:CNS 'String'	String = ALPH CNS

SERVICE MODE

RS-232C Command	Range	Description
● Signal Generator		
SERV:SG:FRQ <value>	0.1-50, 130-960	Forward Frequency(MHz)
:LEV <value>	(-120)-(-20)	Output Level(dBm)
:RF {ON|OFF}	ON/OFF	RF Level
:MOD {ON|OFF}	ON/OFF	Modulation
:TYPE {AM|FMSI|FMRE}		SG Type Selection
SERV:SG:AM:FRQ <value>	200-4000	AM Modulation Frequency(Hz)
:DEPT <value>	0-100	AM Modulation Depth
SERV:SG:FMSI:FRQ <value>	20-4000	FM Modulation Frequency(Hz)
:DEV <value>	0.1-7.0	FM Deviation(KHz)
SERV:SG:FMRE:BPS {512/2|1200/2|1600/2|2400/2|3200/2|3200/4|6250/4|6400/4}		Bit Per Second
:DEV <value>	0.1-7.0	FM Deviation(KHz)
:POLA {INV|NOR}		FM Deviation Polarity
● System Out Setup		
SERV:SYST:TYPE {UNIPOLAR|BIPOLAR}	UNIPOLAR/BIPOLAR	Polarity Type Selection
:PEAK <value>	0.0-2.0	Peak Voltage(V)

Appendices

Technical Information

Testing 2-way Pagers
Using TESCOM TC-2000A
Universal Pager Tester and TC-5060B TEM Cell

TESCOM Co., Ltd.

Introduction

TC-2000A Universal Pager Tester is a precision signal source and receiver capable of testing advanced messaging devices such as ReFLEX25 or ReFLEX50 2-way pagers. When used with the complementary product such as TC-5060B TEM Cell, an ideal test bed is established allowing accurate measurement of receiver sensitivity and transmitter power. This article describes the test principles and calibration methods.

Principles of TEM Cell Testing

Receiver Sensitivity Test

When a voltage V is applied to TEM Cell, predictable E-H field is generated inside the TEM Cell. The ratio, E/V, is referred to as ***TEM Cell Conversion Factor.*** The relationship is approximately E=V/h, where h is TEM Cell septum height in meter, therefore CF=20LOG(1/h) dB. By applying receiver test signal to TEM Cell with the receiver inside, the sensitivity of the receiver is measured in terms of field strength.

The calibration of E-field can be made using E-field sensors with known ***Antenna Factor*** (AF), which is defined as the ratio of the antenna output voltage V (into 50-ohm load) for given applied field strength E. If we place a calibrated reference antenna with known AF inside TEM Cell, the path loss (dB) from TEM Cell input to the antenna output is determined by AF(dB) -CF(dB).

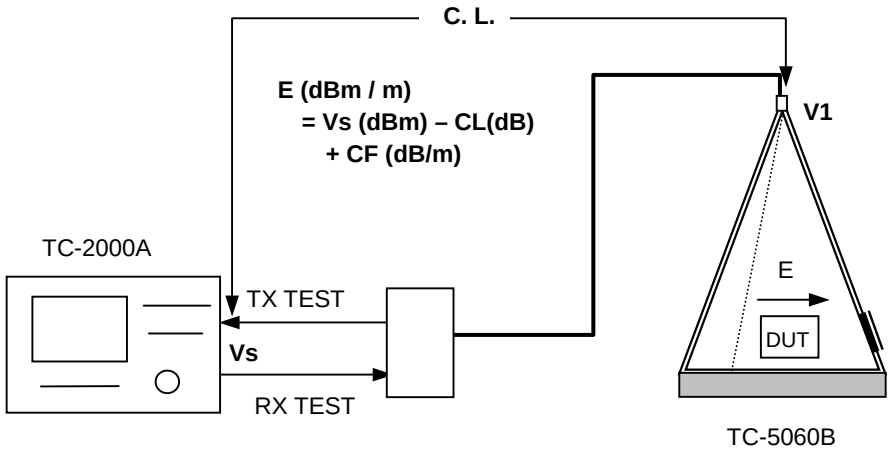


Fig. 1 Receiver Test

Transmitter Power Test

When a radiating device is placed inside a TEM Cell, some part of the radiated power intercepted by TEM Cell appears at the input. If we know the relationship between the radiated power of the device and the coupled output, the device power can be estimated. The relationship can be found from the following logical deduction. Suppose a device under test has an antenna with known AF. The insertion loss from the TEM Cell input to the antenna output is already known by (AF-CF). Since there is no active non-reciprocal device inside TEM Cell, the insertion loss between the TEM Cell input to the device antenna output has to be the same in both directions. We can easily find the device power delivered to the antenna by adding (AF-CF) dB to the power measured at the TEM Cell input port.

Since every device has different AF, it is more convenient to represent the radiated power in terms of a normalized transmitter power called ERP (Equivalent Radiated Power) which assumes the radiating devices use the same reference antenna, a tuned dipole. The AF of a tuned dipole is about 30dB at 1 GHz and increases with frequency by 6dB/Octave. *Assuming AF = 30dB at 1GHz for the reference dipole and CF is 13dB for TC-5060B. the insertion loss is about 17dB at 1GHz and 23 dB at 2GHz.*

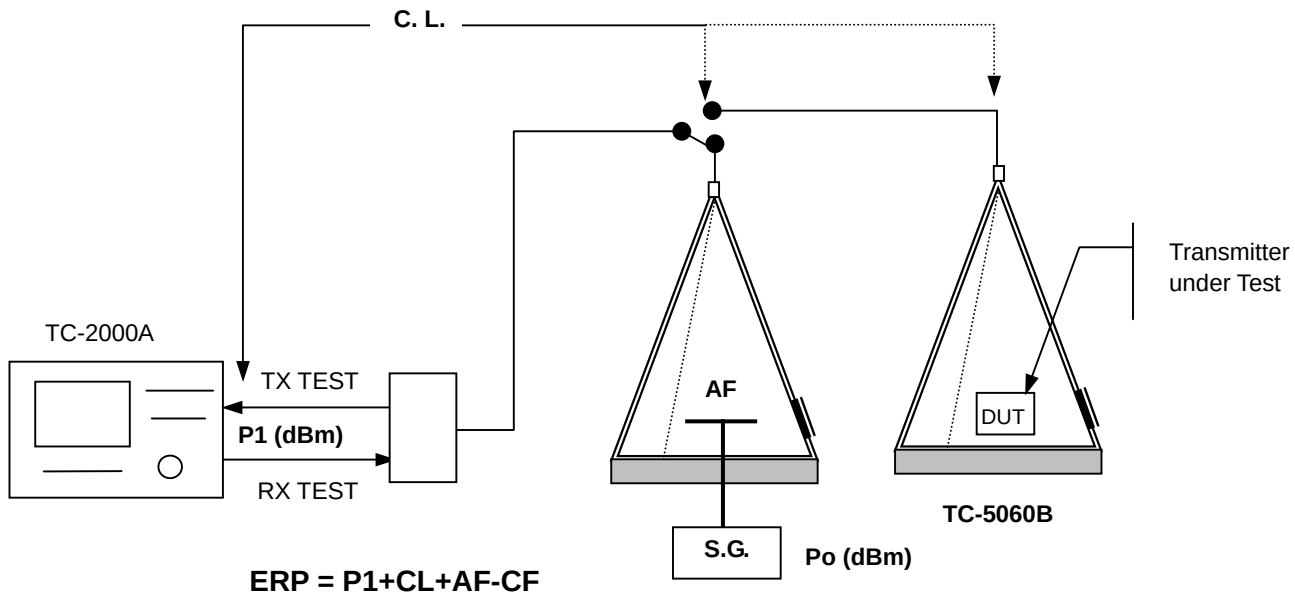


Fig. 2 Concept of Transmitter ERP Test

Application Examples

Receiver Sensitivity Test

A receiver sensitivity is usually defined by the minimum field strength E(uV/meter) at which receiver works properly. For a receiver test, E field can be conveniently established using TEM Cell. If the TEM Cell Conversion Factor (CF) is known, and if CL represents the cable loss or any connection loss between the signal generator and TEM Cell input.

E(dBuV/meter)=Vs(dBuV) +CF(dB) -CL.(dB) ……..(1)

Example 1: Let CF=13dB for TC-5060B and CL=3dB. If a pager must be tested at 20dBuV/meter sensitivity, the signal generator output, Vs ,need be set at 10dBuV

E-Field Detection and Antenna Insertion Loss

When an antenna of known AF (Antenna Factor) is placed in a given TEM Cell, the output voltage V2 is given by input voltage V1 as follows.

V2(dBuV)=V1(dBuV) +CF(dB)- AF(dB)……..,(2)

or IL(dB)= 20LOG(V1/V2) = AF(dB) -CF(dB) ……(3)

The insertion loss IL in equation (3) does not depend on signal direction, whether it is from port 1 to port 2 or vice versa. This reciprocity is used to measure radiated power of a transmitter. Note that the receiving AF is frequency dependent and the value increases linearly with frequency for the same type of antenna.

Equivalent Radiated Power (ERP)

If a transmitter under test is put inside of TEM Cell, its ERP is given by

ERP(dBm) = AF(dB) –CF(dB) + P1(dBm)……(4)

where P1 is the measured power at the TEM Cell input port. AF is the antenna factor of the reference antenna.

For TC-5060B/B system, where CF=13dB,

ERP(dBm) = 17+20LOG(F) +P1(dBm) ……(5)

where F is the frequency of the transmitter in GHz. *Note that for TC-5010B CF=22.5dB and the measured power level P1 would be ~9.5dB higher.*

Example 2: If P1=10mW or 10dBm at the TC-5060B/B input port with DUT at test position, estimated ERP is 27dBm or 500mW.

Measurement Error

For TC-2000A/TC-5060B/B system, it would be sufficient to know TEM Cell conversion factor CF and cable loss CL(dB) for receiver and transmitter test. AF value of 30dB is used as the estimate for the Reference Dipole at 1 GHz, but this value is not an absolute constant and can be adjusted to correlate the test results with existing data obtained from other methods. It is also important to note that TEM Cell CF may also deviate from its theoretical value due to VSWR, loss, and test position dependency.

ydk

Self Test Program

TC-2000A

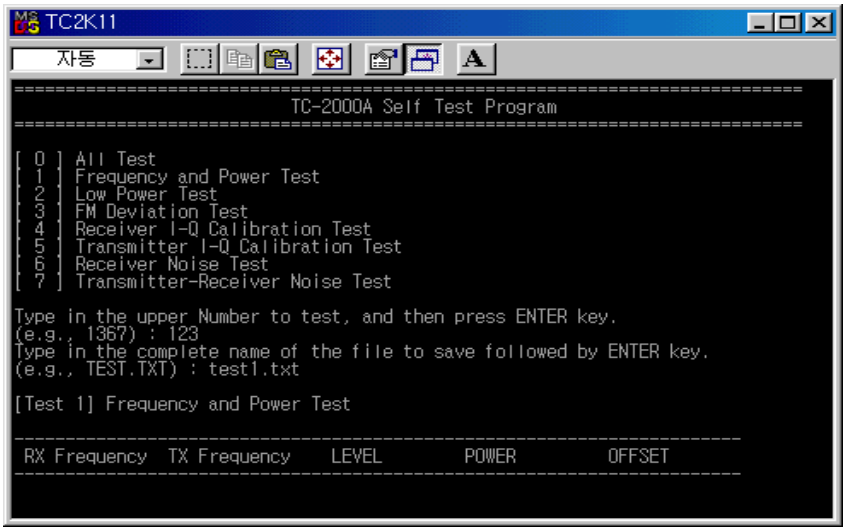
Introduction

This short PC program allows easy verification of TC-2000A by operator without the use of external equipment. The test is performed by loop back method by feeding the internal RF signal source to the internal receiver. This program runs under Windows 95/98/NT or MSDOS.

Test	Description
Frequency and Power Test	RF Power Accuracy vs. Frequency and Level (-20dBm ~ -70dBm, 10dB Step)
Low Power Test	Low Level Accuracy vs. Frequency and Level (-80dBm ~ -120dBm, 10dB Step)
FM Deviation Test	Source and Receiver combined FM Deviation Accuracy (1kHz ~ 5kHz, 1kHz Step)
Receiver I-Q Calibration Test	IQ Spurious level of the Demodulator
Transmitter I-Q Calibration Test	IQ Spurious level of the Modulator
Receiver Noise Test	IQ Demodulator Noise and Ripple
Transmitter and Receiver Noise Test	Noise and Ripple of both TX and RX

Operation Procedure

1) Connect TC-2000A RS-232C Port to PC Serial Port COM1 with a cable. Turn on TC-2000A.
2) Connect a short N-N RF cable between RF IN and RF OUT of TC-2000A.
3) Insert Program Upgrade Install Diskette to floppy drive and copy the SELFTEST.EXE file to a directory. Execute **SELFTEST.EXE**.
4) Follow the instruction on the screen.



5) If all 7 tests are performed, it takes about 30minutes.
6) The results are stored as a text file in the same directory of SELFTEST,EXE. This file can be opened and printed after the test is over.
7) If the test results shows FAIL check Chapter 6 Performance Test of the manual. If necessary contact TESCOM Support TC-2000A may require calibration.

Version Upgrade History

TC-2000A

TC-2000A Upgrade history

ROM Upgrade and Release Dates

Version Number	Release Date
1.01	February 23, 2000
1.02	March 10, 2000
1.03	May 2, 2000
1.10	October 5, 2000
1.20	December 11, 2000
1.21	January 16, 2001
1.22	February 19, 2001
1.30	Jun 25, 2001
1.31	July 3, 2001

Version 1.01

1.1 Frequency offset, Variance, Deviation readings: Improved averaging algorithm.

1.2 Remote SPECTRUM Reading: Offset error removed:

1.3 Addition of Receiver I-Q Self-Calibration:

1.4 RF turns on if FREQ is set in TX Mode, RF=OFF: RF stays off.

1.5 Improved algorithm to fix ALC problem near 730MHz

Version 1.02

2.1 Dummy Call function in FLEX: Added

When Dummy Call is invoked, the message areas of non-call phases are filled with all 5s(Hex) to randomize the bits for test consistency. This function is turned off automatically when SSID, NID or TIME function in BIW menu is turned on.

ON : Turns on Dummy Call.

OFF : Default setting. Turns off Dummy Call. Idle Frames fills the non-call phases.

Refer to Operating Manual, pages 4-13, 6-28 ~ 6-31

2.2 Alphanumeric Message in FLEX Secure Vector mode: Added.

Refer to Operating Manual, pages 4-19, 6-8, 6-26

2.3 Increased the range of measurement for Slot offset.

2.4 Cursor resolution increased In FM Demodulation Display, TRIGGER=SINGLE. In TX Test Mode.

Version 1.03

3.1 Automatic-Message Index (AMI) function

AMI function automatically inserts the message number at the end of each message when message is sent repeatedly. Select “AMI” in the “Vector” or “Base Parameter” menu.

AMI is used in the following message types:

POCSAG : Numeric, Alphanumeric
FLEX : Numeric, Alphanumeric Vector
ReFLEX25 : Numeric, Alphanumeric, Short Message Vector
InFLEXion : Numeric, Short Message Vector
ReFLEX50 : Numeric, Alphanumeric, Short Message

Refer to Operating Manual, pages 4-5, 4-19, 4-44, 4-45, 4-65 ~ 4-67, 6-29, 6-31, 6-36, 6-37, 6-41~6-45

3.2 F/W Bug Fixed: Freq display changes, but actual frequency does not change in case the channel is set using BIW parameter in ReFLEX and InFLEXion.

3.3 F/W Bug Fixed: Recall Pop-up Menu. Upon pressing Special Key (ADR, FRQ, LEV, MSG), Recall menu did not change.

Version 1.10

4.1 ReFLEX version update from G2.6 to G2.7

- SH (Subzone Handoff flag) added to BIW:ROAMING
- Range of SC (SCI Collapse Mask) for BIW:TX SCHEDULE, changed from [0,7] to [0, 5]
- Range of SF (SCI Base Frame) for BIW:TX SCHEDULE, changed from [0,127] to [8, 24]
- Range of IF (IS Base Frame) for BIW:TX SCHEDULE, changed from [0, 127] to [0, 126]
- LOCAL SCAN added to BIW
- LR, LL(Maximum Inbound MSG. Length) added to BIW:RX SCHEDULE
- LT deleted from BIW: RX SCHEDULE
- Updated BIW: CHANNEL FREQUENCY
- K, EN deleted from VECTOR: ALPHANUMERIC
- K, EN deleted from VECTOR: BINARY
- RD(Response Disable Flag) added to VECTOR:BINARY
- K, EN deleted from VECTOR: SECURE
- RD (Response Disable Flag) added to VECTOR: SECURE

Refer to Operation Manual, pages 4-37 ~ 4-58, 6-35 ~ 6-39

4.2 ADRIN (Auto-setting of the address)

In previous F/W versions, TC-2000A automatically reads the pager address submitted during registration and ignores the preset address. In some types of testing, it is, however, required to use a preset address for the pager under test. This function turns on and off the auto-setting feature of the pager address.

Refer to Operating Manual, pages 4-39, 6-35

4.3 Deletion of InFLEXion Protocol:

4.4 Addition of RefLEX25 Address Auto Set Flag

Version 1.20

5.1 Elimination of confusing ATT and ALC function simplifying TX test.

In order to test wide dynamic range of input signals in TX Test (or Monitor) mode, an optimum input attenuation is required to assure error free measurement. In previous versions, the attenuation is set automatically in ALC:ON mode or manually in ATT, ATTEN. This new feature finds an optimum attenuation value quickly and automatically without user intervention. As the results,

- ATT menu deleted from ReFLEX25, ReFLEX50 test screens.
- ALC and ATT deleted from FSK RECEIVER test screen.
- ALC and ATTEN deleted from all screens of TX Test mode (IQ, FM DEMOD, AM DEMOD, SPECTRUM, FM HIST).

Refer to Operating Manual, pages 3-21 ~ 3-27, 3-29, 4-38, 4-61, 6-25, 6-35, 6-44

5.2 Power Measurement speed: increased several times by improved DSP algorithm

5.3 SCENARIO of ReFLEX25/ ReFLEX50 Test reorganized

AUTO ATT SET and TEST MODE are deleted from SCENARIO list. BER test may be done in OUTBOUND Test Mode. New scenario, IDLE FRAME is added for certain 2-way pagers that can utilize this test mode. This scenario allows the transmission of the idle code words continuously as shown below..

<Frame Description>

Sync1	FIW	Sync2	IDLE CODE WORD

Refer to Operating Manual, pages 4-53, 4-92, 6-38, 6-45

5.4 Power Trigger (TRIG POW) function

Trigger Level can be set to capture the instantaneous signal power in SINGLE or NORMAL trigger mode. Input Range is -80 ~ 10 dBm,

Refer to Operationg Manual, pages 3-21 ~ 3-27, 6-25

5.5 RS-232C Configuration.

RS-232 SETUP allows the user configure TC-2000A RS-232C parameters. This configuration must match to that of the PC controller.

Parameter	Range	Description
MAX SPEED	110 ~ 56000 BPS	Maximum Speed
DATA BITS	5 ~ 8 BIT	Word Length
PARITY	EVEN, ODD, NONE, MARK, SPACE	Parity Check
STOP BITS	1, 2	Stop Bits

5.6 Level display in dBm and uV.
5.7 Range of FRAME for VECTOR: ReFLEX50 reduced from [0,127] to [0,63].
5.8 Range of RT (Response Type) for VECTOR: ReFLEX50 changed from [0,3] to [ALOHA or SCHEDULED]
5.9 Unscheduled ACK problem in ReFLEX50 fixed and waiting time increased to 128 frames

Version 1.21

6.1 Reference Oscillator Select: 10MHz or 12.8MHz
6.2 External Reference Auto-detect Function.
6.3 ALC ON/OFF function for factory trouble shooting

Version 1.22

7.1 Fixes F/W Bug in Ver. 1.20 and 1.21: Missing received message in R25,
7.2 Front panel entry of FREQ and LEVEL disabled during 2-way testing. RS-232C control is allowed.

Version 1.30

8.1 Added “SYNC (Synchronous Transmit ON/OFF)” function in R25/50
8.2 Added “TX Power (Estimated TX Power)” in R25/50
8.3 Added “ARL (ALOHA Response Time Limit) in R50

Version 1.31

9.1 Fixes Two Bugs, LL and LR parameters problem in the ReFLEX25

Version 1.32

10.1 TX Power can be changed during transmission.
10.2 The name of some menu is changed in ReFLEX 25
BIW: TX SCH → BIW: FORWARD SCH
BIW: RX SCH → BIW: REVERSE SCH

Version 1.33

1. ReFLEX25 : When TC2000A receives the packet from Pager, it should send ACK response through RS232C. But it did not send ACK response. (RS-232C SEND Mode)
2. ReFLEX25 : the CS-flag is not transmitted in BIW for Forward Channel Info. By setting the CS to ON in the BIW field, TYPE = CHANNEL FREQUENCY, you can set a frequency with 10kHz channel spacing but the flag was not set in the transmitted BIW.
3. When the FORWARD SCHEDULE : PC = 0 , then it will get response from the device, but when it select PC large than 0 (1,2,3 ...) then it would not get complete response from the device ! it stop at receiving MSG.
4. ReFLEX25 and FLEX : The Sync codeword specially at 3200/4 was not correct.

*All Corrected

Version 1.40

1. Add the “Surrogate SPID Flag” in BIW-ROAMING.
2. Change the input range of “SF” in BIW-FORWARD SCHEDULE : [8, 24] -> [0, 31]
3. Add the “Extended Collapse” in BIW-FORWARD SCHEDULE.
4. Add the “SCI Frame Pair Indicator” in BIW-LOCAL SCAN.
5. Change the input range of “SF” in BIW-LOCAL SCAN. : [0, 127] -> [0, 31]
6. Change the input range of “SC” in BIW-LOCAL SCAN. [0, 7] -> [0, 5]
7. Add “BIW for ALOHA Messaging”
   - Add the “Number of ALOHA Messaging SAUs (AN)” in BIW-REVERSE SCHEDULE
   - Assume that “Separation between ALOHA Messaging SAUs” is ‘0’.
   - Assume that “Maximum number of packets allowed in ALOHA” is ‘0’
8. Add “Number of most recent measurement frames (LN)” in BIW-LOCAL SCAN.
9. Add “Measurement frame collapse mask (MC)” in BIW-LOCAL SCAN.
10. Add a new scenario : “ALOHA Message Test”.

Version 1.41

1. Add the “First Time flag (FT)”in VECTOR
   A. Short Message(Test Mode, Special, numeric)
   B. Alphanumeric
   C. Binary
   D. Secure Message
2. Add the “SCI frame pair flag (SP)”in BIW-FORWARD SCHEDULE.
3. Add the “Zone Time-sharing flag (ZT)” in BIW-ROAMING.
4. Add the “Subzone Time-sharing flag (ST)” in BIW-ROAMING.
5. Add the “Zone type flags (OW, OK, PC)” in BIW-ROAMING.
6. Add the “ALOHA linear randomization time flag (LT)” in BIW-REVERSE SCHEDULE.
7. Add the “Implied ACK (IA)” in BIW-REVERSE SCHEDULE.
8. Change the range of “Message Sequence Number (MSN)”:[32,127] -> [0, 127].
9. In the FSK receiver Mode, if the input signal power is lower than -80dBm, the frequency setting can be changed not properly. => Fixed.

Version 1.50

1.Add "Multiple Choice Command Scenario (Scenario Number 4 in Scenario screen)
=> To test a Multiple Choice Message application. (ref. specification 2.72 page164)
2. Add "Message Read Notification" Scenario (Scenario Number 5 in Scenario screen)
=> To test a message read notification. (ref. specification 2.72 page163)
3. Modify FSK demodulation algorithm to improve accuracy of FM deviation value.
=> Increase the window size to get the center frequency from the Inbound Packet.
=> Decrease the window size to get the FM deviation values from the Inbound Packet.
4. Fix a bug in "ALOHA Messaging" Scenario.
=> It couldn't display the ALOHA message correctly because the TC2000A discarded the ALOHA messages from the Pager.