![TERIDIAN SEMICONDUCTOR CORP. logo]

Simplifying System Integration™

73M2901CE

AT Command User Guide

Table of Contents

Tables

1   Introduction

The Teridian Semiconductor 73M2901CE supports an optimized version of the industry standard Hayes AT Command Set. The primary distinction between the Hayes AT Command Set and the 73M2901CE AT Command Set is in the use of the & (ampersand) command. The 73M2901CE does not use the & command. Many 73M2901CE commands relate directly to the Hayes & commands but this is not always the case. For instance the 73M2901CE ATC[n] command is similar to the Hayes AT&C[n] command but it is not identical. Please be aware that these differences exist.

AT commands are issued using the following convention:

> AT<command string><Enter>

AT commands must be preceded by the characters "AT". The modem uses this sequence of ASCII characters to determine the speed and parity of the DTE. The modem expects a command or string of commands to follow.

Command String Conventions

The command string may consist of a letter, for example F.
The command string may consist of a letter followed by a number, for example N2.
The command string may consist of an S-register set equal to a value, for example S30=4.
The command string may consist of a string of all of the above, for example FS99=1B2C1X4S30=4.
Generally the order of the commands is not significant unless S-registers are set. Refer to Section 4, S-registers.

Enter

AT Commands must be followed by an <Enter>

EXAMPLES: ATFS99=1Y6K3C1R2S30=4   V.22bis using flow control (U.S.)
              ATDT2   Go off hook and dial the number 2
              ATS95+$10   Set the Caller ID enable pin

There are two exceptions to this convention, the commands A/ (repeats last instruction issued) and +++ (enter online command mode) are neither preceded by an "AT" nor followed by a "CR", nor do they take any arguments. They are each described under the AT Commands heading in this section.

Online Command Mode

Online command mode allows the user to issue AT commands, including setting and reading some S-registers, while connected. After a connection has been established, and in the absence of streaming data, one can enter online command mode and send instructions to the modem. Not all commands issued while in online command mode will take effect immediately. Some AT commands, including S-Register settings, will not take effect until after the connection has been broken. For instance you would not be able to change modulation standards or from synchronous to asynchronous data while connected. In addition values read from some S-registers while in online command mode may not accurately reflect certain states.

Entering Online Command Mode

Issue this command to the modem (neither preceded by "AT" nor followed by <ENTER>):   +++
Timing is critical when entering this command, enter each "+" character one after another at a steady rate. If the modem does not respond, repeat the command adjusting the speed of the key presses.
The modem should respond with: OK
The modem is now ready to accept AT Commands just as if it were in idle mode. The "+++" can be followed by an AT command without waiting for the OK, so the string "+++ATS10=255O" could be sent to cause the modem to go into the command mode change the setting of S10 and go back on line without waiting for the modem to return the OK message.

Return to Data Mode

Issue the following command: ATO
The modem should respond with: CONNECT [DTE SPEED]
The modem is now back in data mode and ready to send and receive data.

2   AT Commands

2.1   A – Answer

The A command causes the modem to immediately go on-line (off-hook) in the Answer mode and attempt to handshake regardless of the value of register S0, discussed later. This command gives you a method of manually answering an incoming phone call. For restrictions, see also the R command.

2.2   A/ – Repeat Last Command

The A/ command causes the modem to re-execute the last command that was issued. For example, this command can be used to redial a number if the previous command was a dial command.

NOTE: A/ and +++ are the only commands that are neither preceded by AT nor followed by <Enter>.

2.3   B – Bell, ITU, V.23, or Bell202 Operation

The B[n] command is used to select between modes of operation.

   B0   Selects ITU V.22Bis, V.22 or V.21 operation (default).
   B1   Selects Bell212A or Bell103 operation.

   B2   Selects 1200 bps. receive and 75 bps. transmit for V.23 operation.
   B3   Selects 75 bps. receive and 1200 bps. transmit for V.23 operation.

   B4   Selects 1200 bps. receive for Bell202 operation.
   B5   Selects 1200 bps. transmit for Bell202 operation.

   B6   Selects 1200 bps. receive and transmit for 4-Wire V.23 operation. (V23T)
   B7   Selects 1200 bps. receive and transmit for 4-Wire V.23 operation. (V23T)

   B8   Selects 1200 bps. receive and transmit for 4-Wire Bell202 operation. (B202T)
   B9   Selects 1200 bps. receive and transmit for 4-Wire Bell202 operation. (B202T)

   B10   Selects 1200 bps V.23 Half duplex mode (V23H). B10 and B11 are the same.
   B11   Selects 1200 bps V.23 Half duplex mode (V23H). B10 and B11 are the same.

2.4   C[n] – Select Carrier Detect Option

The C[n] command selects how the Carrier Detect (CD) signal is controlled.

   C0   CD forced ON. (Default)

   C1   CD ON in presence of valid debounced carrier signal.

   C2   CD ON in presence of raw carrier signal. Receive data independent of valid carrier signal. (May
          be reserved)

Operation of DCD:
Normal modes:

C0 – ON at all times

```
 ____          _ _ _ _ _ _ _ _ _ _   OFF
|DCD|     _____   ON
```

C1 – ON while connected
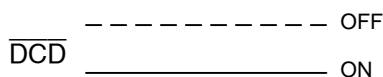
```
 ____     _____           _____
|DCD|    | Not connected |   | Not Connected
         |_____|
            Connected
```
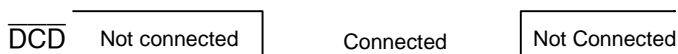
V.23 turnaround

```
 ____     _____           _____
|DCD|    |                |  |
         |   V.23 turn around  |
         |_____|
```
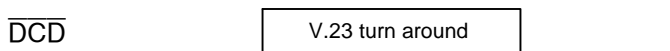
2.5   D[n...n] – Dialing String

This command puts the modem into originate mode and instructs the modem to dial the phone number expressed by the string argument n...n. The number will be dialed with either tones or pulses depending on how the last number was dialed. On power up, this command will default to pulse dialing. (See the note in DT[n...n] command.) The allowable arguments for n...n differ for pulse and tone dialing; see the descriptions under DT[n...n] and DP[n...n].

     DP[n...n] n = 0-9 , P T R ; @ ! W S[r]=[n]J5.[n]

This command instructs the modem to dial the phone number expressed by the argument n...n using pulse dialing. (See the detailed description of the arguments under DT[n...n] below.)

     DT[n...n] n = 0-9 A B C D * # , P T R ; @ ! W S[r]=[n]J5.[n]

This command instructs the modem to dial the phone number expressed by the argument n...n using tone dialing.

In addition to 0-9 A B C D * #, which are the same as the keys on your phone, there are some special characters that can be included in a dialing string. They are called Dial String Modifiers, and they define how the phone number is to be dialed. These characters are P R T ; , @ ! W.

A-D*# The characters A B C D, and the symbols * and #, can be used only during tone dialing. They are typically used to access newer features of modern telephone systems.

P   The modem pulse dials the digits that follow.

R   The modem uses answer mode frequencies after dialing the number. This allows you to dial up an originate only modem. Busy detect is disabled during Reverse Dial.

T   The modem tone dials the digits, characters, and symbols that follow.

;   A ; (semicolon) causes the modem to go back into the Command State, allowing you to enter other commands while on-line. To do this, the ; must be the last character in the command line.

,   When inserted in a dialing string, a , (comma) causes the modem to pause. The default time for the pause is two seconds, and can be changed by modifying register S8.

@   A @ (commercial "at") causes the modem to wait up to 30 seconds for a 5 second period of quiet before proceeding. This is often used to detect the end of a prerecorded message. The default wait

time is 30 seconds, and can be changed by modifying register S7. Result Codes 7 and 8 will be reported regardless of which Result Code Set is selected.

!   An ! (exclamation mark) causes a "hook flash." This simulates hanging up for 1/2 second and then reconnecting. It is typically used for transferring calls.

W   Causes the modem to wait for a dial tone for a specified length of time before proceeding. The default is 8 seconds, and can be changed by modifying register S66. Result Code 6 will always be included regardless of which Result Code Set is selected.

J   PTT Test. See the J[n] command.

2.6   E[n] – Echo Commands On/Off

n = 0 or 1 (factory default = 1)

Causes the modem to either echo characters or not to echo characters while in the Command State.

E0   Command State Echo mode is OFF.

E1   Command State Echo mode is ON.

2.7   F– Load Factory Defaults

The F command replaces the current active configuration profile with the factory standard configuration profile stored in permanent memory. Returns ERROR result code, if modem is off-hook.

2.8   G – Guard Tone Select

This command selects the guard tone.

G0   Guard tones disabled (default).

G1   550Hz guard tone enabled.

G2   1800Hz guard tone enabled.

2.9   H[n] – On-Hook/Off-Hook Control

n = 0 or 1 (factory default = 0)

The H[n] command causes the modem to go off-hook or on-hook. (Going off-hook means that the modem "picks up" the telephone; going on-hook means that the modem "hangs up" the telephone.) The H[n] command applies only to asynchronous operation.

H0   Go On-hook (hang up) or terminate PTT test.

H1   Go Off-hook (pick up the phone).

Note: ON HOOK:
Commands used:
@Z, Z, H0, F, J0, at the beginning of hook flash, at a pulse break and at disconnect and reset.
OFF HOOK:
Commands used:
H1, D, J1, J2, J3, J4, A and auto answer

2.10   I[n] – Identification and ROM Tests

n = 0 to 11. Default is no test in progress.

The I[n] command requests that the modem respond with certain product information.

I0   Returns product identification code.

I1   Returns the firmware ROM checksum number.

I2   Computes the firmware ROM checksum and returns with either an OK or ERROR result code
message

I3   Returns firmware revision number.

I4   Returns copyright notice.

I5   RAM test.

I6   MAC RAM test.

I7   MAC ROM test.

I8   RAM address decode test.

I9   MAC address decode test.

I10   Return ROM CRC.

I11   Check ROM CRC.

2.11   J[n] – PTT Test

Default is take no action (not in test mode).

J0   Stop J test in progress.

J1   Transmit DTMF tones specified by S12, S13, and S85.

J2   Transmit Answer tone or Calling tone specified by S27, S13 and S91.

J3   Transmit Modulation specified by S14, S30, S60 and the B command.

J4   Transmit Silence.

J5   Delay (To set up the delay use J5.[n]. [n] is in 10ms. Range is 1 to 211).

J6   Allow detection of CAS and DTMF tones.

J7   Analog interface test mode. (S113 is used as the minimum carrier detect threshold).

J8   Type 2 CID test mode for use with the Advent system.

2.12   K[n] – Flow Control

The K[n] command selects which flow control options are available when rate buffering.

K0   Flow Control Disabled (Default).

K3   RTS/CTS.

K4   XON/XOFF.

When 15 or more bytes are in the TX buffer   When 4 or less bytes are in the TX buffer

$\overline{CTS}$
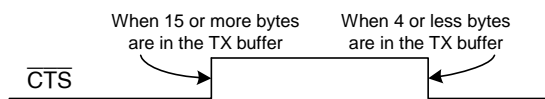
RTS/CTS flow control

2.13   L[n] – Fast Connect

The L[n] command enables the modem to perform 1200 Fast Connects.

L0   Disable Fast Connect (default).

L1   Disable 2100Hz answer tone and billing delay.

L2   2-second billing delay enabled with no 2100Hz answer tone.

L3   400ms answer tone and billing delay enabled.

2.14   N[n] – Data Set Ready Signal Control

The function of the $\overline{DSR}$ line is determined by the N[n] command. n = 0 to 2.

N0 $\overline{DSR}$ is always ON (low).

N1 $\overline{DSR}$ off (high) in the idle state and when in a test mode. $\overline{DSR}$ circuit is turned on at start of the handshaking   process. $\overline{DSR}$ is turned off when hang-up process is started.

N2 $\overline{DSR}$ off in the idle state and when in a test mode. $\overline{DSR}$ circuit is turned on at the end of handshake after issuing the "CONNECT" result code. $\overline{DSR}$ is turned off when hang-up process is started.

1.   Mode V.22bis, Protocol enabled (through S25), Extended result codes.

V.22bis Connection	Carrier Result	V.42 Detection	Protocol/Connect Result	Data Mode

$\overline{DCD}$

$\overline{DSR}$
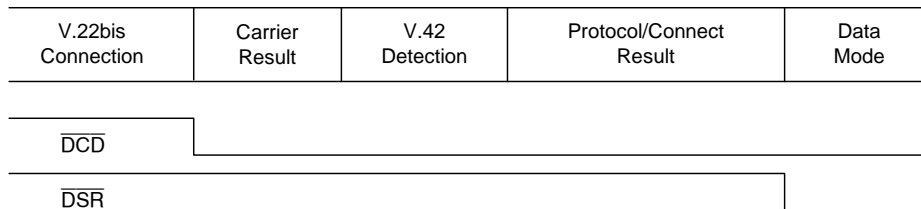
2. Mode V.22bis, Protocol enabled (through S25), Normal result codes.

V.22bis Connection	V.42 Detection	Connect Result	Data Mode

$\overline{\text{DCD}}$

$\overline{\text{DSR}}$
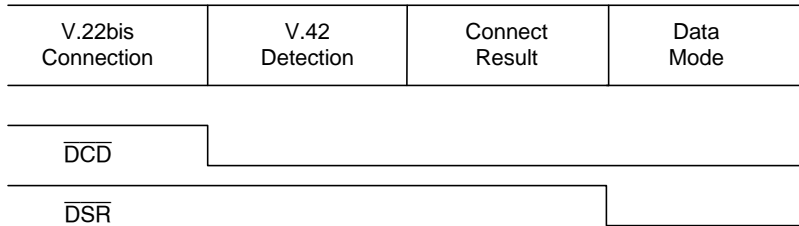
3. Mode V.22bis, Protocol enabled (through S25), No result codes.

V.22bis Connection	V.42 Detection	Data Mode

$\overline{\text{DCD}}$

$\overline{\text{DSR}}$
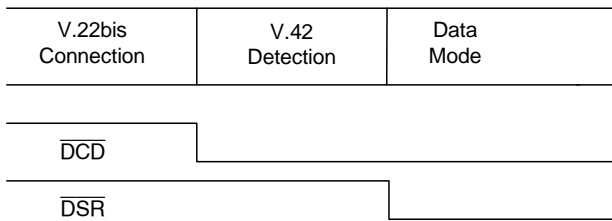
4. Mode V.22bis, No Protocol, Extended result codes

V.22bis Connection	Carrier Result	Protocol/Connect Result	Data Mode

$\overline{\text{DCD}}$

$\overline{\text{DSR}}$
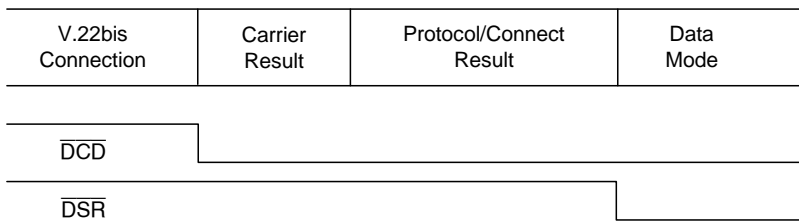
5. Mode V.22bis, No Protocol, No result codes.

V.22bis Connection	Data Mode

$\overline{\text{DCD}}$

$\overline{\text{DSR}}$
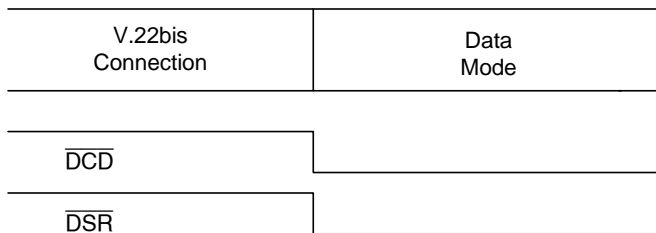
2.15   O[n] – Return to On-Line

The O[n] command is used to go back on-line when the command state was entered by issuing the +++AT escape sequence or turning DTR from ON to OFF with the appropriated S-Register setting in effect. The O[n] command applies only to asynchronous operation.

O0   If you have returned to Command state from Data state without breaking a connection, the O0 command will   return you on-line (Data state).

O[1-7] Retrain
O1   Similar to O0, but also causes the modem to initiate an equalizer retrain sequence.

O2   Enables the modem to respond to a remote request for retrain.

O3   Disables the modem to respond to a remote request for retrain (default).

O4   Enables speed negotiation.

O5   Disables speed negotiation (default).

O6   Enables rate change to 1200 bps.

O7   Enables rate change to 2400 bps (default).

Note: If commands O0 or O1 are given to the modem while not connected, it will respond with ERROR.

2.16   P – Pulse Dial

Causes the modem to pulse dial until tone dialing is selected or the modem is reset.

2.17   Q[n] – Result Codes On/Off

The Q[n] command tells the modem to either report result codes or to remain quiet. Result codes acknowledge AT commands and call status events. Also refer to the V[n] and X[n] commands.

Q0   Report Result Codes (default).

Q1   Stay quiet.

2.18   R[n] – Select Data Terminal Ready Option

The R[n] command selects how the Data Terminal Ready ($\overline{DTR}$) signal is used by the modem.

R0 – In Asynchronous mode, the modem ignores $\overline{DTR}$. (Default)

R1 – Modem assumes the Command State when $\overline{DTR}$ transitions from ON to OFF.

R2 – Modem goes on-hook (hangs up), disables the Auto Answer mode, and assumes the Command State when $\overline{DTR}$ transitions from ON to OFF. Turning $\overline{DTR}$ back ON will enable auto-Answer mode.

R3 – Modem is reset when $\overline{DTR}$ transitions from ON to OFF.

R4 – Enable V.23 Turnaround via $\overline{DTR}$ (On to Off edge triggered) in Master mode. Turn around is done via $\overline{RTS}$ in all other R command settings.

R5 – Power Down with setting $\overline{DTR}$ high (requires hard reset to resume normal operation).

2.19   S[r] – Modify/Read S-registers

S[r]? Show S-register Value

The S[r]? command requests the modem to report the current value of register [r]. These registers are used to set up various operating parameters of the modem as explained in Section 5. The value reported is in decimal notation.

S[r]$ Show S-register Value in Hexadecimal

The S[r]$ command requests the modem to report the current value of register [r]. The value reported is in hexadecimal notation.

S[r]???… Show Successive S-register Values

The S[r]???… command requests the modem to report the current value of [r] and successive registers. The values are reported in decimal notation. The number of registers reported corresponds to the number of ? (question marks) given to the modem.   For an example: S10??? will report the values stored in the registers S10, S11, and S12.

S[r]$$$… Show Successive S-register Values in Hexadecimal

The S[r]$$$… command requests the modem to report the current value of [r] and successive registers. The values are reported in hexadecimal notation. The number of registers reported corresponds to the number of $ (dollar signs) given to the modem.   For an example: S10$$$ will report the values stored in the registers S10, S11, S12.

S[r]=[n] Set S-Register Value

S[r]=[n] Set S-Register Value r = 0 to 104   n = 0 to 255

The S[r]=[n] command allows you to set (modify) the value of any of register [r] to new value [n]. The value [n] is entered in decimal notation.

S[r]=n.$n.n.$n … Set S-register Values

The S[r]=n.$nn.n.$nn… command allows you to set (modify) the value of any of [r] and successive registers to the new values n (decimal notation) or $n (hexadecimal notation). For an example: S10=$F0.128.$EC.25 will set register S10=F0 (hexadecimal) , S11=128 (decimal), S12=EC (hexadecimal), and S13=15 (decimal). All hexadecimal values must be entered in as a two digit hex value. For example enter $0A instead of $A.

S[r]+[n] Set Bits in S-registers

The S[r]+[n] command sets bits in [r] S register by ORing the [n] value and the value currently in the S-Register.

S[r]-[n] Clear Bits in S-registers

The S[r]-[n] command clears bits in [r] S register by ANDing the [not n] value and the value currently in the S-Register.

2.20   T – Tone Dialing

Causes the modem to tone-dial until pulse dialing is selected.

2.21   V[n] – Select Result Codes Numbers/Words

n = 0, 1, 2 (factory default = 1)

The V[n] command instructs the modem to report either verbal (whole words) or numerical result codes. Also refer to the Q[n] and X[n] commands.

V0   Result codes reported as digits (numerals).

V1   Result codes reported as whole words.

V2   Result codes reported as digits (numerals) preceded and followed by <CR><LF>.

2.22   W[n] – Select Extended Result Code

n = 0, 1, 2 (factory default = 0)

The W[n] command determines which result codes will be used to describe the type of connection that was negotiated by the handshake.

W0   Do not return extended result codes (40-80). The message CONNECTS followed by the data rate
         between the DTE and the modem will be sent to the DTE.

W1   The CONNECT message will report the DTE speed then enable the carrier and extended result
         codes.

W2   The CONNECT message will report the DCE speed. All extended result codes are disabled.

Extended Result Codes:

    Result Code 40 = CARRIER 300
    Result Code 41 = CARRIER 600
    Result Code 46 = CARRIER 1200
    Result Code 47 = CARRIER 2400
    Result Code 44 = CARRIER 1200/75
    Result Code 45 = CARRIER 75/1200
    Result Code 70 = PROTOCOL: NONE
    Result Code 77 = PROTOCOL: LAP-M
    Result Code 80 = PROTOCOL: ALT

	Pre Dial			Post Dial		
	W0	W1	W2	W0	W1	W2
X0	0, 2 – 4, 14	0, 2 – 4, 14	0, 2 – 4, 14	0 – 1, 3 – 4, 14	0–1, 3–4, 14	0–1, 3–4, 14
X1	0, 2 – 4, 14	0, 2 – 4, 14 plus extended result codes	0, 2 – 4, 14	0 – 1, 3 – 5, 9 – 14, 22, 23	0–1, 3–5, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 9-14, 22, 23
X2	0, 2, 4, 6, 14	0, 2, 4, 6, 14 plus extended result codes	0, 2, 4, 6, 14	0 – 1, 3 – 5, 9 - 14, 22, 23	0–1, 3–5, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 9-14, 22, 23

	Pre Dial			Post Dial		
X3	0, 2 – 4, 14	0, 2 – 4, 14 plus extended result codes	0, 2 – 4, 14	0 – 1, 3 – 5, 7, 9 - 14, 22, 23	0–1, 3–5, 7, 22, 23 plus extended result codes	0–1, 3–5, 7, 9-4, 22, 23
X4	0, 2, 4, 6, 14	0, 2, 4, 6, 14 plus extended result codes	0, 2, 4, 6, 14	0 – 1, 3 – 5, 7, 9 - 14, 22, 23	0–1, 3–5, 7, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 7, 9–14, 22, 23
X5	0, 2 – 4, 7, 14	0, 2 – 4, 7, 14 plus extended result codes	0, 2 – 4, 7, 14	0 – 1, 3 – 5, 9 - 14, 22, 23	0–1, 3–5, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 9-14, 22, 23
X6	0, 2, 4, 6 - 7, 14	0, 2, 4, 6 - 7, 14 plus extended result codes	0, 2, 4, 6 - 7, 14	0 – 1, 3 – 5, 9 - 14, 22, 23	0–1, 3–5, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 9-14, 22, 23
X7	0, 2 – 4, 7, 14	0, 2 – 4, 7, 14 plus extended result codes	0, 2 – 4, 7, 14	0 – 1, 3 – 5, 7, 9 - 14, 22, 23	0–1, 3–5, 7, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 7, 9-14, 22, 23
X8	0, 2, 4, 6 - 7, 14	0, 2, 4, 6 - 7, 14 plus extended result codes	0, 2, 4, 6 - 7, 14	0 – 1, 3 – 5, 7, 9 - 14, 22, 23	0–1, 3–5, 7, 9–14, 22, 23 plus extended result codes	0–1, 3–5, 7, 9-14, 22, 23

2.23   X[n] – Select Result Code Set

n = 0 to 8 (factory default = 4)
The X[n] command selects normal or extended result code reporting and enables or disables advanced functions.

X0   Enable Result Codes 0-4, 14.

X1   Enable Result Codes 0-5, 10-14.

X2   Enable Result Codes 0-6, 10-14.

X3   Enable Result Codes 0-5, 7, 10-14.

X4   Enable Result Codes 0-7, 10-14 (default).

X5   Enable Result Codes 0-5, 10-14 and detect BUSY at OFF HOOK.

X6   Enable Result Codes 0-6, 10-14 and detect BUSY at OFF HOOK.

X7   Enable Result Codes 0-5, 7, 10-14 and detect BUSY at OFF HOOK.

X8   Enable Result Codes 0-7, 10-14 and detect BUSY at OFF HOOK.

    Result Code 0 = OK
    Result Code 1 = CONNECT
    Result Code 2 = RING
    Result Code 3 = NO CARRIER
    Result Code 4 = ERROR

Result Code 5 = CONNECT 1200
Result Code 6 = NO DIALTONE
Result Code 7 = BUSY
Result Code 8 = NO ANSWER (if @ dial modifier is used and quiet answer is not detected within S7)
Result Code 9 = CONNECT 0600
Result Code 10 = CONNECT 2400
Result Code 11 = CONNECT 4800
Result Code 12 = CONNECT 9600
Result Code 13 = CONNECT 7200
Result Code 14 = LINE-IN-USE
Result Code 22 = CONNECT 75/1200
Result Code 23 = CONNECT 1200/75

If X0, X1, X3, X5 or X7 modes are enabled, the modem will delay a number of seconds (determined by the value of register S6), not check for a dial tone, and then dial.

The @ and W dial modifier result codes are not affected by the Xn command in effect. The @ dial modifier enables result codes 8 (NO ANSWER) and 7 (BUSY) each time it occurs in the dial string. The W dial modifier enables result codes 6 (NO DIALTONE) and 7 (BUSY) each time it occurs in the dial string.

2.24   Y[n] – Selects Asynchronous or Synchronous Modes

n = 0 to 6 (default = 6)

Y0   Asynchronous mode. No speed buffering, no protocol.

Y1   Synchronous mode. No speed buffering, no protocol.

Y4   Quasi-Synchronous mode. Allows the transmission and reception of sync data through an asynchronous DTE by stripping off start and stop bits on transmission and adding them on reception.

Y6   Asynchronous with speed buffering. Allows fixed DTE-DCE speed so applications do not need to change the communications rate based on connection results. (Default) Must be used with flow control (K3 or K4), which is not ON by default.

2.25   Z – Reset Modem

The Z command resets the modem. The Z command is equivalent to a power cycle.

2.26   +++

During a data connection, the escape command (+++) returns you to TIES Command State without terminating the data connection so you can enter AT commands. When in TIES Command State, all the AT commands given to the modem will be seen by the remote modem as data. If a valid AT command is not sent or if data is sent to the modem instead of AT commands while in this mode, the modem will return to data mode.

2.27   +++AT

During a data connection, the escape command (+++AT <ENTER>) returns you to Command State without terminating the data connection so you can enter AT commands.

3   Extended AT Commands

3.1   @A[p] – Modify/Read MAC RAM Memory Value

@A[p].[r]? Inquire MAC RAM Memory Value

The @A[p].[r]? command requests the modem to report the current value of a specified location of MAC RAM. The value reported is in decimal notation.

@A[p].[r]$ Inquire MAC RAM Memory Value

The @A[p].[r]$ command requests the modem to report the current value of a specified location of MAC RAM. The value reported is in hexadecimal notation.

@A[p].[r]=[n].[n]…[n] Set MAC RAM Memory

@A[p].[r]=[n] Set MAC RAM, n = 0 to 255 (decimal) or $n = 00 to FF (hexadecimal)

The @A[p].[r]=[n] command allows you to set (modify) the value of a specified location of MAC RAM. The value [n] can be entered in multiple instances separated by a dot in either decimal or hexadecimal (preceded by $) notation.

3.2   @B[p] – Modify/Read IRAM Memory Value

@B[p].[r]? Inquire IRAM Memory Value

The @B[p].[r]? command requests the modem to report the current value of a specified location of IRAM. The value reported is in decimal notation.

@B[p].[r]$ Inquire IRAM Memory Value

The @B[p].[r]$ command requests the modem to report the current value of a specified location of IRAM. The value reported is in hexadecimal notation.

@B[p].[r]=[n].[n]…[n] Set IRAM Memory

@B[p].[r]=[n] Set MAC RAM, n = 0 to 255 (decimal) or $n = 00 to FF (hexadecimal)

The @B[p].[r]=[n] command allows you to set (modify) the value of a specified location of IRAM. The value [n] value [n] can be entered in multiple instances in decimal or hexadecimal (preceded by $) notation.

3.3   @L[n] – Set Lease Line Operation

Lease line operation is designated by S89 bit 2
n = 1 sets lease line bit
n = 0 clears lease line bit

3.4   @P[n] – Alternate Pulse Dial Make/Break Ratio

The @P[n] command, where n = 0 or 1 sets S22 bit 7 to new value n. The effect of this is to toggle between two pulse dial make break ratios. n = 0 selects U.S. (39/61). n = 1 selects U.K/Hong Kong (33/67). This command works only when S32 and S33 are each set to 0.

3.5   @T[n] – Select Test Mode

n = 0, 1, 3 to 8

@T0   Terminate any test in progress. The @T command must be the last in the command line.

@T1   Initiate a Local Analog Loopback Test (ITU V.54 Loop 3).

@T3   Initiate a Local Digital Loopback test.

@T4   Instructs the modem to grant a request from the remote modem for a Remote Digital Loopback test.

@T5   Instructs the modem to deny a request from the remote modem for a Remote Digital Loopback test.

@T6   Initiate a Remote Digital Loopback test (ITU V.54 Loop 2).

@T7   Initiate a Remote Digital Loopback self-test (ITU V.54 Loop 2).

@T8   Initiate a Local Analog Loopback self-test (ITU V.54 Loop 3).

3.6   @Z Power Down

Allows the part to go into deep power down mode. All commands following the @Z command are ignored, therefore it is advisable that the @Z command be at the end of a command line.

4   S-registers

The 73M2901CE allows the user to directly access the S-registers through the AT Command Set. This feature enables an added level of control over the modem's operation. Setting S-registers directly involves some amount of risk, and requires understanding of the internal function of the modem. The order in which S-registers are set in the command string may be significant, for instance when setting S99 it is necessary that it be the first command in the command string because it affects many other S-registers. The F command, which the restores factory defaults, voids any commands preceding it including S-Register settings. AT commands themselves set S-registers so the user must be aware of each operation remembering that each command in a command string is executed one at a time in the order they are presented in the command string. The AT Command interpreter can set and reverse the commands, giving a result far from what was intended; the modem assumes that the user knows what he or she is doing.

4.1   Setting S-registers

The mechanism for directly setting an S-Register is the ATS[n] = [value] command. Where [n] is equal to the particular S-Register, and [value] is equal to the value that is to be written to the register. The [value] may be in either decimal or hex. Hexadecimal values must be preceded with a $ and must be two digits, for example ATS14 = $A is not valid, but ATS14 = $0A is.

4.2   Reading S-registers

The mechanism for reading an S-Register is the ATS? or the ATS$ command. ATS? with result in a decimal value reported to the DTE and ATS$ will result in a hexadecimal value being reported to the DTE. The user should be aware that many registers have bits that are used internally and are constantly changing in the idle state.

4.3   Setting/Reading S-registers While in Online Command Mode

While connected, it is possible to enter online command mode and Set or Read some S-registers. This may not always produce the desired effect. Some S-register settings will not take effect until after the connection has been broken. For example you would not be able to change modulation standards or go from synchronous to asynchronous mode while connected. In addition values read from some S-registers while in online command mode may not accurately reflect certain states.

4.4   S-registers Definitions

4.4.1   S0 – AutoAnswer

(Default = 0)

This register specifies the ring on which the modem will answer. A value of 1 to 255 will place the modem in auto-answer mode and cause it to answer on the ring set by S0. A value of zero will disable auto-answer. $\overline{RI}$ will toggle after each ring cycle is qualified, the timing determined by the setting of the S53 minimum ring off time register and the DTE data rate. The $\overline{RI}$ signal duration will be 60ms plus the time to output the "RING" result code.
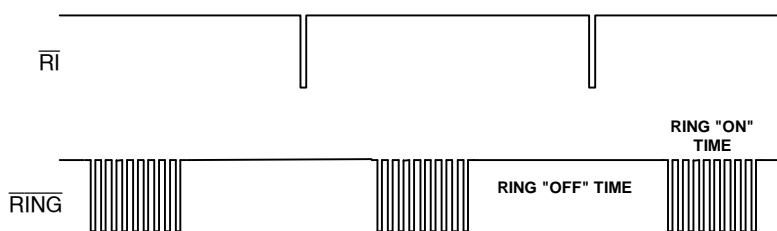
S0 is cleared on Reset.

4.4.2   S1 – Ring Count

(Default = 0)

When the modem is set for Auto-Answer, register S1 keeps track of the number of times the phone rings. After the end of ring-on time, the S1 register is reset to 0 after the maximum of S54 or S58 seconds, which ever is less. Range is 0 - 255 rings.

4.4.3   S2 – Escape Code Character

(Default = 43)

The S2 register contains the ASCII value of the Escape Command character. The default is 43, which is the ASCII "+". If you select a value greater than 127, the Escape feature is disabled and you cannot switch from the Data State to Command State while maintaining your data connection. Range is 0 – 127 (ASCII). Default is 43 (+).

4.4.4   S3 – Carriage Return Character

(Default = 0Dh)

The S3 register contains the ASCII value of the carriage return character. This character terminates both the command line and the result codes. Range is 0 – 127 (ASCII). Default is 13 (carriage return).

4.4.5   S4 – Line Feed Character

(Default = 0Ah)

The S4 register contains the ASCII value of the line feed character. It is used only when verbose result codes (V1) are selected. If you do not want a line feed to be automatically sent after the return following a verbal result code set this value to 0. Range is 0 – 127 (ASCII). Default is 10 (line feed).

4.4.6   S5 – Backspace Character

(Default = 08h)

The S5 register contains the ASCII value of the backspace character. Do not set S5 to ASCII 33 to 126 (ASCII printable characters) or to greater than ASCII 127. Range is 0 – 32 and 127 (ASCII). Default is 8 (backspace).

4.4.7   S6 – Wait to Blind Dial

(Default = 2)

The S6 register sets the number of seconds the modem waits before blind dialing. Range is 1 - 25 (seconds). Resolution is 100ms.

4.4.8   S7 – Wait For Carrier After Dialing

(Default = 50)

The S7 register performs two functions. It sets the maximum time between dialing and responding to an incoming carrier signal. It also sets the duration of the pause generated by the W dial string modifier. Range is 1 -254 (seconds).

4.4.9   S8 – Pause Time For Comma

(Default = 2)

The S8 register sets the number of seconds the modem will pause during a pause created by a ","
(comma) in the dialing sequence. Range is 1 - 254 (seconds).

4.4.10   S9 – Carrier Detect Response Time

(Default = 6)

The S9 register sets (in 10ths of a second) how long a carrier signal must exist before the modem issues
a carrier detect response. Range is 1 - 254 (1/10 seconds).

Note: Carrier detection while the modem is in the on-line state is governed by the times specified by S9
and S10. The CD light is the carrier detect indicator. If the carrier signal goes off, CD goes off within
20ms. If the carrier returns, CD turns on within 20ms after the carrier has been on continuously for the
time specified by S9. If CD is off for the time specified by S10, then carrier is lost and the modem hangs
up. If S10 is set to 255, the time is considered to be infinite, meaning that the modem will not hang up.

4.4.11   S10 – Lost Carrier To Hang Up Delay

(Default = 14)

The S10 register sets (in 10ths of a second) the delay time between loss of carrier and the modem
hanging up. After the S10 delay time, the modem hangs up and returns to Command State. Then you
will see the NO CARRIER response. If the register is set with a value of 255, the modem will ignore
carrier detect status and operate as if the carrier signal were present. If the value of S10 is less than the
value of S9 a momentary loss of carrier will cause the modem to hang-up. Range is 0 - 255 (1/10
seconds). See note on S9.

4.4.12   S11 – DTMF Dialing Speed

(Default = 70)

The S11 register sets the duration and spacing of touch-tones for tone dialing. (Setting this value lower
than 50 may produce inaccurate dialing.) This register does not affect pulse dialing. Range is 20 - 211
(milliseconds).

4.4.13   S12 – DTMF / Twist Dial Register

(Default = 20h)

Register S12 reflects the status of the DTMF options.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	TWIST2	TWIST1	TWIST0	DTMF3	DTMF2	DTMF1	DTMF0

DTMF3	DTMF2	DTMF1	DTMF0	Digit	Low Tone	High Tone
0	0	0	0	D	941	1633
0	0	0	1	1	697	1209
0	0	1	0	2	697	1336
0	0	1	1	3	697	1477
0	1	0	0	4	770	1209
0	1	0	1	5	770	1336
0	1	1	0	6	770	1477
0	1	1	1	7	852	1209
1	0	0	0	8	852	1336
1	0	0	1	9	852	1477
1	0	1	0	0	941	1336
1	0	1	1	*	941	1209
1	1	0	0	#	941	1477
1	1	0	1	A	697	1633
1	1	1	0	B	770	1633
1	1	1	1	C	852	1633

TWIST2	TWIST1	TWIST0	Relative Level
0	0	0	0 dB nominal.
0	0	1	1 dB low frequency below the high frequency tone.
0	1	0	2 dB low frequency below the high frequency tone (default).
0	1	1	3 dB low frequency below the high frequency tone.
1	0	0	4 dB low frequency below the high frequency tone.
1	0	1	5 dB low frequency below the high frequency tone.
1	1	0	6 dB low frequency below the high frequency tone.
1	1	1	7 dB low frequency below the high frequency tone.

Note: For normal operation, only the twist needs to be set. The digit is filled in automatically when dialing.

4.4.14   S13 – DTMF Transmit Attenuation

(Default = 10h)

Gain/Attenuation level can go from +4.0 dB to –10.0 or –11.0 dB from nominal.

DTMF				CP / Data			
D7	D6	D5	D4	D3	D2	D1	D0
DTMF bit3	DTMF bit2	DTMF bit1	DTMF bit0	X	CP/D bit2	CP/D bit1	CP/D bit0

Note: DTMF gain increments have to be a minimum of 1dB, while for CP/Data the minimum is 2dB gain increments.

Bit 3	Bit 2	Bit 1	Bit 0	DTMF Gain	CP/Data Gain
0	0	1	0	+4.0 dB	+4.0 dB
1	0	1	0	+3.0 dB	+4.0 dB
0	0	0	1	+2.0 dB	+2.0 dB
1	0	0	1	+1.0 dB	+2.0 dB
0	0	0	0	0.0 dB	0.0 dB
1	0	0	0	-1.0 dB	0.0 dB
0	1	1	1	-2.0 dB	-2.0 dB
1	1	1	1	-3.0 dB	-2.0 dB
0	1	1	0	-4.0 dB	-4.0 dB
1	1	1	0	-5.0 dB	-4.0 dB
0	1	0	1	-6.0 dB	-6.0 dB
1	1	0	1	-7.0 dB	-6.0 dB
0	1	0	0	-8.0 dB	-8.0 dB
1	1	0	0	-9.0 dB	-8.0 dB
0	0	1	1	-10.0 dB	-10.0 dB
1	0	1	1	-11.0 dB	-10.0 dB

4.4.15   S14 – Bit Mapped Register

(default=AAh)

Register S14 reflects the status of certain options. Register S14 is a bit mapped register whose bits are defined as follows:

Bit 0 **In Data Mode:**
        0 = Clear Channel for receiver.
        1 = Receive Channel speed buffered.

         In Call Progress Mode:
        0 = Single cadence detection.
        1 = Dual Cadence Detection.

Bit 1   0 = No echo.
         1 = Echo (see the E[n] command) (Default)

Bit 2   0 = Result codes enabled (see Q[n] command) (Default).
         1 = Result codes disabled.

Bit 3   0 = Numeric result codes.
          1 = Verbal result codes (see the V[n] command) (Default).

Bit 4   0 = No Match.
          1 = First Cadence of Dual Cadence Matched.

Bit 5   0 = Touch tone dialing (see T or P command).
          1 = Pulse dialing (Default).

Bit 6   General Handshake Complete Bit:
          0 = Not Connected.
          1 = Connected.

Bit 7   0 = Answer.
          1 = Originate (Default).

4.4.16   S15 – Calling Tone Off Time

(Default = 17)

The value of this register sets the duration of the calling tone off time in units of 100ms.

4.4.17   S16 – Calling Tone On Time

(Default = 60)

The value of this register sets the duration of the calling tone on time in units of 10ms.

4.4.18   S17 – Minimum Ring Frequency Register

(Default = 10)

The minimum ring frequency to be acceptable in Hz.   Range is from 0 to 253.
Note: The values need to be doubled if a full wave detector is used.

4.4.19   S18 – Maximum Ring Frequency Register

(Default = 75)

The maximum ring frequency to be acceptable in Hz.   Range is from 1 to 254.
Note: The values need to be doubled if a full wave detector is used.

4.4.20   S19 – Dial Tone and Busy Precise Tones Bit Mask

(Default = C3h)

Defines which precise tones constitute a dial tone and which constitute a busy tone. High nibble defines
dial tone and low nibble defines busy.
bit 0   S63 bit 0 is selected tone of precise dial tone (Default).

bit 1   S63 bit 1 is selected tone of precise dial tone (Default).

bit 2   S63 bit 2 is selected tone of precise dial tone.

bit 3   S63 bit 3 is selected tone of precise dial tone .

bit 4   S63 bit 0 is selected tone of precise busy.

bit 5   S63 bit 1 is selected tone of precise busy (Default).

bit 6   S63 bit 2 is selected tone of precise busy .

bit 7   S63 bit 3 is selected tone of precise busy (Default).

Note: See calling code table on use.

4.4.21   S20 – Call Progress Tones Detect Type

(Default = 11h)

Busy				Dialtone			
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Bits 3/7	**Bits 2/6**	**Bits 1/5**	**Bits 0/4**	**Function**			
0	0	0	1	Detect Imprecise tones ONLY (default).			
0	0	1	0	Detect All Precise tones ONLY.			
0	1	0	0	Detect Any of the Precise tones.			

4.4.22   S21 – Bit Mapped Register

(Default = 01h)

Bit 0   0 = Keypress abort disable.
         1 = Keypress abort enable (Default).

Bit 1   0 = Use debounce carrier detect (Default).
         1 = Use raw carrier detect (set by C2 command).

Bit 2   0 = Disable V.23 turnaround via $\overline{DTR}$ toggle (Default).
         1 = Enable V.23 turnaround via $\overline{DTR}$ toggle (set by R4 command).

Bit 4	**Bit 3**	**Function: $\overline{DTR}$ Control**
0	0	Modem ignores $\overline{DTR}$ (Default) (R0)
0	1	Modem assumes the Command State when $\overline{DTR}$ transitions from ON to OFF (R1).
1	0	Modem goes on hook, disables Auto Answer and assumes the Command State when $\overline{DTR}$ transitions from ON to OFF (Auto Answer can be enabled by transitioning $\overline{DTR}$ from OFF to ON) (R2).
1	1	Modem is reset when $\overline{DTR}$ transitions from ON to OFF (R3).

Bit 5   0 = CD always ON (equivalent to C0 command) (Default).
         1 = CD ON indicates the presence of CD (equivalent to C1 command).

Bit 6   0 = No $\overline{RTS}$ / $\overline{CTS}$ DTE flow control (equivalent to K3) (Default).
         1 = $\overline{RTS}$ / $\overline{CTS}$ DTE flow control.

Bit 7   0 = No XON / XOFF DTE flow control (equivalent to K4)(Default).
         1 = XON / XOFF DTE flow control.

4.4.23   S22 – Bit Mapped Register

(Default = 36h)
Register S22 reflects the status of certain options. Register S22 is a bit mapped register whose bits are defined as follows:

Bit 2	Bit 1	Bit 0	Function: Synchronous/Asynchronous Control
0	0	0	Y0 Asynchronous Mode
0	0	1	Y1 Synchronous Mode
1	0	0	Y4 Quasi-Synchronous Mode
1	1	0	Y6 Asynchronous with speed buffering (Default)

Bit 6	Bit 5	Bit 4	Bit 3	Function: Select Result Code Set
0	0	0	1	X0 Enable Result Codes 0-4.
0	0	0	0	X1 Enable Result Codes 0-5, 10.
0	0	1	0	X2 Enable Result Codes 0-6, 10.
0	1	0	0	X3 Enable Result Codes 0-5, 7, 10.
0	1	1	0	X4 Enable Result Codes 0-7, 10. (Default)
1	0	0	0	X5 Enable Result Codes 0-5, 10, and detect BUSY at OFF HOOK.
1	0	1	0	X6 Enable Result Codes 0-6, 10, and detect BUSY at OFF HOOK.
1	1	0	0	X7 Enable Result Codes 0-5, 7, 10, and detect BUSY at OFF HOOK.
1	1	1	0	X8 Enable Result Codes 0-7, 10, and detect BUSY at OFF HOOK.

```
Result Code 0  = OK
Result Code 1  = CONNECT
Result Code 2  = RING
Result Code 3  = NO CARRIER
Result Code 4  = ERROR
Result Code 5  = CONNECT 1200
Result Code 6  = NO DIALTONE
Result Code 7  = BUSY
Result Code 8  = NO ANSWER (if @ dial modifier is used and quiet answer is not detected within S7)
Result Code 9  = CONNECT 0600
Result Code 10 = CONNECT 2400
Result Code 11 = CONNECT 4800
Result Code 12 = CONNECT 9600
Result Code 13 = CONNECT 7200
Result Code 14 = LINE-IN-USE
Result Code 22 = CONNECT 75/1200
Result Code 23 = CONNECT 1200/75
```

bit 7   0 = Pulse dialing make/break ratio = 39/61 (U.S.) (Default).
          1 = Pulse dialing make/break ratio = 33/67 (U.K., Hong Kong).
This bit has an effect only when S32 or S33 are set to zero.

4.4.24   S23 – Busy Detect Cadence Count

(Default = 3)

Defines how many busy cadence cycles before sending the busy result code.

4.4.25   S24 – Desired DCE Speed

(Default = 0)

0 = Last AT Command Speed

3 = 300 bits/s

5 = 1200 bits/s

6 = 2400 bits/s

Note: This command only pertains to the DCE speed, and not to Bell or ITU operation. To establish ITU or Bell connections, use S24 combined with the B command or set S26 bit 7 to obtain the desired modem operation.

4.4.26   S25 – Protocol Selection Register

(Default = 0)

Register S25 reflects the status of certain options. Default Value is 0. Register S25 is a bit mapped register whose bits are defined as follows:

Bit 0	1 = Disconnect if No Protocol is detected
Bit 1	1 = LAP-M Protocol

Note: In order to perform a connection without protocol negotiation, clear all bits (set to 0).
When a connection is made and the selected protocol is detected an appropriate result code is returned:

PROTOCOL: NONE or numeric '70'
PROTOCOL: LAPM or numeric '77'

If no protocol is detected within 1.5 seconds after CARRIER is established, PROTOCOL: NONE or numeric result code '70' will be sent.

4.4.27   S26 – Bit Mapped Data Mode Control Register

(Default = 0)

Register S26 reflects the status of certain options. Register S26 is a bit mapped register whose bits are defined as follows:

Bit 0   1 = Force rate change to 1200 bps.

Bit 1   0 = Disables speed negotiation during a retrain request (default).
          1 = Enables speed negotiation during a retrain request.

Bit 2   0 = Disables automatic retrain requests (default).
          1 = Enables an automatic retrain request to be negotiated.

Bit 3   0 = Disables retrain request response (default).
          1 = Enables the modem to respond to a retrain request.

Bit 4   0 = Select 1800 Hz guard tone to be generated during answer mode handshake (default).
          1 = Select 550 Hz guard tone to be generated during answer mode handshake (not used in North America).

Bit 5   0 = Disables guard tone generation (default).
         1 = Enables guard tone generation.

Bit 6   0 = Disable V.23 turnaround.
         1 = Enable V.23 turnaround.

Bit 7   Channel Set:
         0 = Tx 1200 bps (Bell 202 and V.23 slave mode) (default).
         1 = Rx 1200 bps (Bell 202 and V.23 master mode).

4.4.28   S27 – Call Progress Transmit Register

(Default = 0h)

Register S27 reflects the status of certain options. Default is 64. Register S27 is a bit mapped register that behaves in the following manner when its bits are set:

Bit 0   Do not send DTE "0FFh" characters in pseudo sync (Y4 or &Q4) mode.

Bit 1   Transmit 1100 Hz when set to one.

Bit 2   Transmit 1300 Hz when set to one.

Bit 3   Transmit 2100 Hz when set to one.

Bit 4   Transmit 2225 Hz when set to one.

Bit 5   Disconnect Bit.

Bit 6   0 = CCITT V.22bis, V.22, V.21, V.23 (equivalent to B0) (Default).
         1 = Bell103, Bell202, Bell212A (equivalent to B1).

Bit 7   Protocol Selection Done (read only).

Precedence is as follows:
Bit 1 takes precedence over bit 2, which takes precedence over bit 3, which in turn takes precedence over bit 4.

4.4.29   S28 – Fast Connect, and Calling Tone Enable

(Default = 32h or 33h (reserve bit 0 toggles in idle state))

Register S28 reflects the status of various options. Register S28 is a bit mapped register whose bits are defined as follows:

Bit 0   Reserved (SAGC Bit).

Bit 1   Reserved.

Bit 2   Demodulated FSK Microbit.

Bit 3   Sync Mode (set by Y1 or Y4).

Bit 4   Answer Tone Enable @ 1200 bps (default).

Bit 5   Billing Delay Enable @ 1200 bps (default).

Bit 6   400ms. Answer Tone @ 1200 bps.

Bit 7   0 = Calling Tone Disable (default).
         1 = Calling Tone Enable.

4.4.30   S29 – Extended Result Selection / Cadence Type Selection

(default = 88h)

Register S29 reflects the status of various options. This register is normally read only since its contents are set by other commands. Register S29 is a bit mapped register whose bits are defined as follows:

bits 0/1
  0/0   Do not return extended result codes (40 - 80). The message CONNECT followed by the data rate between the
       DTE and the modem will be sent to the DTE (W0 command) (default).
  0/1   The CONNECT message will report the DTE speed then enable the carrier and extended result codes (W1
       command).
  1/0   The CONNECT message will report the DCE speed. All extended result codes are disabled (W2 command).

  Bit 2   0 = All Carrier, Protocol and Connect Result Codes enabled if W1 in effect.
        1 = All Carrier Result Codes enabled if W1 in effect (No Protocol or Connect Result Codes).

  Bit 3   0 = Escape sequence disabled.
        1 = Escape sequence enabled.

  Bit 4   0 = Alternate cadences for dial tone (default).
        1 = Dual cadence for dial tone.

  Bit 5   0 = Alternate cadences for busy tone (default).
        1 = Dual cadence for busy tone.

  Bit 6   0 = Alternate cadences for Ring (default).
        1 = Dual cadence for Ring.

  Bit 7   0 = Continuous Dial tone Disabled.
        1 = Continuous Dial tone.

4.4.31   S30 – Bit Mapped Handshake Register

(Default = 6Ch)

Bit	Decimal Value	Hex Value	Mode
0	1	$01	4-Wire mode (T)
1	2	$02	Bell 202
2	4	$04	V.22 bis (default).
3	8	$08	V.22 (default).
4	16	$10	Bell 212.
5	32	$20	Bell 103 (default).
6	64	$40	V.21 (default).
7	128	$80	V.23.

The settings in this register determine the handshake method(s) to be attempted (bits 1 – 7).

Precedence from highest to lowest: V.22bis, V.22, Bell 212, Bell 103, V.21, V.23, Bell 202.

4.4.32   S31 – Bit Mapped Connect Detect Register

(Default = 00h)

The value in this register indicates the DCE speed of the last established connection. This is a read only register. The default value is 0 until connection is established.

Bit	Decimal Value	Hex Value	Mode
0	1	$01	Successful 4-Wire Connection. (T)
1	2	$02	Successful Bell 202 Connection
2	4	$04	Successful V.22 bis Connection.
3	8	$08	Successful V.22 Connection.
4	16	$10	Successful Bell 212 Connection.
5	32	$20	Successful Bell 103 Connection.
6	64	$40	Successful V.21 Connection.
7	128	$80	Successful V.23 Connection.

Note: All bits are zero until a successful connection has been established (carrier detect valid, data mode active). Then the appropriate bit will be set.

4.4.33   S32 – Pulse Dial Make Timer

(Default = 39)

Duration of Pulse Make time in ms. Range is 1 to 211.

4.4.34   S33 – Pulse Dial Break Timer

(Default = 61)

Duration of Pulse Break time in ms. Range is 1 to 211.

4.4.35   S34 – Pulse Dial Inter-digit Timer

(Default = 75)

Duration of Pulse Inter-digit time interval in units of 10ms. Range is 1 to 211.

4.4.36   S35 – Cadence A Min On Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the primary cadence minimum dial tone ON time in units of 40ms.

4.4.37   S36 – Cadence A Max On Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the primary cadence maximum dial tone ON time in units of 40ms.

4.4.38   S37 – Cadence A Min Off Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the primary cadence minimum dial tone OFF time in units of 40ms.

4.4.39   S38 – Cadence A Max Off Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the primary cadence maximum dial tone OFF time in units of 40ms.

4.4.40   S39 – Cadence B Min On Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum dial tone ON time in units of 40ms..

4.4.41   S40 – Cadence B Max On Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the alternate cadence maximum dial tone ON time in units of 40ms.

4.4.42   S41 – Cadence B Min Off Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum dial tone OFF time in units of 40ms.

4.4.43   S42 – Cadence B Max Off Time of Dial Tone

(Default = 0)

The value of this register sets the duration of the alternate cadence maximum dial tone OFF time in units of 40ms.

4.4.44   S43 – Cadence A Min On Time of Busy

(Default = 10)

The value of this register sets the duration of the primary cadence minimum busy signal ON time in units of 40ms.

4.4.45   S44 – Cadence A Max On Time of Busy

(Default = 15)

The value of this register sets the duration of the primary cadence maximum busy signal ON time in units of 40ms.

4.4.46   S45 – Cadence A Min Off Time of Busy

(Default = 10)

The value of this register sets the duration of the primary cadence minimum busy signal OFF time in units of 40ms.

4.4.47   S46 – Cadence A Max Off Time of Busy

(Default = 15)

The value of this register sets the duration of the primary cadence maximum busy signal OFF time in units of 40ms.

4.4.48   S47 – Cadence B Min On Time of Busy

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum busy signal ON time in units of 40ms.

4.4.49   S48 – Cadence B Max On Time of Busy

(Default = 0)

The value of this register sets the duration of the alternate cadence maximum busy signal ON time in units of 40ms.

4.4.50   S49 – Cadence B Min Off Time of Busy

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum busy signal OFF time in units of 40ms.

4.4.51   S50 – Cadence B Max Off Time of Busy

(Default = 0)
The value of this register sets the duration of the alternate cadence maximum busy signal OFF time in units of 40ms.

4.4.52   S51 – Cadence A Min On Time of Ring

(Default = 40)

The value of this register sets the duration of the primary cadence minimum ring ON time in units of 40ms.

4.4.53   S52 – Cadence A Max On Time of Ring

(Default = 60)

The value of this register sets the duration of the primary cadence maximum ring ON time in units of 40ms.

4.4.54   S53 – Cadence A Min Off Time of Ring

(Default = 80)

The value of this register sets the duration of the primary cadence minimum ring OFF time in units of 40ms.

4.4.55   S54 – Cadence A Max Off Time of Ring

(Default = 120)

The value of this register sets the duration of the primary cadence maximum ring OFF time in units of 40ms.

4.4.56   S55 – Cadence B Min On Time of Ring

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum ring ON time in units of 40ms.

4.4.57   S56 – Cadence B Max On Time of Ring

(Default = 0)

The value of this register sets the duration of the alternate cadence maximum ring ON time in units of 40ms.

4.4.58   S57 – Cadence B Min Off Time of Ring

(Default = 0)

The value of this register sets the duration of the alternate cadence minimum ring OFF time in units of 40ms.

4.4.59   S58 – Cadence B Max Off Time of Ring

(Default = 0)
The value of this register sets the duration of the alternate cadence maximum ring OFF time in units of 40ms.

4.4.60   S59 – Bit Mapped Register

(Default = 0)

Register S59 reflects the status of various options. This register is normally used as a read only register. Register S59 is a bit mapped register whose bits are defined as follows:

 Bit 0   In FSK: Skipped STOP, resync to it.
             In QAM or PSK: Full equalizer back propagation.

 Bit 1   16 way decisions in QAM receiver.

 Bit 2   Scrambler invert flag (whether inversion of next modulated bit should occur).

 Bit 3   Scrambler history bit.

 Bit 4   De-scrambler invert flag.

 Bit 5   De-scrambler history bit.

 Bit 6   Last received bit.

 Bit 7   Last transmitted bit.

4.4.61   S60 – Bit Mapped Test Control Register

(Default = 0)

Register S60 reflects the status of test control options and the generation of data patterns. Register S60 is a bit mapped register whose bits are defined as follows:

Bit 4	Bit 1 SDP1	Bit 0 SDP0	Function
0	0	0	Data Mode (default)
0	0	1	Send Marks
0	1	0	Send Spaces
0	1	1	Send Dotting '5'
1	0	0	Send S1
1	0	1	Send S0
1	1	0	Send Dotting 'A'
1	1	1	Send Flags

Bit 3   Enable detection of dial tone.

Bit 4   0 = Disables the scrambler (default).
        1 = Enables the scrambler.

Bit 5   0 = Disables the de-scrambler (default).
        1 = Enables the de-scrambler.

Bit 6   In RDLB mode.

Bit 7   In ALB mode.

Note: In V.22 and V.22bis modes, the first pattern out of reset should not be spaces, the scrambler needs to be primed with another pattern.

4.4.62   S61 – Signal Detect Register 1

(Default = 0)

Register S61 reflects the status of various options. It is only valid in Data mode. Register S61 is a bit mapped register that behaves in the following manner when its bits are set:

Bit 0   Causes S62 or S65 (J6) to be sent out USER PORT 2 (available in a special test package only).

Bit 1   Remote digital loopback enabled (equivalent to @T4).

Bit 2   Carrier detect bit. This bit will be set when conditions for V.24 circuit 104 have been met by the modulation mode being connected.

Bit 3   Wait for Calling Tone before sending Answer Tone.

Bit 4   In Call Progress: Energy detect bit. This bit will be set if the receive level is above a certain threshold.
        In Data Mode: Raw Carrier Detect bit.

Bit 5   S1 Detect bit. This will be set if S1 (unscrambled 1100Hz) is detected. This bit is also used to detect a retrain   request if connected in V.22 bis or V.22

Bit 6   USB1 Detect bit. This will be set if USB1 (unscrambled binary ones) is detected. This bit is also
used to detect a remote digital loopback request if connected in V.22 bis or V.22.

Bit 7   Causes S63 to be sent out USER PORT 2 (available in a special test package only).

4.4.63   S62 – Signal Detect Register 2

(Default = 0)

This is a read only register, and it is only valid in Call Progress.

Bit 0   Detected 1650Hz (V.21 answer marks).

Bit 1   Detected 1300Hz.

Bit 2   Detected 2100Hz (ITU answer tone).

Bit 3   Reserved

Bit 4   Detected 2225Hz (Bell answer tone).

Bit 5   Detected 2250Hz (component of USB1).

Bit 6   Detected 1100Hz (fax calling tone). Detect changes to 1270Hz at the end of answer Call Progress.

Bit 7   Detected 1300Hz (data calling tone). Detect changes to 980Hz at the end of answer Call Progress.

4.4.64   S63 – Precise Call Progress Detect

(Default = 0)

This is a read only register, and it is only valid in Call Progress.

Bit 0   Detected f0 (350Hz).

Bit 1   Detected f1 (440Hz).

Bit 2   Detected f2 (480Hz).

Bit 3   Detected f3 (620Hz).

Bit 4   Detected 2130Hz – CAS Tone component.

Bit 5   Detected 2750Hz – CAS Tone component.

Bit 6   Busy tone detection enabled.

Bit 7   Call Progress filter #1 detect bit.

4.4.65   S64 – Signal Quality

(Default = 0)

This is a read only register that contains the Signal Mean Square Error (MSE) value calculated during
demodulation. Not valid in FSK.

4.4.66 S65 – DTMF Detect Register

(Default = 0)

Bit 7 indicates a valid DTMF detection. A register value of zero indicates no detect for the polled application. Bits 6 - 4 are reserved. Bits 3 - 0 indicate the tone pair detected. Works with command J6 and bit 7 has to be set in order to be valid. The following tables define DTMF decoding:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Det Valid	Reserved	Reserved	Reserved	DTDET3	DTDET2	DTDET1	DTDET0

DTMF Detect bits					Dialed Digit	Tone Pair Detected	
Det Valid	DTDET 3	DTDET 2	DTDET 1	DTDET 0		Low Tone (Hz)	HighTone (Hz)
1	0	0	0	0	D	941	1633
1	0	0	0	1	1	697	1209
1	0	0	1	0	2	697	1336
1	0	0	1	1	3	697	1477
1	0	1	0	0	4	770	1209
1	0	1	0	1	5	770	1336
1	0	1	1	0	6	770	1477
1	0	1	1	1	7	852	1209
1	1	0	0	0	8	852	1336
1	1	0	0	1	9	852	1477
1	1	0	1	0	0	941	1336
1	1	0	1	1	*	941	1209
1	1	1	0	0	#	941	1477
1	1	1	0	1	A	697	1633
1	1	1	1	0	B	770	1633
1	1	1	1	1	C	892	1633

4.4.67 S66 – Wait for Dialtone

(Default = 8)

Sets the maximum number of seconds the modem waits for dial tone. Range is 1 - 254 (seconds).

4.4.68 S67 – Qualify Dialtone

(Default = 120)

Sets the minimum duration for dial tone. Range is 1 – 254 (1/100 sec).

4.4.69 S68 – Test Timer

(Default = 0)

Times how long the self-tests should run in seconds. Range is 0 to 254.

4.4.70   S69 – Test Error Count

(Default = 0)

Keeps count of how many errors occur during the self-test.

4.4.71   S70 – Auto Retrain Threshold

(Default = 16)

Forces auto retrain if threshold is below the mean square error.

4.4.72   S71 – Originate Mode Fallback Timer

(Default = 6)

0 = The modem does not fall back to Bell103 or V.21.

The modem will fall back after the number of seconds this register is set to for any number greater than 0. Range is 0 to 254.

4.4.73   S72 – Pulse Map, Caller-ID, BlackList

(Default = 0)

Bit 1	Bit 0	Tone Dial Digit: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
0	0	Pulse: 10, 1, 2, 3, 4, 5, 6, 7, 8, 9
0	1	Pulse: 10, 9, 8, 7, 6, 5, 4, 3, 2, 1
1	0	Pulse: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Bit 2   Enable test pins – This option allows the user to control port pins such as CTS, RI, etc.

Bit 3   Enable option to generate Wetting-Pulse by pulsing Hook signal for CID.

Bit 4   Enable option to go Off-Hook for CID (used for Japan).

Bit 5   CID preamble starts with Marks instead of Dots (used for Japan or Type 2 Snoop mode).

Bit 6   Reserved (Used to Disable FSK CID mark/space Twist compensation).

Bit 7   Enable blacklist option.

4.4.74   S73 – Configuration Register 1

(Default = 30h)
  Bit 0   Enable teletel SEP codes in V.23.
  Bit 1   Low Power mode enabled.
  Bit 2   Clear to Send Signal Control.
  Bit 3   Reserved (Used internally to indicate Fast running Main state).
  Bit 4   Reserved (Used internally to indicate Home state).
  Bit 5   Enable 125ms delay between 'AT' commands.
  Bit 6   Adaptive dialing enable.
  Bit 7   Reserved

4.4.75   S74 – Billing Delay Register

(Default = 20)

This register sets the duration of billing delay in units of 100ms. Range is 20 - 254.

4.4.76   S75 – Pre-Dial Call Progress Imprecise Detect Level

(Default = 30)

S75 determines at what minimum level imprecise call progress tones are detected before dialing. Range is 1 to 96. (a larger value corresponds to a lower signal level). The default value translates into –45 dBm. The dBm level depends on the DAA used. The range is –25 to –45 dBm. Refer to the following table for registers S75 – S78.

Detect Level (dBm)	S75, S76, S77, S78 Value (decimal)
-25	3
-26	3
-27	4
-28	4
-29	5
-30	5
-31	6
-32	7
-33	8
-34	9
-35	10
-36	11
-37	12
-38	14
-39	15
-40	17
-41	19
-42	22
-43	24
-44	27
-45	30

4.4.77   S76 – Post-Dial Call Progress Imprecise Detect Level

(Default = 30)

S76 determines at what minimum level imprecise call progress tones are detected after dialing.
Range is 1 to 96. (a larger value corresponds to a lower signal level). The default value translates into –45 dBm. The dBm level depends on the DAA used. The range is –25 to –45 dBm. Refer to table under S78.

4.4.78   S77 – Pre-Dial Call Progress Precise Detect Level

(Default = 30)

S77 determines at what minimum level precise call progress tones are detected before dialing. Range is 1 to 96. (a larger value corresponds to a lower signal level). The default value translates into –45dBm. The dBm level depends on the DAA used. The range is –25 to –45dBm. Refer to table under S78.

4.4.79   S78 – Post-Dial Call Progress Precise Detect Level

(Default = 30)
S78 determines at what minimum level precise call progress tones are detected after dialing. Range is 1 to 96. (a larger value corresponds to a lower signal level). The default value translates into –45dBm. The dBm level depends on the DAA used. The range is –25 to –45dBm.

4.4.80   S79 – FSK Originate Carrier Detect Level

(Default = 35)

S79 determines at what minimum level carrier is detected for originating FSK. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.81   S80 – FSK Answer Carrier Detect Level

(Default = 35)

S80 determines at what minimum level carrier is detected for answering FSK. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.82   S81 – DPSK Originate Carrier Detect Level

(Default = 40)

S81 determines at what minimum level carrier is detected for originating PSK. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.83   S82 – DPSK Answer Carrier Detect Level

(Default = 35)

S82 determines at what minimum level carrier is detected for answering PSK. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.84   S83 – QAM Originate Carrier Detect Level

(Default = 40)
S83 determines at what minimum level carrier is detected for originating QAM. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.85   S84 – QAM Answer Carrier Detect Level

(Default = 35)

S84 determines at what minimum level carrier is detected for answering QAM. Range is 1 to 96. (a larger value corresponds to a lower signal level). The range is –25 to –45dBm.

4.4.86 S85 – DTMF Transmit Level

(Default = 60)

S85 determines the maximum value sent to the DAC when sending DTMF tones.
Range is 60 to 127.

4.4.87 S86 – Flash On Time (!)

(Default = 50)

This register determines the on time for flash hook (!) in 10ms. Range is 1 – 211.

4.4.88 S87 – Flash Off Time (!)

(Default = 50)

This register determines the off time for flash hook (!) in 10ms. Range is 1 – 211.

4.4.89 S88 – Imprecise Filter Selection

(Default = 0)

Bits 0 through 3 0 to 15 selected imprecise filters for pre-dial.
Bits 4 through 7 0 to 15 selected imprecise filters for post-dial.
Frequencies are defined as follows:

Hex Value	Frequency Range
$0	280-680Hz
$1	370-500Hz
$2	240-580Hz
$3	200-650Hz
$F	User Defined

4.4.90 S89 – Data Set Ready

(Default = 0)

Bits 0 thru 1	N command value
Bit 2	Enables Lease Line Operation
Bit 3	Enables Off-Hook Energy sensing Parallel pick-up detection (PPU-E)
Bit 4	Toggles ring input polarity for PPU-V (Default is $\overline{RING}$ active low)
Bit 5	Toggles ring input polarity for LIU-V (Default is $\overline{RING}$ active low)
Bit 6	VFI fast connect originate handshake when specifying Bell 212. Will send FLAGS as part of the handshake when Y1 or Y4 is selected.
Bit 7	Reserved

4.4.91   S90 – RTS to CTS Turn-around Delay

(Default = 2)

When the N0 command has been issued, register S90 defines the time interval between an OFF to ON transition of $\overline{RTS}$ and when the modem turns $\overline{CTS}$ ON. The S90 setting applies to Synchronous modes only.
Range is 1 to 254 (X 10ms).

$\overline{RTS/CTS}$
delay

$\overline{RTS}$

$\overline{CTS}$
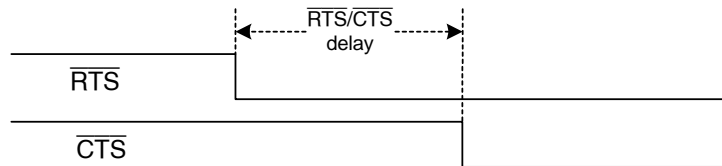
4.4.92   S91 – Call Progress Transmit Level

(Default = 90)

S91 determines the maximum value sent to the DAC when sending call progress tones. Range is 60 to 127.

4.4.93   S92 – Bit Mapped Register

(Default = 04h)

Bit 0   0 = Bell202 / V.23 receiver optimized for flat line.
         1 = Bell202 / V.23 receiver optimized for 3002A line (unnecessary in versions 2901CL.01.36 and later).

Bit 1   0 = Disables DTMF boost
         1 = Enables DTMF boost (Sets VREF to 2.25V and TXboost when using 5V power supply).

Bit 2   0 = Disables Pulse dial.
         1 = Enables Pulse dial (default).

Bit 3   0 = No Imprecise Tones detected (last tone)
         1 = Last value before imprecise tones went off.

Bit 4   Ring Bounce

Bit 6   0 = ITU answer tone 180 Degrees Phase Reversal disabled.
         1 = For ITU answer tone, 180 Degrees Phase Reversal will occur every 450ms.

Bit 7   0 = Does not preserve the user changes to the DSP filters between connections (default).
         1 = Preserves the user changes to the DSP filters between connections.

4.4.94   S93 – Ring Interval Register

(Default = 20)

The value in this register sets the duration of the minimum ring interval in units of 10ms. Range is 1 to 254.

4.4.95   S94 – TIES Escape Prompt Delay Timer Register

(Default = 100)

The value in this register sets the duration of delay in units of 10ms. Range is 1 to 254.

4.4.96   S95 – Caller-ID Configuration Register

(Default = 88h)
  Bit 0   Dual Tone – Alert Signal expected.
  Bit 2:1 Number(0-3) of Line Reversal and/or Ring Pulse – Alert Signals expected before Caller-ID.
  Bit 3   CID expected between 1st and 2nd Power Rings.
           Note: bits 0 through 3 of S95 are ignored if bit 7 = 0.
  Bit 4   Enables Caller-ID option. This bit applies only to On-Hook/Offline/Type I Caller-ID.
  Bit 5   0 = FSK modulation used for CID.
           1 = DTMF type Caller-ID.
  Bit 6   Enables using USER 11output to signal DAA to enter CID state during measure_dc_offset in
IDLE mode.
  Bit 7   Enables using USER11 output to signal DAA to enter Idle-line signaling state for CID. Bit 7 = 0
           sets continuous CID mode where S95 bits 0, 1, 2, and 3 are ignored.   Also enables using USER
           11 output to signal DAA to enter idle line signaling state for LIU-E detection.
Special modes:
S95 = 0X01 0000B   FSK Continuous Caller ID mode.
S95 = 0X110000B   Send detected DTMF codes to DTE without "CID:" message.
S95 = 10011001B   Detect US Type 1 and Type2 Snoop CID simultaneously. In this mode the modem
                         may automatically modify S72 register bit 5 to look for Dots (Type1) or marks (Type
                         2 Snoop).

4.4.97   S99 – Country Codes Register

(Default = 1)

S99 allows the 73M2901CE to be set up for different countries by using a single command. By changing
the configuration of S99, the dial tone, busy tone detection as well as DTMF and pulse timings are
modified. No other commands are needed to program the country requirements of the countries
supported by register S99.
Since the S99 register affects multiple registers, it should be set at the beginning of the AT String (but
after the F command. I.e., ATFS99=1).

  0   = CTR 21 (Euro community)
  1   = U.S.A. / Canada (Default = 1)
  33 = France
  34 = Spain
  39 = Italy
  44 = U.K.
  49 = Germany
  61 = Australia
  81 = Japan

Table 1: S99 Country Code S-Register Settings

Country implemented (all timing is in seconds and levels in dBm)

	USA Canada	CTR21	France	UK	Italy	Germany	Japan	Australia	Spain	Affected Register
S99=	1	0	33	44	39	49	81	61	34	S99
Wait for blind dial time	2	4	2	4	4	4	4	4	4	S6
Billing_delay	2	2	2	2	2	2	2	2	2	S74
DTMF_speed	0.070	0.080	0.085	0.085	0.085	0.085	0.085	0.085	0.150	S11
Pulse dial make time	0.039	0.033	0.033	0.033	0.040	0.039	0.033	0.033	0.033	S32
Pulse dial break time	0.061	0.067	0.067	0.067	0.060	0.061	0.067	0.067	0.067	S33
Pulse dial interdigit time	0.750	0.850	0.900	0.850	0.880	0.850	0.850	0.850	0.900	S34
Pulse dial map	0	0	0	0	0	0	0	0	0	S72
Imprecise dial tone filter	280/680	240/580	370/500	240/580	370/500	240/580	240/580	240/580	240/580	S88
Imprecise Dial tone det. level	-45	-42	-38	-38	-38	-38	-38	-38	-38	S75
Precise Dial tone detection level	-45	-45	-40	-45	-40	-45	-45	-45	-40	S77
Dial tone type	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	S20
Dial tone 350Hz selected	Sel.	-	Sel.	-	Sel.	-	-	-	Sel.	S19
Dial tone 440Hz selected	Sel.	-	-	Sel.	-	Sel.	Sel.	Sel.	-	S19
Dial tone 480Hz selected	-	-	Sel.	-	Sel.	-	-	-	-	S19
Dial tone 620Hz selected	-	-	-	Sel.	-	-	-	-	Sel.	S19
Dialtone qualification time	1.2	1.0	0.8	0.8	2.0	0.8	1.0	1.0	1.0	S67
Continuous Dial Tone	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	S29
Cadenced Dial tone	Cadence A or B	Double Cadence	Cadence A or B	Cadence A or B	Double Cadence	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	S29
min_on_A_dt	0.000	0.160	0.000	0.000	0.160	0.000	0.000	0.000	0.800	S35
Max_on_A_dt	0.000	0.240	0.000	0.000	0.240	0.000	0.000	0.000	1.200	S36
min_off_A_dt	0.000	0.160	0.000	0.000	0.160	0.000	0.000	0.000	0.080	S37
Max_off_A_dt	0.000	0.240	0.000	0.000	0.240	0.000	0.000	0.000	0.120	S38
min_on_B_dt	0.000	0.480	0.000	0.000	0.480	0.000	0.000	0.000	0.240	S39
max_on_B_dt	0.000	0.720	0.000	0.000	0.720	0.000	0.000	0.000	0.400	S40
min_off_B_dt	0.000	0.800	0.000	0.000	0.800	0.000	0.000	0.000	0.000	S41

	USA Canada	CTR21	France	UK	Italy	Germany	Japan	Australia	Spain	Affected Register
max_off_B_dt	0.000	1.200	0.000	0.000	1.200	0.000	0.000	0.000	0.040	S42
Imprecise busy tone filter	280/680	240/580	370/500	240/580	370/500	240/580	240/580	240/580	240/580	S88
Imprecise busy tone det.level	-45	-45	-45	-45	-50	-55	-45	-45	-45	S76
Precise busy tone detection level	-45	-45	-45	-45	-50	-55	-45	-45	-45	S78
Busy tone type	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	Imprecise	S20
Busy tone 350Hz	-	-	Sel.	-	Sel.	-	-	-	-	S19
Busy tone 440Hz	-	-	-	-	-	Sel.	Sel.	Sel.	Sel.	S19
Busy tone 480Hz	Sel.	-	Sel.	Sel.	Sel.	-	-	-	Sel.	S19
Busy tone 620Hz	Sel.	-	-	-	-	-	-	-	-	S19
Cadenced busy tone	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	Cadence A or B	S29
min_on_A_busy	0.400	0.400	0.400	0.240	0.400	0.360	0.400	0.280	0.160	S43
max_on_A_busy	0.600	0.600	0.600	0.520	0.600	0.600	0.600	0.440	0.320	S44
min_off_A_busy	0.400	0.400	0.400	0.240	0.400	0.360	0.400	0.280	0.160	S45
max_off_A_busy	0.600	0.600	0.600	0.520	0.600	0.600	0.600	0.440	0.320	S46
min_on_B_busy	0.000	0.000	0.000	0.000	0.000	0.080	0.000	0.000	0.000	S47
max_on_B_busy	0.000	0.000	0.000	0.000	0.000	0.240	0.000	0.000	0.000	S48
min_off_B_busy	0.000	0.000	0.000	0.000	0.000	0.360	0.000	0.000	0.000	S49
max_off_B_busy	0.000	0.000	0.000	0.000	0.000	0.600	0.000	0.000	0.000	S50
ring_min_Hz	10	10	10	10	10	10	10	10	10	S17
ring_max_Hz	75	75	75	75	75	75	75	75	75	S18
Cadenced ring	Cadence A or B	Cadence A or B	Cadence A or B	Double Cadence	Cadence A or B	Cadence A or B	Cadence A or B	Double Cadence	Cadence A or B	S29
min_on_A_ring	1.600	0.800	1.200	0.320	0.800	0.720	0.800	0.320	1.200	S51
max_on_A_ring	2.400	1.200	1.800	0.480	1.200	1.200	1.200	0.480	1.800	S52
min_off_A_ring	3.200	3.200	3.000	0.120	3.200	3.200	1.600	0.080	2.400	S53
max_off_A_ring	4.800	6.000	4.000	0.280	5.000	6.000	2.400	0.280	3.600	S54
min_on_B_ring	0.000	0.000	0.000	0.320	0.000	0.000	0.000	0.320	0.000	S55
max_on_B_ring	0.000	0.000	0.000	0.480	0.000	0.000	0.000	0.480	0.000	S56
min_off_B_ring	0.000	0.000	0.000	1.600	0.000	0.000	0.000	1.600	0.000	S57
max_off_B_ring	0.000	0.000	0.000	2.400	0.000	0.000	0.000	2.400	0.000	S58

Table 2: Worldwide Termination Impedance Requirements

Country	AC	Country	AC	Country	AC Impedance
Argentina	600	Hong Kong	600	Oman	600
Australia	Australia	Hungary	600	Pakistan	600
Austria	Australia	Iceland	CTR-21	Peru	600
Bahrain	CTR-21	India	Australia	Philippines	600
Belgium	CTR-21	Indonesia	600	Poland	600
Brazil	600	Ireland	CTR-21	Portugal	CTR-21
Bulgaria	Australia	Israel	CTR-21	Romania	600
Canada	600	Italy	CTR-21	Russia	600
Chile	600	Japan	600	Saudi	600
China	600	Jordan	600	Singapore	600
Columbia	600	Kazakhstan	600	Slovakia	Australia
Croatia	CTR-21	Kuwait	600	Slovenia	CTR-21
CTR/TBR	CTR-21	Latvia	CTR-21	S. Africa	CTR-21
Cyprus	CTR-21	Lebanon	CTR-21	S. Korea	600
Czech	CTR-21	Luxembourg	CTR-21	Spain	CTR-21
Denmark	CTR-21	Macao	600	Sweden	CTR-21
Ecuador	600	Malaysia	600	Switzerland	CTR-21
Egypt	600	Malta	CTR-21	Syria	600
El	600	Mexico	600	Taiwan	600
Finland	CTR-21	Morocco	CTR-21	Thailand	600
France	CTR-21	Netherlands	CTR-21	UAE	600
Germany	Australia	New	Australia	UK	CTR-21
Greece	CTR-21	Nigeria	CTR-21	USA	600
Guam	600	Norway	CTR-21	Yemen	600

4.4.98   S100 – Idir

(Default = 158)

External Interrupt direction Register.

4.4.99   S101 – USR1x I/O

(Default = 195)

USR1x I/O Port status and control. When read, outputs the current status of USR1 port. When defined as an output, a user port pin will assume the state written to it.

4.4.100   S102 – Direction control for USR1x

(Default = 4)

USR1x Port Direction. If a bit is set to 0, the corresponding port pin is an output. If it is a one, the corresponding port pin is an input. USR10=1, USR11=2, etc.

4.4.101   S103 – USR2x I/o

(Default = 254)

USR2x I/O Port status and control. When read, outputs the current status of USR1 port. When defined as an output, a user port pin will assume the state written to it. Only USR20 is accessible.

4.4.102   S104 – Direction control for USR2x

(Default = 1)

USR2x Port Direction. If a bit is set to 0, the corresponding port pin is an output. If it is a one, the corresponding port pin is an input. USR20=1.

4.4.103   S105 – Delay after any Call attempt

(Default = 5)

Sets the minimum delay between any call attempts of any phone number. Range is 1 – 254 (second). Used for blacklisting.

4.4.104   S106 – Delay between 1st and 2nd attempt

(Default = 5)

Sets the minimum delay between 1st and 2nd call attempt of the same phone number. Range is 1 – 254 (second). Used for blacklisting.

4.4.105   S107 – Delay between nth and n+1th attempt

(Default = 60)

Sets the minimum delay between nth and n+1th call attempt, after 2nd try, of the same phone number. 1 – 254 (second). Used for blacklisting.

4.4.106   S108 – Maximum successive Failed attempts

(Default = 15)

Sets the number of maximum failed attempts to the same phone number before it is blacklisted.

4.4.107   S109 – Delay between Series (Re-enable delay)

(Default = 0)

Sets the value of minimum delay, since the 1st attempt, before re-enabling calls to a specific number. A special value of 0 means that numbers are never re-enabled once blacklisted. Range is 0 – 254 (minutes).

4.4.108   S110 – Line-In-Use Configuration Register

(Default = 70h)

  Bit 0   Enables Off-Hook Voltage sensing Parallel pick-up detection (PPU-V).

  Bit 1   Enables On-Hook Line-In-Use Voltage sensing detection (LIU-V).

  Bit 2   Enables On-Hook Line-In-Use Energy sensing detection (LIU-E).

  Bit 3   Enables Call-Waiting Caller-ID option. This bit applies only to Off-Hook/Online/Type II Caller-ID.

Bit 4   Enables HiZ TXAN/TXAP while looking for CID (only for 2901; no effect for 2909).

Bit 5   Enables RxGain (20 dB) while looking for CID (only for 2901; no effect for 2909).

Bit 6   Enables using USER10 output to signal DAA to activate on-hook LIU-V sensing.

Bit 7   Enables "long space disconnect" option. When enabled, the 73M2901CE sends 3.5 seconds of space bits (zeros) before disconnecting after receiving an on-hook command from the DTE. When enabled the 73M2901CE disconnects and goes on-hook upon receiving NULL characters from the remote modem for 1.5 seconds.

States	Idle mode or AT Command Processing other than ATD	ATD Command Processing	"Wait for Dial Tone" or "Wait for Blind Dial" Delays	Pulse Dialing	Tone Dialing	Call Progress Phase	Connected Phase
Polling of Line-in-Use Signal	No	Yes	Yes	No	Yes	Yes	Yes
Action If LIU Is Active	N/A	No seizing of the phone line	Release of the line	N/A	Release of the line	Release of the line	Release of the line
Returned Code to DTE	N/A	"Line-in-use"	"Line-in-use"	N/A	"Line-in-use"	"Line-in-use"	"Line-in-use"

4.4.109   S111 – Line-In-Use Settle Time

(Default = 20)

Sets the settling time to wait, after the LIU sensing circuit is enabled, before sampling LIU signal. This is used for both on-hook(Voltage sensing LIU) and off-hook(PPU) detection. Range is 0 – 254 (X10ms units).

4.4.110   S112 – Line-In-Use Energy Detection Wait

(Default = 20)

Sets the qualify time that Energy must remain below threshold. Range is 0 – 254 (X100ms units).

4.4.111   S113 – Line-In-Use Energy Detection Threshold

(Default = 15)

Sets the Threshold for the voice Energy. Lower number means Stronger signal strength. The value of 0 would effectively never detect and higher than 95 would always detect. This register is also used by (J7) test mode as a minimum carrier detect threshold. Range is 0 – 95.

4.4.112   S114(Hi)-S115(Lo) – Maximum Carrier Detect Threshold (J7)

(Defaults: HI = 0, LOW = 50h)

Sets the maximum carrier detect threshold used by (J7) test mode. Higher value may indicate open circuit in either TXAP or TXAN signals to RXA.

4.4.113   S116 – Parallel-Pick-Up Energy Detection Threshold

(Default = 50h)

Sets the Threshold for PPU to detect loss of Energy compared to the energy level at the time of connection. Use 48h/50h/5Ah for 1/2/3dB loss of Energy when parallel phone is picked up.

4.4.114   S117 – No Activity Timeout

(Default = 0)
Sets the duration for the no activity timeout option. Resolution is in seconds. Range is 0 - 255. When set to zero the no activity timeout option is disabled. When enabled, values of S117 >= to 15 are recommended.

4.4.115   S118 – Caller ID Ring Interrupt Delay

(Default = 20)
Disables ring interrupt detection for the specified period of time during CID enable/disable transitions, measured in ms.

4.4.116   S119 – Wait Before Connect

(Default = FFh)
Allows programmable delay between completion of handshake and connect (ready for data). User should be careful, Host will have to complete delay period before transmitting data. Setting the value at this register will affect timing for all modes. Resolution is in 10ms increments. The Default delay times are as follows:

QAM Answer Mode = 200ms
PSK Answer Mode = 770ms
PSK Originate Mode = 770ms
FSK Originate Mode = 300ms

NOTE: Special mode when S119 = $FF (Default), uses same value of wait as in the past.

4.4.117   S120 – Accepted Answer Tone Frequencies

(Default = $35)
Enables control over what the modem will qualify as answer tone. By default, the modem functions as it has in the past.

  Bit 0   1650Hz – V21 Marks (default)

  Bit 1   1300Hz – V23 Marks

  Bit 2   2100Hz – ITU Answer Tone (default)

  Bit 3   Reserved

  Bit 4   2225Hz – Bell Answer Tone (default
)
  Bit 5   2250Hz – S0 (default)

  Bit 6   Reserved

  Bit 7   Reserved

4.4.118   S121 – Answer Tone Qualify Time

(Default = 0)
The value of this register extends the answer tone qualification time beyond the 155ms minimum in 10ms units. For example a value of 10 would yield a total answer tone qualification time of 255ms (100ms + 155ms).

4.4.119   S122 – Parallel Pick Up Debounce Timer

(Default = 0)
Sets the duration of the parallel pick debounce timer in 10ms increments.

4.4.120   S123 – Soft Ring Detect

(Default = 0)
This register controls the ring amplitude threshold and selects hardware or software ring detection.

Bit Map:
Bits 0-6   Ring Amplitude Detection Threshold. Lower value detects lower amplitude ring signal.
Bit 7   1 = No frequency checking, enables Phonex operation.
                 0 = Frequency and amplitude checking, normal operation.

Special Values:

S123 = 0   Disable soft ring detect, use hardware ring.
S123 = 255   Auto detect phonex mode, the modem will automatically detect an user phonex system
                 and configure itself accordingly.
S123 = 1-127   Force soft ring detection with frequency qualification for non-phonex operation.
                 Recommend value of 7 (or 2 for very Low Amplitude and Frequency detection).
S123 = 128-254   Force soft ring detection with no frequency qualification for phonex operation.
                 Recommend value of 170.

4.4.121   S124 – V23 Half Duplex Enable

(Default = 0)
Bit 0   Selects V.23, 1200 bps Half Duplex mode.
Bit 1-7   Reserved

5   Related Documentation

The following 73M2901CE documents are available from Teridian Semiconductor Corporation:

73M2901CE Data Sheet
73M2901CE Demo Board User Manual

6   Contact Information

For more information about Teridian Semiconductor products or to check the availability of the 73M2901CE, contact us at:

6440 Oak Canyon Road
Suite 100
Irvine, CA 92618-5201

Telephone: (714) 508-8800
FAX: (714) 508-8878
Email: modem.support@teridian.com

For a complete list of worldwide sales offices, go to http://www.teridian.com.

Revision History

Revision	Date	Description
1.0	10/21/2004	First publication part of the *73M2901CE Demo Board User Manual*.
2.0	11/12/2008	Content now moved to its own document.