

**Technical Guide to**

**CNI-930M**

**( Two Way Messenger )**

**CNI Inc.**

---

|                                      |           |
|--------------------------------------|-----------|
| <b>1. Overview</b>                   | <b>3</b>  |
| <b>2. Specification and features</b> | <b>3</b>  |
| <b>A.Environment</b>                 | <b>3</b>  |
| <b>B.General RF specifications</b>   | <b>3</b>  |
| <b>C.Radio interface</b>             | <b>3</b>  |
| <b>D.Transmitter</b>                 | <b>4</b>  |
| <b>E.Receiver</b>                    | <b>4</b>  |
| <b>3. Circuit guide</b>              | <b>5</b>  |
| <b>4. Antenna Specificaltion</b>     | <b>10</b> |
| <b>5.Duty cycle</b>                  | <b>16</b> |

## 1. Overview

CNI-930M, TWM3(Two Way Messenger), is a digital data communication equipment in accordance with Mobitex specification. The frequency it uses ranges from 896Mhz to 901Mhz for transmission and from 935MHz to 941MHz for reception.

TWM3 enables you to make data communication in two-way, and it also helps you to enjoy various types of data services with full mobility due to support for roaming.

With high-resolution graphic LCD display, you can manipulate various types of information to communicate with others in many ways.

- Basic specification

- Dimension : 106(L) X 68(W) X 19(H) mm
- Weight : 145g
- Supply voltage : Main 4.2V (Li-Ion)  
Sub 2.4V(Ni-MH) or 3V(Alkaline), AAA size 2cell
- RF protocol : Mobitex
- Host protocol : MASC

## 2. Specification and features

### A. Environment

- Operation temperature: -30℃ ~ +60℃
- Storage temperature : -35℃ ~ +80℃
- Humidity : normal operation after 8 hours storage in 95% non-condensed

### B. General RF specifications

- Modulation : GMSK
- Mode : half-duplex
- Bit rate : 8,000bps

### C. Radio interface

- Channel spacing : 12.5KHz
- Bandwidth : 10KHz

**D. Transmitter**

- Frequency : 896 ~ 901 MHz
- Transmit power (MAX Power : 2W)

| Roaming Value<br>dBμV (RV) | Output-Power<br>W(dBm) |
|----------------------------|------------------------|
| RV<30                      | 2.00W±2dB(33dBm)       |
| 30≤RV<36                   | 0.5W±2dB(27dBm)        |
| 36≤RV<42                   | 0.125W±2dB(21dBm)      |
| 42≤RV<50                   | 0.03W±2dB(15dBm)       |

- Frequency stability : ±1.5ppm
  - Modulation stability : ±5%
  - FM deviation : 2.0KHz ± 0.1KHz (Logic '1')  
-2.0KHz ± 0.1KHz (Logic '0')
  - Harmonic and Spurious Emission : ≤ -56dBc(Portable)  
≤ -60dBc(Mobile)
  - Output Power in carrier off : 0.25μW(-36dBm)
  - Spurious RF Radiation Carrier Off
    - : ≤ -60dBm (896 ~ 901MHz band)
    - : ≤ -80dBm (935 ~ 941MHz band)

**E. Receiver**

- Frequency : 935 ~ 941MHz
- Sensitivity : ≤ -115 dBm (<1% BER )
- Adjacent Channel Rejection : > 55dB
- Out-of-Band Rejection (fo ±1 to 10MHz) : > 60dBc
- Image frequency rejection : > 45dBc

### 3. Circuit guide

#### A. RF circuit

CNI-930M circuit consists of five parts, each of which is power supply, antenna, synthesis/modulation of frequency, transmission and reception.

##### ① Power supply

Power supply is composed of voltage regulator and switching part. Voltage regulator generates 3V of power supplied from VBB when the control of RF\_EN switch is turned on.

When RF\_EN is high, RF\_VCC is regulated with 3V, and RF\_VCC is supplied to PLL IC, VCTCXO, OP-Amp, VCO, and Drive Amp.

When RX\_EN is low, RX\_VCC is turned on by switching TR for RX, and RX\_VCC (3V) is supplied to LNA, MIXER, IF AMP and IF IC.

When TX\_EN is low, TX\_VCC is turned on by switching TR for TX, and TX\_VCC (3V) is supplied to Buffer Amp and OP-Amp.

The switch between TX mode and RX mode can be achieved by control of RX\_EN and TX\_EN.

##### ② Antenna

Antenna part is composed of antenna matching circuit, BPF, and RX/TX signal isolation circuit.

CNI-930M adapts  $\lambda/4$  retractable antenna to match to mid range frequency of communication. (refer to Antenna Specification)

TX/RX signal isolation circuit isolates signals of communication and is composed with switching diode and inductor.

The signals received from antenna meet the send/receive path and then switching diode is turned on and the signals proceed only to receiving path. In receiving mode, signals from TX Power Amp can not go through RX path because switching diode is off.

### ③ Frequency synthesizer and modulator

Frequency synthesizer consists of PLL part, VCO module and pre-modulation filter. The PLL part is composed of phase detector, loop filter, and 12.6Mhz VCTCXO

VCO module generates 896~901Mhz frequencies in accordance with the voltage which is from charge pump of PLL to loop filter. Programmable Divider in PLL makes the VCO output frequency to any channel value according to the frequency data from Logic CPU. Phase detector gets low and high frequencies from comparison of phase. Loop filter filters the frequencies to get a value of voltage. The voltage is input to VCO to achieve phase lock process.

Modulation is completed when modem IC signal of Logic part is input to VCO and authorized.

### ④ Receiver

Receiver filters and amplifies RF signal through SAW filter and LNA.

RX part is double super heterodyne type, and consists of LNA, LPF, Mixer, SAW filter and IF IC part. There happens RX signal from antenna and the signal is low-noise-amplification(LNA) through SAW filter and LNA, and it comes to 2nd IF 455KHz via 2nd X-TAL(39.545MHz).

SAW filter rejects Image frequency( $RX \pm 2 \cdot IF$ ) generated from 1'st Mixer while receiving. For example, if the input channel is 939MHz, the output frequency would be 40MHz from mixer while local frequency is 899MHz. But if SAW filter will not filter the image frequency of  $899 \pm 2 \cdot IF$ , S/N would be worse with 40MHz( $899 - 859 = 40$ ) of noise. And SAW filter should filter to prevent local frequency becoming spurious through LNA and reverse path.

LNA amplifies and sends the faint signal from antenna to mixer, and mixer TR mixes and generates 1st IF with frequency from antenna.

IF comes from mixer, and IF contains inter-modulation product component. MCF removes that product component. So clean IF(40MHz) can be inserted to IF IC. 2nd local frequency entered IF IC is mixed with the IF(40MHz) signal to be 2nd IF of

455KHz simultaneously.

2nd IF signal of 455KHz passes LPF(Ceramic filter) to remove the noise, and the signal is de-modulated with discriminator method. Here detected RF signal entered into receiver and RSSI signal which indicates the strength, and they are passed to micro processor in analogue value.

## ⑤ Transmitter

Transmitter consists of driver amp and power amplifier, and TX power control. It generates carrier frequency while share RX with frequency synthesizer.

Local frequency is used to direct transmission frequency because there is difference between transmission and reception. So it only amplifies and propagates through PA(Power Amp.) which can get high level of gain easily with low power.

## B. LOGIC Circuit

### ① Summary

This unit consists of CPU part, memory part, IO part, modem part, and power supply part.

### ② CPU part

The CPU adopted by this unit has 16/32-bit ARM7TDMI RISC processor (66MHz) and works on 20.48MHz. The main functions are as follows;

- Execute MASC protocol
- Control PLL circuit of RF part and perform Power Saving function
- Perform Data transaction function( receiving and transmitting) through Data Pump(Modem) part
- Checking and processing of RSSI Level come from RF part
- Perform Data transaction with DTE through DTE interface part

### ③ Memory part

Memory part consists of FLASH Memory (16Mb, IC2) and DRAM(16Mb, IC6). Flash Memory stores LLI information and program. And SRAM supplies memory stacks for program.

**④ IO Part**

Input Part is consists of

- Touch PAD Interface adopted touch panel enables user's graphic data input
- side SLIDE Key
- side ESC Key

Output Part is consist of

- Screen Display Part with 160\*240 pixel, legible high resolution display screen, all kind of information composed of characters and graphics can be caught by simple glance of look
- front top dual mode LED operation control signal of CPU.

**⑤ Modem Data Pump**

Modem part is in charge of MASC protocol , and transmits two way Data between CPU and RF part. The main functions are as followings :

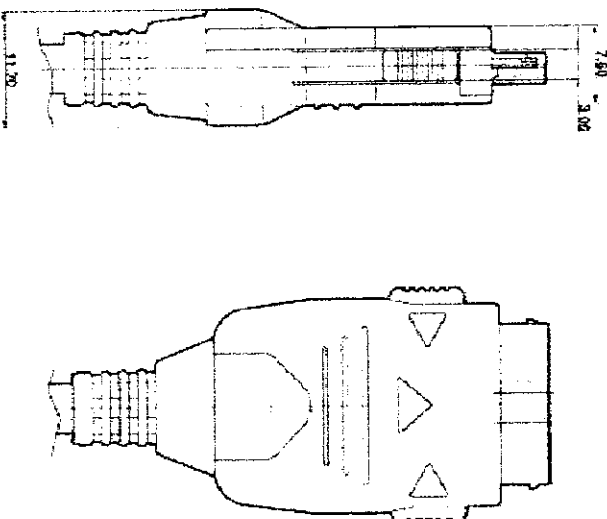
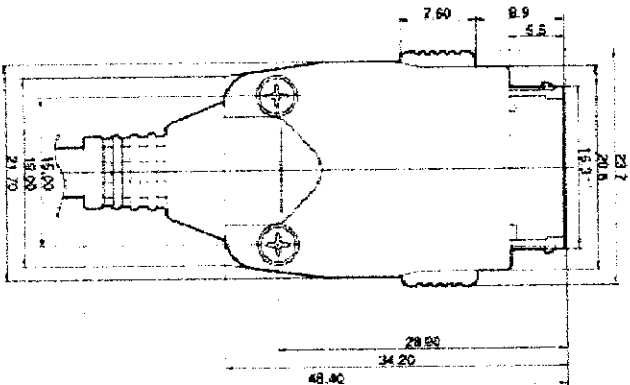
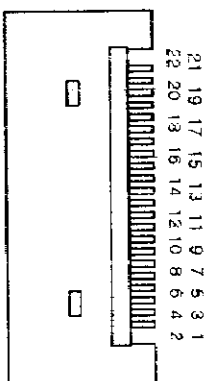
- Packet Data Framing
- GMSK Data Modulation
- FEC Encoding/Decoding
- Interleaving/De-interleaving

**⑥ POWER Supply Part**

Power Supply part converts external Power source, VBB to 3V which is needed for internal operation.

**⑦ Screen Display Part**

With 240 X160 pixel, legible high resolution display screen, all kinds of information composed of characters and graphics can be caught by simple glance of look. And adopted touch panel enable user's graphic data input.



|             |                       |
|-------------|-----------------------|
| 1. DCD IC   | : Data Carrier Detect |
| 2. RXD IC   | : Receive Data        |
| 3. TXD OC   | : Transmit Data       |
| 4. DTR OC   | : Data Transmit Ready |
| 5. GND      | : Ground to Host      |
| 6. DSR IC   | : Data Set Ready      |
| 7. RTS OC   | : Request to Send     |
| 8. CTS IC   | : Clear to Send       |
| 9.          | : Reserved            |
| 10. DCD I   | : Data Carrier Detect |
| 11. RXD I   | : Receive Data        |
| 12. TXD O   | : Transmit Data       |
| 13. DTR O   | : Data Transmit Ready |
| 14. DSR I   | : Data Set Ready      |
| 15. RTS O   | : Request to Send     |
| 16. CTS I   | : Clear to Send       |
| 17.         | : Reserved            |
| 18. EXT_GND | : Ground to Host      |
| 19. EXT_GND | : Ground to Host      |
| 20.         | : Reserved            |
| 21. EXT_VCC | : 4V Power Supply     |
| 22. EXT_VCC | : 4V Power Supply     |

#### 4. Antenna Specification

**Product Name :** Retractable ANT of 900MHz Range

**MODEL :** HR-809

**Manufacturer :** ACE ANTENNA Corp.

##### ① Application

This specification describes  $\lambda/4$  WHIP ANTENNA used for frequency range of 900MHz for transmission DATA of wireless.

##### ② Conditions of using Antenna

■ Handheld ■ Fixed ■ Mobile ■ Outdoor ■ Indoor □ Others

##### ③ Antenna type

Extendable with  $\lambda/4$  Helical over  $\lambda/4$  WHIP.

##### ④ Electrical features and Performance

| Item              | Features/Performance                                          | Remark |
|-------------------|---------------------------------------------------------------|--------|
| Frequency range   | 910 ~ 914 MHz                                                 |        |
| Nominal impedance | 50 $\Omega$                                                   |        |
| V.S.W.R           | Less Than 1.9:1 (Extended )<br>Less Than 1.9:1 (Retractable ) |        |

|                   |                |  |
|-------------------|----------------|--|
| Radiation Pattern | Omni-direction |  |
| Polarization      | Vertical       |  |
| Gain              | 0±1dBi(Unity)  |  |

### ⑤ Structural Specification

| Item           | Specification/Features | Remark |
|----------------|------------------------|--------|
| Connector Type | SCREW                  |        |
| Total length   | 95 ± 0.5mm             |        |

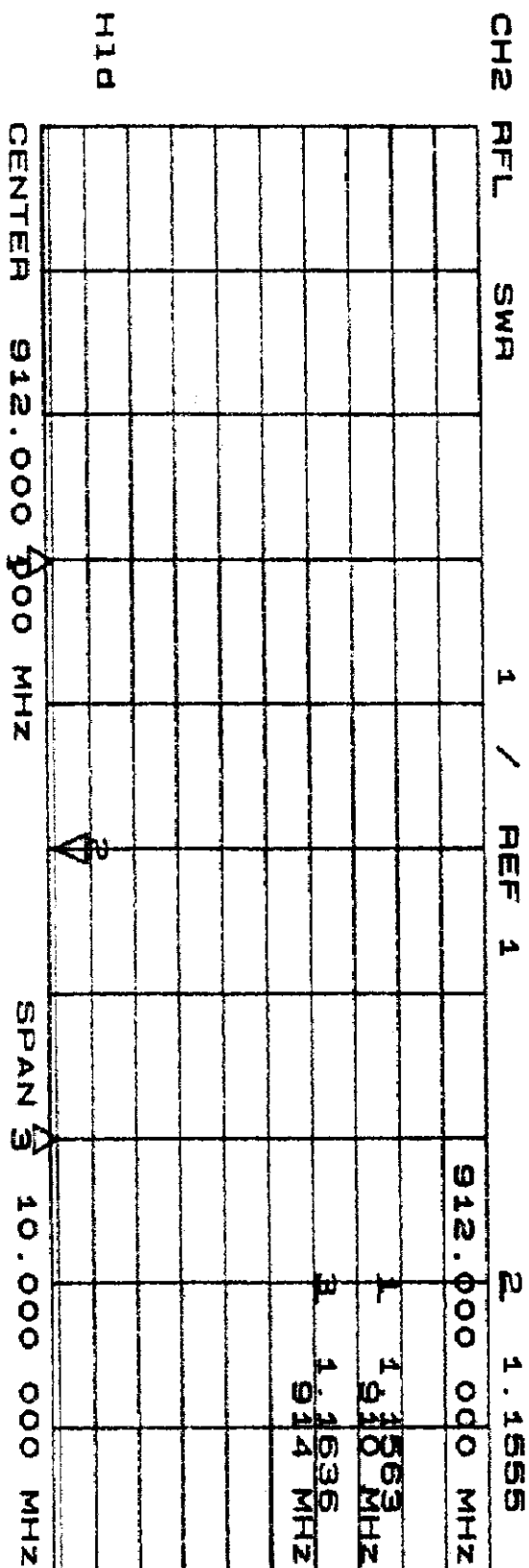
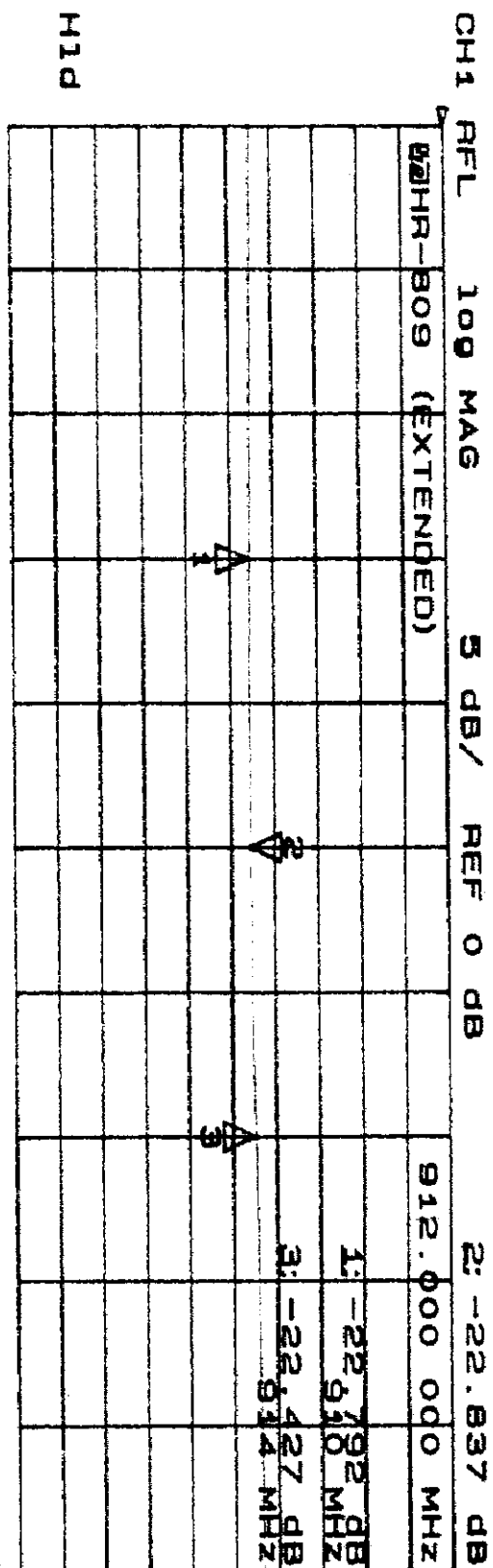
### ⑥ Other features and performance

#### A. Temperature

Antenna shall not be deformed or damaged and shall satisfy "Clause 4" in this specification after Placing Antenna at -30℃ and 60℃ for 96 hours.

#### B. Humidity

After placing Antenna at surrounding temp. 40℃ with relative humidity of 90 ~ 95 for 96 hours, antenna shall not be deformed or damaged, and shall satisfy "Clause 4" in this specification



[illegible]

HHH

| CH2 | RFL | 1 U FS | 2 |  | -1.9473 n       | 89.619 DF |
|-----|-----|--------|---|--|-----------------|-----------|
|     |     |        |   |  | 912.000 000 MHz |           |

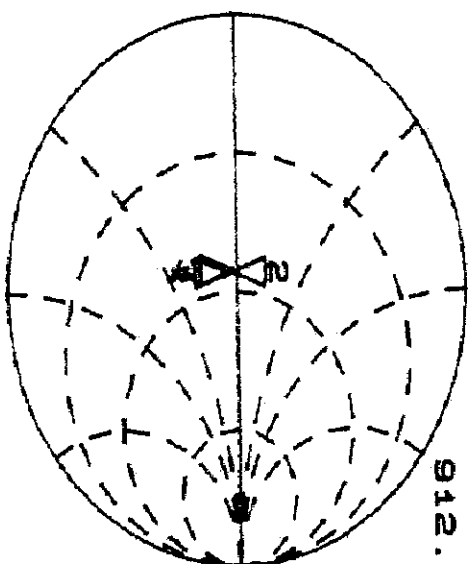
CH2 PFL 1 U FS

**10**

43.537 6

-1.9473 2

89.619 pt



|   |        |      |     |
|---|--------|------|-----|
| 1 | 43.910 | 63.7 | GC  |
| - | 9.1    | 0.1  | MHZ |
| 3 | 43.914 | 63.7 | GC  |
| - | 9.1    | 0.1  | MHZ |

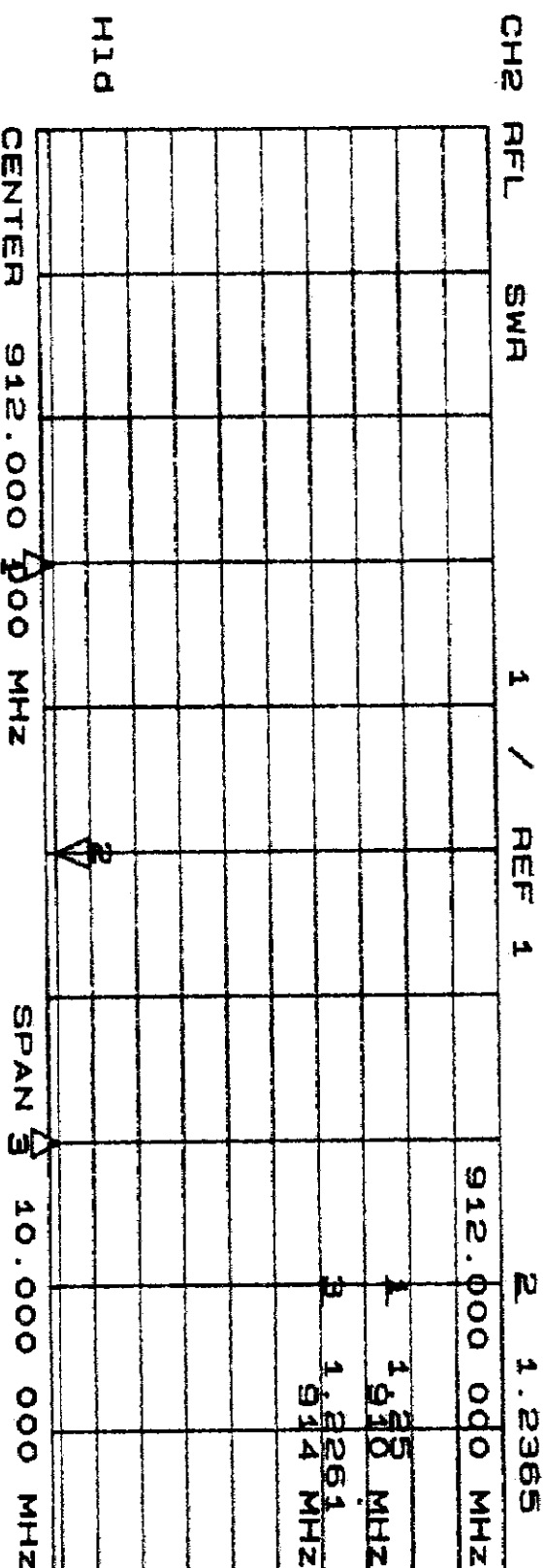
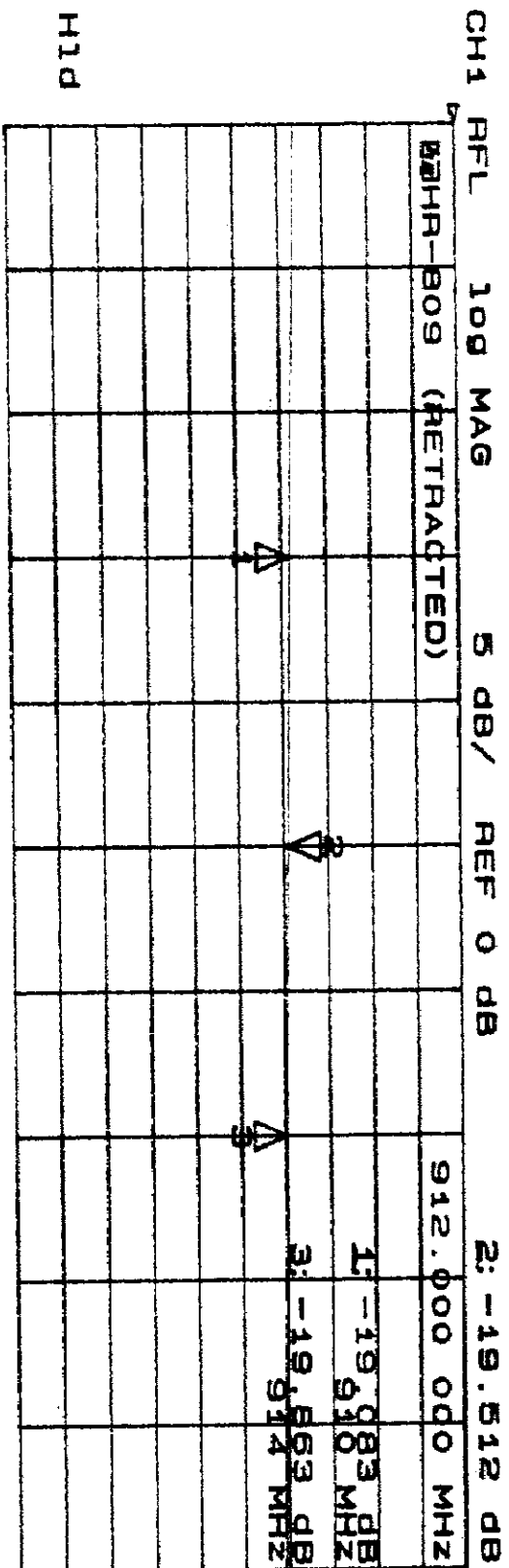
1  
 2  
 3  
 4  
 5  
 6  
 7  
 8  
 9  
 10  
 11  
 12  
 13  
 14  
 15  
 16  
 17  
 18  
 19  
 20  
 21  
 22  
 23  
 24  
 25  
 26  
 27  
 28  
 29  
 30  
 31  
 32  
 33  
 34  
 35  
 36  
 37  
 38  
 39  
 40  
 41  
 42  
 43  
 44  
 45  
 46  
 47  
 48  
 49  
 50  
 51  
 52  
 53  
 54  
 55  
 56  
 57  
 58  
 59  
 60  
 61  
 62  
 63  
 64  
 65  
 66  
 67  
 68  
 69  
 70  
 71  
 72  
 73  
 74  
 75  
 76  
 77  
 78  
 79  
 80  
 81  
 82  
 83  
 84  
 85  
 86  
 87  
 88  
 89  
 90  
 91  
 92  
 93  
 94  
 95  
 96  
 97  
 98  
 99  
 100  
 101  
 102  
 103  
 104  
 105  
 106  
 107  
 108  
 109  
 110  
 111  
 112  
 113  
 114  
 115  
 116  
 117  
 118  
 119  
 120  
 121  
 122  
 123  
 124  
 125  
 126  
 127  
 128  
 129  
 130  
 131  
 132  
 133  
 134  
 135  
 136  
 137  
 138  
 139  
 140  
 141  
 142  
 143  
 144  
 145  
 146  
 147  
 148  
 149  
 150  
 151  
 152  
 153  
 154  
 155  
 156  
 157  
 158  
 159  
 160  
 161  
 162  
 163  
 164  
 165  
 166  
 167  
 168  
 169  
 170  
 171  
 172  
 173  
 174  
 175  
 176  
 177  
 178  
 179  
 180  
 181  
 182  
 183  
 184  
 185  
 186  
 187  
 188  
 189  
 190  
 191  
 192  
 193  
 194  
 195  
 196  
 197  
 198  
 199  
 200  
 201  
 202  
 203  
 204  
 205  
 206  
 207  
 208  
 209  
 210  
 211  
 212  
 213  
 214  
 215  
 216  
 217  
 218  
 219  
 220  
 221  
 222  
 223  
 224  
 225  
 226  
 227  
 228  
 229  
 230  
 231  
 232  
 233  
 234  
 235  
 236  
 237  
 238  
 239  
 240  
 241  
 242  
 243  
 244  
 245  
 246  
 247  
 248  
 249  
 250  
 251  
 252  
 253  
 254  
 255  
 256  
 257  
 258  
 259  
 260  
 261  
 262  
 263  
 264  
 265  
 266  
 267  
 268  
 269  
 270  
 271  
 272  
 273  
 274  
 275  
 276  
 277  
 278  
 279  
 280  
 281  
 282  
 283  
 284  
 285  
 286  
 287  
 288  
 289  
 290  
 291  
 292  
 293  
 294  
 295  
 296  
 297  
 298  
 299  
 300  
 301  
 302  
 303  
 304  
 305  
 306  
 307  
 308  
 309  
 310  
 311  
 312  
 313  
 314  
 315  
 316  
 317  
 318  
 319  
 320  
 321  
 322  
 323  
 324  
 325  
 326  
 327  
 328  
 329  
 330  
 331  
 332  
 333  
 334  
 335  
 336  
 337  
 338  
 339  
 340  
 341  
 342  
 343  
 344  
 345  
 346  
 347  
 348  
 349  
 350  
 351  
 352  
 353  
 354  
 355  
 356  
 357  
 358  
 359  
 360  
 361  
 362  
 363  
 364  
 365  
 366  
 367  
 368  
 369  
 370  
 371  
 372  
 373  
 374  
 375  
 376  
 377  
 378  
 379  
 380  
 381  
 382  
 383  
 384  
 385  
 386  
 387  
 388  
 389  
 390  
 391  
 392  
 393  
 394  
 395  
 396  
 397  
 398  
 399  
 400  
 401  
 402  
 403  
 404  
 405  
 406  
 407  
 408  
 409  
 410  
 411  
 412  
 413  
 414  
 415  
 416  
 417  
 418  
 419  
 420  
 421  
 422  
 423  
 424  
 425  
 426  
 427  
 428  
 429  
 430  
 431  
 432  
 433  
 434  
 435  
 436  
 437  
 438  
 439  
 440  
 441  
 442  
 443  
 444  
 445  
 446  
 447  
 448  
 449  
 450  
 451  
 452  
 453  
 454  
 455  
 456  
 457  
 458  
 459  
 460  
 461  
 462  
 463  
 464  
 465  
 466  
 467  
 468  
 469  
 470  
 471  
 472  
 473  
 474  
 475  
 476  
 477  
 478  
 479  
 480  
 481  
 482  
 483  
 484  
 485  
 486  
 487  
 488  
 489  
 490  
 491  
 492  
 493  
 494  
 495  
 496  
 497  
 498  
 499  
 500  
 501  
 502  
 503  
 504  
 505  
 506  
 507  
 508  
 509  
 510  
 511  
 512  
 513  
 514  
 515  
 516  
 517  
 518  
 519  
 520  
 521  
 522  
 523  
 524  
 525

W. C. H. N.

III

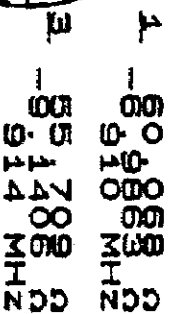
CENTER 912.000 000 MHZ

SPAN 10.000 000 MHZ



**HLA**

CH12



CENTER 912.000 000 MHZ SPAN 10.000 000 MHZ

## 5. Duty Cycle

The SAR measurement is used CW mode with test firmware modified but on Mobitex network does not allow the mobile devices to control the timing of transmitted packets on a message transaction basis. This makes that the duty factor is limited to the maximum allowable over all network transactions.

### Duty Cycle Calculation

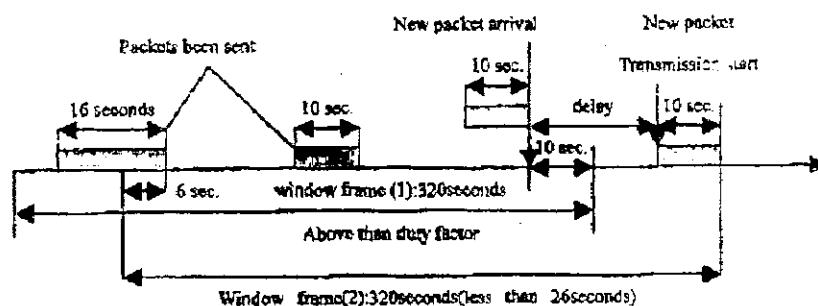
The Two Way Messenger model CN1-930M(FCC ID : N79CN1-930M) is designed to use Mobitex protocol and data speed is 8,000 bps.

The operating duty factor implemented in our two-way messenger will be limited to 8.13% to meet maximum allowable SAR requirement.

The limiting algorithm's basic idea is as follows:

The basic window frame is 320 seconds. Within this window frame period, the actual transmission time will be restricted to duty factor 8.13% (26 seconds). To insure that the duty factor is limited to the maximum allowable overall network transaction, we use calculation based window averaging, not fixed duration windowed time averaging.

The following figure will explain our duty factor limiting algorithm.



From the above figures, whenever new packet transmission is required, new window frame including predefined new packet transmission time has to be determined and the duty factor for this new window frame is calculated. If the calculated duty factor is less

than 8.13% (26 seconds). Then the packet transmission will be confirmed and transmitted immediately. However, if the duty factor is more than the limit, the packet transmission will be delayed until confirmation. In the figure, the duty factor calculated within window frame(1) is more than 26 seconds so that the packet cannot be transmitted immediately. The packet will be delayed until new window frame is calculated and calculated duty factor is evaluated to be less than 8.13% which is like the case of window frame(2).

As convenience, the above explanation does not include the time between confirmation to actual transmission which is like sync search time etc.. Every time factor that affects duty factor calculation will be considered in the device to be marked.