HAL DSP MODEM SERIAL INTERFACE SPECIFICATIONS

(DSP4100 V5.1 and DXP38)
(CLOVER-II, CLOVER-2000, RTTY, TOR, P-MODE*)

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EDITORIAL NOTE: The information contained in this document is subject to change. We are continuing DSP4100 product development, and we will add new commands or modify existing ones as required. While we will attempt to retain compatibility with previous releases, that cannot be guaranteed. Please contact HAL directly with any specific questions regarding the software interface.

*The word "P-MODE" is the HAL designation for a communications protocol that may also be known as "Pactor", a registered trademark of the Spezielle Communications Systeme (SCS) firm in Hanau, Germany. HAL affirms that, to the best of its knowledge, P-MODE is compatible and interoperable with the protocol SCS calls "Pactor" and with the link establishment and weak signal modes of the protocol SCS calls "Pactor-II".

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1. INTRODUCTION

The HAL DSP4100 and DXP38 DSP based modems are standalone products that connect to a PC application program over a standard RS232 serial port and connect to an HF radio with simple audio and PTT signals. Although the two products use different input and output connectors, the serial port command protocol for both units is much the same. In this memorandum, references to "DSP4100" apply to both the DSP4100 and the DXP38 products unless otherwise noted.

2. HARDWARE INTERFACE

The DSP4100 is a standalone data modem that connects to a PC COM port using a serial asynchronous RS232 interface. The DSP4100 stores the operating firmware in flash memory, and it automatically loads the LOD and S28 files when the modem is turned ON. The DSP4100 has six front panel LED indicators that report the current status and a rear panel mounted ON/OFF switch. The DXP38 includes a front panel tuning indicator and a front panel mounted power switch.

2.1 DSP4100 Serial Port Signals

The DSP4100 has a standard DB25S DCE type RS232 serial interface that runs, typically, at 9600 bps. A single physical connector supports both the primary communications port and a secondary serial port that can be used to control other serial devices.

SIGNAL	Pin	IN/OUT	Description
GND	1		Signal ground
TXD	2	INPUT	Transmit data input
RXD	3	OUTPUT	Receive data output
RTS	4	INPUT	Hardware flow control signal for RXD
CTS	5	OUTPUT	Hardware flow control signal for PC COM port
DSR	6	OUTPUT	+5 VDC
GND	7		Signal ground
DCD	8	OUTPUT	Carrier Detect
DTR	20	INPUT	Hardware ABORT signal
SDCD	12	OUTPUT	Secondary carrier detect
SCTS	13	OUTPUT	Secondary clear-to-send
STXD	14	INPUT	Secondary transmit data
SRXD	16	OUTPUT	Secondary receive data
SRTS	19	INPUT	Secondary request-to-send
CTRL	25	INPUT	Extra control input

Brief descriptions of each of these port signals follow:

TXD (2): The serial RS232 Transmit Data input to the DSP4100. The character format is 8 bits, no parity, one stop bit at 9600 bps.

RXD (3): The serial RS232 Receive Data output from the DSP4100. The character format is 8 bits, no parity, one stop bit at 9600 bps. Hardware flow control is always active on the serial port; the RTS input must be ON or HIGH to enable RXD output. When RTS is OFF, the RXD output remains in the MARK HOLD state.

RTS (4): The Request to Send input is the hardware flow control signal for the serial RXD output, and this signal must be HIGH or not connected for RXD data output. If the attached PC must momentarily halt its receive data input, the RTS can be turned OFF to stop the RXD output, however if RTS remains OFF for extended periods, data loss will occur. An internal resistor defaults the RTS signal to the ON state.

CTS (5): The Clear to Send output is the hardware flow control signal for the COM port TXD output. When the DSP4100 internal buffers fill above a set level, the CTS signal turns OFF to stop the data coming in the DSP4100 RXD input. The attached device must implement CTS flow control to avoid DSP4100 buffer overflow and data loss.

DSR (6): The Data Set Ready output signal is connected to +5 VDC with a 10K ohm resistor. NOTE: Most DSP4100 boards do not include this resistor; it was added to the DSP4110 board revision.

DCD (8): The Data Carrier Detect output signal provides a hardware link indication. When a data link is established in TOR or Clover, the DCD output goes ON or HIGH until the end of the link.

DTR (20): The Data Terminal Ready input signal is used by the DSP4100 as an input buffer clear signal. When this input is held LOW for more than 250 ms, all data buffered in the serial TXD input buffer is cleared so that the next character transmitted to the TXD input will be processed immediately. If the CTS output signal is OFF when the DTR signal is pulsed LOW, CTS will immediately turn ON after the buffer is cleared. If the DTR buffer clear feature is not required, this input must be held HIGH or disconnected.

SDCD (12): The Secondary Data Carrier Detect output is a programmable output signal (see the $806D command description). When the DSP4100 is reset, this output signal defaults to the OFF state.

SCTS (13): The Secondary Clear to Send output is a programmable output signal (see the $806D command description). When the DSP4100 is reset, this output signal defaults to the OFF state.

STXD (14): The Secondary Transmit Data input provides a second serial port for the DSP4100. Once the secondary port rate configured with the $806B command and the port rate is set with the $8069 command, all serial data characters received on this port are passed to the primary port after the $8032 stream switch status message. Note that the secondary port configuration command ($806B) will set the port rate to 9600 bps, and it will clear both SCTS and SDCD.

SRXD (16): The Secondary Receive Data output provides a second serial port for the DSP4100 to control external devices. After the secondary port is enabled with the $806B and $8069 commands, serial data is passed from the primary port to the secondary port after the Switch to Secondary port command ($8034) is issued.

SRTS (19): The Secondary Request to Send input is an undedicated RS232 input. The state of this input signal is read using the Read Secondary Port Signals ($80A3) command.

CTRL (25): The Extra Control input is an undedicated RS232 input. The state of this input signal is read using the Read Secondary Port Signals ($80A3) command.

2.2 DXP38 Serial Port Signals

The DXP38 has a standard DE9S DCE type RS232 serial interface that runs at 9600 bps. The serial port can be connected to a 9 pin PC serial port connector with a standard 9 pin MF serial cable.

SIGNAL	Pin	IN/OUT	Description
DCD	1	OUTPUT	Carrier Detect
RXD	2	OUTPUT	Receive data output
TXD	3	INPUT	Transmit data input
DTR	4	INPUT	Hardware ABORT signal
GND	5		Signal ground
DSR	6	OUTPUT	+5 VDC
RTS	7	INPUT	Hardware flow control signal for RXD
CTS	8	OUTPUT	Hardware flow control signal for PC COM port
	9		(no connection)

Brief descriptions of each of these port signals follow:

DCD (1): The Data Carrier Detect output signal provides a hardware link indication. When a data link is established in TOR or Clover, the DCD output goes ON or HIGH until the end of the link.

RXD (2): The serial RS232 Receive Data output from the DSP4100. The character format is 8 bits, no parity, one stop bit at 9600 bps. Hardware flow control is always active on the serial port; the RTS input must be ON or HIGH to enable RXD output. When RTS is OFF, the RXD output remains in the MARK HOLD state.

TXD (3): The serial RS232 Transmit Data input to the DSP4100. The character format is 8 bits, no parity, one stop bit at 9600 bps.

DTR (4): The Data Terminal Ready input signal is used by the DSP4100 as an input buffer clear signal. When this input is held LOW for more than 250 ms, all data buffered in the serial TXD input buffer is cleared so that the next character transmitted to the TXD input will be processed immediately. If the CTS output signal is OFF when the DTR signal is pulsed LOW, CTS will immediately turn ON after the buffer is cleared. If the DTR buffer clear feature is not required, this input must be held HIGH or disconnected.

DSR (5): The serial RS232 Data Set Ready output from the DSP4100 is tied to +5 VDC with a 1000 ohm resistor.

RTS (7): The Request to Send input is the hardware flow control signal for the serial RXD output, and this signal must be HIGH or not connected for RXD data output. If the attached PC must momentarily halt its receive data input, the RTS can be turned OFF to stop the RXD output, however if RTS remains OFF for extended periods, data loss will occur. An internal resistor defaults the RTS signal to the ON state.

CTS (8): The Clear to Send output is the hardware flow control signal for the COM port TXD output. When the DSP4100 internal buffers fill above a set level, the CTS signal turns OFF to stop the data coming in the DSP4100 RXD input. The attached device must implement CTS flow control to avoid DSP4100 buffer overflow and data loss.

2.3 Serial Port Protocol

The DSP4100 serial port protocol combines control and data information through the use of an escape signal. In the DSP4100 commands and status messages are passed as two character sequences where the first character is $80. All single characters are assumed to be data characters, not command characters.

The DSP4100 serial protocol includes only two escape characters: $80 and $81. Any character following an $80 is interpreted as a command to the DSP4100 (with certain exceptions below) or a status response from the DSP4100. Any character following $81 is interpreted as a binary data character including, of course, $80 and $81. All other characters are considered to be binary data characters.

For example, the hardware reset command ($8009) is sent to the DSP4100 as the following two character sequence:

$80 $09

To set CCIR 476 SELCAL to 12345, use the following sequence:

SELCAL	"1"	"2"	"3"	"4"	"5"	END
$80 $90	$80 $31	$80 $32	$80 $33	$80 $34	$80 $35	$80 $00

To send the five character string 'A' $80 'B' $81 'C', use the $81 escape character as follows:

"A"	$80	"B"	$81	"C"
$41	$81 $80	$42	$81 $81	$43

The DSP4100 also has a simple AT style command set for Clover modes only. When active, the AT serial interface permits the DSP4100 to operate with any AT compatible terminal program. HAL document E2010 describes the AT command set in detail.

2.4 Serial Port Flow Control

The DSP4100 implements an interrupt driven process to handle characters received on the primary serial port TXD input. The interrupt routine decodes the $80 command escape sequences and stores the data bytes and commands in a circular buffer. Background routines remove characters from the interrupt buffer as commands are decoded and transmit data blocks are assembled. Hardware flow control using the CTS control signal is required to prevent receive buffer overflow and data loss. The flow control threshold level is different for FSK and Clover modes due to the way that data blocks are assembled prior to transmission.

FLOW CONTROL	FSK	CLOVER	Buffer Length
CTS OFF	>= 3	>= 1000	1024
CTS ON	= 1	< 200	1024

On the DSP4100 only, the Secondary Port TXD input is handled in the same interrupt routine and those bytes are stored in a 128 byte circular buffer. There is no flow control associated with the secondary port, and if this 128 byte buffer fills before the bytes are passed to the primary port RXD output, secondary characters will be lost. The DXP38 does not support the secondary port.

The DSP4100 RXD output uses a 4096 byte circular buffer for speed conversion and flow control. When bytes are pending for the primary serial port output, the serial controller is polled to see if the serial transmit buffer is ready and if the RTS input is HIGH. If both conditions are true, then the next byte is read from the buffer and transmitted on the primary serial port RXD output. When RTS is LOW, no data bytes are sent to the RXD output register in the serial controller, and the output remains in the MARK HOLD condition. Note that if the RTS signal is held OFF long enough for the internal buffer to fill completely, bytes will be lost.

2.5 DSP4100 Radio Port Interface

The DSP4100 uses a standard DE-9S type connector for the audio and control signal connections to the HF radio.

SIGNAL	PIN	IN/OUT	DESCRIPTION
AUDIO IN+	1	IN	Receive Audio Input +
AUDIO IN-	2	IN	Receive Audio Input -
FSK OUT (1)	3	OUT	FSK Keyed Output
AUDIO OUT+	4	OUT	Transmit Audio Output+
AUDIO OUT-	5	OUT	Transmit Audio Output-
SIGNAL GND	6		Audio Signal Ground
SELCAL (2)	7	OUT	SELCAL Output
PTT (3)	8	OUT	PTT Output
SIGNAL GND	9		Audio Signal Ground

NOTE (1): FSK on pin 3 is the collector of an NPN transistor switch to ground. A jumper option adds a pull-up resistor to +5 VDC.
NOTE (2): SELCAL on pin 7 is the collector of an NPN transistor switch to ground
NOTE (3): PTT on pin 8 is the collector of an NPN transistor switch to ground.

The audio input and audio output of the DSP4100 use a 600 ohm balanced interface. If an unbalanced connection is required, then one of the balanced signal pins can be connected to the radio signal ground. There is no hardware level adjustment for the receive audio input. The maximum transmit audio output level is set by rear panel jumper J2 to -30 (no jumper) or 0 dBm (jumper installed). The rear panel audio level control adjusts the output level from no signal to the maximum transmit level selected.

2.6 DXP38 Radio Port Interface

The DXP38 uses five phone plug connectors for the audio and control signal connections to the HF radio.

SIGNAL	LOC	IN/OUT	DESCRIPTION
AF IN	1	IN	Receive Audio Input
AF OUT	2	OUT	Transmit Audio Output
PTT (1)	3	OUT	PTT Output
FSK (2)	4	OUT	FSK Keyed Output
SELCAL (3)	5	OUT	SELCAL Output

NOTE (1): PTT is the collector of an NPN transistor switch to ground.
NOTE (2): FSK is the collector of an NPN transistor switch to ground. A jumper option adds a pull-up resistor to +5 VDC.
NOTE (3): SELCAL is the collector of an NPN transistor switch to ground.

The audio input and audio output of the DXP38 use an unbalanced interface. The maximum transmit audio output level is set by an internal jumper to -30 or 0 dBm. The rear panel audio level control adjusts the output level from no signal to the maximum transmit level selected.

2.7 Hardware Reset

When the DSP4100 is first turned ON and when the Hardware Reset command ($8009) is received, the DSP4100 performs a series of power on tests. If all of the tests are successful, the DSP4100 loads the LOD file module from the flash memory into the DSP, sends the $8009 hardware reset message, and starts execution of the S28 file module. If at any point an error condition is detected, an error code is flashed on the front panel LED's and an error status message is available on the serial port.

The first tests the DSP4100 performs are CRC calculations over the BOOT block, the LOD file block, and the S28 file block in the flash memory. If any of these CRC calculations fail, then an error code is flashed on the front panel, and the DSP4100 stops the initialization process. If the CRC calculations indicate that the flash images are good, the LOD file is transferred to the DSP, and the DSP starts execution. The DSP4100, at this point, confirms that the 1 ms interrupt is running, and starts the S28 code execution after sending a $8009 status message to the serial port. If the DSP test fails, an error code is flashed on the front panel.

Error Type	STBY	CALL	LINK	ERR	TX	RX
BOOT CRC error	FLASH	OFF	OFF	...	...	FLASH
LOD file CRC error	FLASH	OFF	OFF	...	FLASH	...
S28 file CRC error	FLASH	OFF	OFF	FLASH	...	...
DSP Run error	FLASH	OFF	FLASH	OFF	OFF	OFF

In addition to the front panel indication, the DSP4100 returns an error status response to the PC Request Status ($8002) command when one or more error conditions have been detected. If no error condition has been detected, the DSP4100 responds with the OK status message ($8002 $800A).

PC		DSP4100	DESCRIPTION
	←	$8009	Hardware reset acknowledge
$8002	→		Request status
	←	$8002 $800N	Status response message

Where N is an 8 bit error status byte:

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	DSP Failed	S28 error	LOD error	BOOT error

B0 = 1 if a checksum error is detected in Boot block
B1 = 1 if a CRC error is detected in LOD block
B2 = 1 if a CRC error is detected in S28 block
B3 = 1 if the DSP fails to run after the LOD file is loaded

If one or more error conditions have been detected, there are two PC application program options: start the File Loader ($800F) to reload the files or force a Hardware Reset ($8009) to try again. Typically, a LOD or S28 file failure requires a reloading of the appropriate file. The BOOT error requires internal component replacement and the unit must be returned to HAL for repair.

If no errors are detected during the power on tests, the DSP4100 loads the DSP with the LOD file and starts execution of the S28 file in the flash memory.

The DSP4100 BOOT section contain two useful built in menus that can be accessed when the DSP4100 is reset; a unit TEST menu and a FILE LOADER menu. When the DSP4100 hardware reset begins, it sends an '@' character to the serial port at 9600 bps to signal the start of these tests. At the end of the tests, the DSP4100 will start one of these built-in menus if it has received one of two specific ASCII characters.

ASCII Char	BOOT Menu
'T' or 't'	TEST Menu at 9600 bps
'L' or 'l'	FILE LOADER Menu at 9600 bps

The FILE LOADER menu can be used to load new LOD and S28 files if the normal loading process does not work for some reason. The TEST menu is used for production testing. The <ESC> key or cycling power will terminate these menu operations and begin the normal DSP4100 startup procedure.

The DSP4100 and DXP38 also include a hardware jumper field on the circuit board to select the TEST or FILE LOADER menu. To select one of the following J5 options, place a suitcase jumper on the appropriate pins then cycle the power. All jumpers must be removed before normal operation can resume.

J5 JUMPER	BOOT Menu
1	TEST Menu at 9600 bps
2	FILE LOADER Menu at 57600 bps
3	(reserved)
R	HARD RESET

3. COMMAND/DATA PROTOCOL

The DSP4100 command set includes commands with and without arguments. Many commands are only active in certain modes and/or when the modem is not linked. Basically, the command interface follows this rule: all commands sent to the modem are acknowledged by echoing the command and some responses include one or more additional status bytes. The echoed acknowledgement is a positive indication that the modem has successfully executed the command. In addition, status messages are generated by the DSP4100 to report changes in status, such as the start of a link and the end of a link, and these status messages have variable length. When sending commands to the DSP4100 and decoding messages from the DSP4100, one must be careful to follow the format for each command to avoid unexpected results.

As mentioned in Section 2.3 the DSP4100 uses a $80 escape character to identify all commands and responses. In the following tables and examples, commands are shown as 16 bit hex values, but they are actually sent and received as two 8-bit ASCII characters. For example, the command $8003 is actually sent as the character string $80 $03. Async characters sent to and received from the DSP4100 without a $80 escape character are interpreted as data characters, not commands or status messages.

One important note: the following sections reflect command changes resulting from recent Clover 2000 based product development for the DSP4100 and DSP4130 hardware platforms running V5.1 firmware. At present, there are no plans to incorporate these changes in the DXP38 firmware, and these command differences are not noted in the remaining sections. If there are any questions regarding DXP38 command operation please contact HAL directly or refer to HAL Engineering Document E2005 Rev. C, dated September 12, 2000.

3.1 Immediate Commands

Immediate Commands are single word commands without any arguments. The DSP4100 acknowledges the execution of each command by echoing the command to the PC. The following Immediate Commands are implemented:

CMD		DESCRIPTION
$8000	P	Load LOD file
$8001	P	Load S28 file
$8002		Check Unit Error Status
$8003	F	Check System Clock
$8004	C	Close PTT and transmit Clover waveform
$8005		Open PTT and stop transmit test
$8006		Immediate Abort (Panic Kill)
$8007		Normal disconnect (wait for ACK)
$8008		Software reset - restore all program defaults
$8009		Hardware Reset - equivalent to power on reset
$800A		Send CW ID
$800B		Close PTT and transmit Single Tone
$800C	F	Normal OVER (AMTOR,P-MODE)
$800D	F	Force RTTY TX (Baudot/ASCII)
$800E	F	Go to RTTY RX (Baudot/ASCII)
$800F		Go to LOD/S28 file loader

CMD		DESCRIPTION
$8080		Switch to CLOVER mode
$8081	F	Select AMTOR Standby
$8082	F	Select AMTOR FEC
$8083	F	Select P-MODE Standby
$8084		Switch to FSK modes
$8085	F	Select Baudot
$8086	F	Select ASCII
$8087	F	Forced OVER (AMTOR, P-MODE)
$8088	F	Forced END (AMTOR, P-MODE)
$8089	F	Force LTRS shift
$808A	F	Force FIGS shift
$808B	F	Send MARK tone
$808C	F	Send SPACE tone
$808D	F	Send MARK/SPACE tones
$808E	F	Received first character on line
$808F	F	Close PTT only (no tones)

NOTE: (C) means CLOVER only
(F) means FSK only
(P) means flash programming mode only

CMD $8000: The Load LOD file command is active only after the Go to LOD/S28 file loader command ($800F) has been issued. See Appendix B for the file loading procedure.

CMD $8001: The Load S28 file command is active only after the Go to LOD/S28 file loader command ($800F) has been issued. See Appendix B for the file loading procedure.

CMD $8002: The Check Unit Error Status command returns the current error status as shown in section 2.7. If no error conditions are detected, this command returns the OK status ($8002 $800A).

CMD $8003: The Check System Clock test the internal modem clock to make sure it is running. If the clock is OK, the $8003 command echo is returned. If the clock has stopped, a hardware reset is performed and a $8009 is returned.

CMD $8004: This test mode keys the transmitter and sends the Clover waveform. This command returns an error when linked with a remote station.

CMD $8005: The STOP TEST command immediately stops any test transmission, turn OFF PTT, and return to the idle state.

CMD $8006: The Immediate Abort command mimics the operation of writing the IMMEDIATE ABORT hardware register. Any current link or FEC transmission stops and DSP4100 returns to standby. No disconnect message is transmitted to the remote station.

CMD $8007: The normal link disconnect transmits a disconnect sequence to the remote station if linked and waits for an acknowledgment. In CLOVER mode the disconnect sequence will be repeated for the Clover Control Block (CCB) maximum retry count if no acknowledgment is received. In TOR modesm the appropriate retry count value applies. Once disconnected, the LINK DISCONNECTED ($8023 $8000) message is returned. This command terminates an FEC transmission.

CMD $8008: The Software Reset command is used to set the program default values in the DSP4100. NOTE: this command cannot restart a hung processor.

CMD $8009: This command forces a DSP4100 hardware reset. When a hardware reset occurs, the DSP4100 returns a $8009 status message after it performs the power on tests. NOTE: The $8009 status message means that DSP4100 has been reset and it must be setup for operation again. All PC application programs should test for the $8009 hardware reset status message.

CMD $800A: When this command is received, the DSP4100 will transmit the CW ID sequence, "DE <MYCALL>", at the next available opportunity. If the automatic CW ID is enabled ($8045) the internal 10 minute ID timer is reset when the Send CW ID command is issued.

CMD $800B: This test command keys the transmitter and sends a single tone for transmitter level adjustment. This command returns an error when linked with a remote station. In FSK mode, this command sends the MARK tone.

CMD $800C: The NORMAL OVER command may be used in AMTOR or P-MODE instead of sending "+?" in the transmit data stream. The NORMAL OVER only works in ISS mode. When IRS this command is ignored.

CMD $800D: When Baudot or ASCII code is selected, the Force RTTY TX command forces the DSP4100 into transmit mode without waiting for the first data character. RTTY TX remains active until the Go to RTTY RX ($800E) command is issued. This command is useful for those applications where the keyboard activated transmit/receive operation is not appropriate or desired.

CMD $800E: When Baudot or ASCII code is selected, the Go to RTTY RX command is used to stop the transmission started with the Force RTTY TX command ($800D).

CMD $800F: This command starts the DSP4100 file loader to program new LOD and S28 files into the internal flash memory. Appendix B describes the file loading procedure in detail.

CMD $8080: The Switch to Clover command configures the DSP4100 for Clover operation.

CMD $8081: The Select AMTOR Standby command changes the code to AMTOR. LISTEN ON or OFF depends on last $8048/58 command received.

CMD $8082: The Select AMTOR FEC command begins conversation FEC or Mode B operation.

CMD $8083: The Select P-MODE Standby command changes the code to P-MODE. LISTEN ON or OFF depends on last $8048/58 command received.

CMD $8084: The Switch to FSK command configures the DSP4100 for FSK operation. .

CMD $8085: The Select BAUDOT command starts Baudot RTTY.

CMD $8086: The Select ASCII command starts ASCII RTTY.

CMD $8087: The FORCED OVER command is recognized in AMTOR and P-MODE codes when this station is IRS to OVER the link. If ISS, this command is ignored.

CMD $8088: The FORCED END command is recognized in AMTOR and P-MODE codes when this station is IRS to END the link. If ISS, this command is ignored.

CMD $8089: In AMTOR and Baudot modes, the FORCE LTR SHIFT command will force the receive case to LTRS.

CMD $808A: In AMTOR and Baudot modes, the FORCE FIGS SHIFT command will force the receive case to LTRS.

CMD $808B: The SEND MARK command closes PTT and transmits the a MARK tone. The STOP TEST command ($8005) terminates this test.

CMD $808C: The SEND SPACE command closes PTT and transmits the a SPACE tone. The STOP TEST command ($8005) terminates this test.

CMD $808D: The SEND MARK/SPACE command closes PTT and transmits the alternating MARK and SPACE tones at 100 baud. The STOP TEST command ($8005) terminates this test.

CMD $808E: This command is sent to the DSP4100 in Baudot mode to signal the first character typed on the keyboard. The DSP4100 will close PTT and start sending SYNC or MARK, depending on the current selection, until the first data character is received from the PC for transmission.

CMD $808F: The CLOSE PTT command causes PTT and SCAN to close, but does not send any tones. The STOP TEST command ($8005) terminates this test.

3.2 Transmit Commands

The Transmit Commands control linking and data transmission. The link commands immediately begin a Clover link attempt in the indicated mode. The FEC command starts an FEC transmission.

In all cases, the strings included with these commands must contain ASCII alphanumeric characters in the range of $20 to $5F and $61 to $7A. All string characters are sent to the DSP4100 after a $80 escape character just like any other command. Note that all MYCALL, MYALTCALL and CALL strings are converted to upper case by the DSP4100.

CMD STRING		DESCRIPTION
$8010 <CALL> $8000	C	Robust Link to <CALL> using MYCALL
$8011 <CALL> $8000	C	Normal Link to <CALL> using MYCALL
$8012 $8000	C	Begin FEC transmission
$8013 <MYCALL> $8000		Set local MYCALL to <MYCALL>
$8014 $8000	C	Start ARQ CQ
$8015 $8000	C	Answer ARQ CQ
$8016 <CALL> $8000	F	Call 476 to <CALL>
$8017 <CALL> $8000	F	Call 625 to <CALL>
$8018 <CALL> $8000	F	Start AMTOR SEL-FEC to <CALL>
$8019 <CALL> $8000	F	Call P-MODE to <CALL>
$801A <CALL> $8000	F	Call P-MODE LP to <CALL>
$801B $8000		(reserved)
$801C $8000	F	Begin P-MODE FEC transmit
$801D $8000	F	Begin AMTOR FEC transmit
$801E <MYALTCALL> $8000	C	Set local MYALTCALL to <MYALTCALL>
$801F <MYALTCALL> $8000	C	Robust Link to <CALL> using MYALTCALL

CMD		DESCRIPTION
$8090 <CALL> $8000	F	Set MYCALL 476 to <CALL>
$8091 <CALL> $8000	F	Set MYCALL 625 to <CALL>
$8092 <CALL> $8000	F	Set GROUP call to <CALL>
$8093 <CALL> $8000	F	Set Alternate MYCALL 476 to <CALL>
$8094 <WRU> $8000	F	Load WRU text (79 char max)
$8095		(reserved)
$8096 <ADR><D> $8000	F	Write EEPROM data byte
$8097 <ADR><L> $8000	F	Read EEPROM data bytes

NOTE: <CALL>, <MYCALL> and <MYALTCALL> are 1 to 8 chars of the form $80cc
(C) means CLOVER only
(F) means FSK only

CMD $8010: Start a Robust Clover link attempt to <CALL> using MYCALL. When successful, the DSP4100 returns a LINKED TO <CALL> ($8020) status message. The <CALL> string must end in a null ($8000) terminator.

CMD $8011: Start a Normal Clover link attempt to <CALL> using MYCALL. When successful, the DSP4100 returns a LINKED TO <CALL> ($8020) status message. The <CALL> string must end in a null ($8000) terminator. Note: In Clover 2000 $8011 starts a Robust Clover link.

CMD $8012: Start FEC transmission. The FEC mode will continue until the NORMAL DISCONNECT ($8007) command is issued.

CMD $8013: Set MYCALL to the callsign included with this command. The callsign string is of the form $80cc and must contain between 1 and 8 characters. The string must end with a null ($8000) terminator. MYCALL is used in CLOVER and P-MODE.

CMD $8014: Start an ARQ mode CQ. This special transmission mode is recognized by a remote Clover station as a CQ. Since the CQ message contains MYCALL, the remote operator knows who is calling CQ and can easily respond using the Answer ARQ CQ ($8015) command.

CMD $8015: Answer an ARQ CQ transmission. When PC-Clover monitors a CQ transmission, it recovers the callsign of the remote station. This command initiates a link with station calling CQ.

CMD $8016: Start a CCIR 476 call to <CALL>. This <CALL> selcal may be entered as 4 letters or 4 or 5 numbers.

CMD $8017: Start a CCIR 625 call to <CALL>. This <CALL> selcal may be entered as 7 letters or 9 numbers.

CMD $8018: Start a CCIR 476 SELECTIVE FEC broadcast to <CALL>. This <CALL> selcal may be entered as 4 letters or 4 or 5 numbers.

CMD $8019: Start a NORMAL P-MODE call to <CALL>. This <CALL> may have up to 8 alphanumeric characters.

CMD $801A: Start a LONG PATH P-MODE call to <CALL>. This <CALL> may have up to 8 alphanumeric characters.

CMD $801C: Start P-MODE FEC broadcast.

CMD $801D: Start CCIR 476 FEC broadcast. This command is used for continuous FEC transmission as opposed to the conversational FEC mode selected with the $8082 command.

CMD $801E: Set MYALTCALL to the callsign included with this command. The callsign string is of the form $80cc and must contain between 1 and 8 characters. The string must end with a null ($8000) terminator. MYALCALL is used in CLOVER only.

CMD $801F: Start a Robust Clover link attempt to <CALL> using MYALTCALL. When successful, the DSP4100 returns a LINKED TO <CALL> ($8020) status message. The <CALL> string must end in a null ($8000) terminator.

CMD $8090: Set the local CCIR 476 Selcal to <CALL>. This callsign may be 4 letters or 4 or 5 numbers.

CMD $8091: Set the local CCIR 625 Selcal to <CALL>. This callsign may be 7 letters or 9 numbers.

CMD $8092: Set the local CCIR 476 Group Selcal to <CALL>. This callsign may be 4 letters or 4 or 5 numbers. This selcal is used for receiving selective FEC broadcasts.

CMD $8093: Set the alternate local CCIR 476 Selcal to <CALL>. This callsign may be 4 letters or 4 or 5 numbers. The DSP4100 will link to this callsign in addition to the call set with $8090.

CMD $8094: Load the CCIR 476 WRU message. The WRU message is transmitted in AMTOR mode upon receipt of a FIGS-D sequence when WRU is enabled ($80D2).

CMD $8096: This command is valid in FSK modes only and it writes a single byte <D> into the DSP4100 EEPROM at the address in <ADR>. The valid EEPROM address range is $000 to $1FF. The address is sent as two bytes, high byte first, in the following format:

<ADR> = 80aa 80bb

Where aa	= 1	0	0	0	0	0	A8	A7
bb	= 1	A6	A5	A4	A3	A2	A1	A0

If the EEPROM write is successful, the $8096 command is echoed. If the write fails, an error message is returned:

$807F $8096 $8036

CMD $8097: This command is valid in FSK modes only and it reads up to 32 consecutive bytes from the EEPROM starting at <ADR>. The starting address is parsed as described in $8096 above. The number of bytes returned <L> can be any number between 1 and 32.

In response, the DSP4100 returns the $8097 command followed by the number of bytes and the string itself. Note that string length will be the same as the length requested in the command.

$8097 $80ll $80dd ... $80dd
ll = the number of bytes in the string (1 to 32)

command: $8097 $8000 $8020 $8003 $8000 --> request three bytes starting at offset 20 hex
response: $8097 $8003 $80ii $80jj $80kk --> return 3 bytes from the EEPROM

3.3 Parameter ON/OFF Commands

Several operational parameters are enabled and disabled with the following commands. These commands have no argument bytes. The default values listed are the parameter values set when the SOFTWARE RESET ($8008) command is issued.

CMD OFF/ON		DESCRIPTION	DEFAULT
$8040/$8050	C	Enable FEC Sputter	ON
$8041/$8051	C	Reports of Channel Statistics	OFF
$8042/$8052		Connect Enable	ON
$8043/$8053		(reserved)	OFF
$8044/$8054	C	Adaptive Clover Waveform Format Adjust	ON
$8045/$8055		(reserved)	OFF
$8046/$8056	C	Expanded Link State Reports	OFF
$8047/$8057		Clear TX Buffer on Disconnect	ON
$8048/$8058		(reserved)	OFF
$8049/$8059		Echo As Sent	OFF
$804A/$805A		Enable Monitor Status	ON
$804B/$805B	F	Normal Tones	ON
$804C/$805C	F	FSK RTTY RX Polarity same as TX	ON
$804D/$805D	F	Enable FSK frequency offset reports	OFF
$804E/$805E	C	Enable 5 character CCB mode	OFF

CMD		DESCRIPTION	DEFAULT
$80C0/$80D0	F	CCITT #2 (ON) or US Baudot (OFF)	ON
$80C1/$80D1	F	Enable SYNC Idle (RTTY)	OFF
$80C2/$80D2	F	Enable WRU (Baudot/AMTOR/P-MODE)	OFF
$80C3/$80D3	F	Enable USOS (Baudot)	ON
$80C4/$80D4	F	Enable lower case (AMTOR)	ON
$80C5/$80D5	F	Pass LTRS/FIGS (AMTOR: when lower case OFF)	OFF
$80C6/$80D6	F	Enable auto-relink (AMTOR)	ON
$80C7/$80D7	F	Allow AMTOR FEC Receive (AMTOR)	ON
$80C8/$80D8		(reserved)	
$80C9/$80D9	F	Enable P-MODE HUFFMAN Compression (P-MODE)	ON
$80CA/$80DA	F	Enable PTT (when OFF, PTT is held OFF)	ON
$80CB/$80DB	F	FSK Output NORMAL (Mark = LOW)	ON
$80CC/$80DC	F	Enable +? Over (P-MODE)	ON
$80CD/$80DD	F	Enable WIDE FSK shift (RTTY)	OFF

NOTE: (C) means CLOVER only
(F) means FSK only

CMD $8040/$8050: When ON, FEC transmit ends with a Clover sputter signal to force all receiving stations back to standby. When OFF, no sputter signal is transmitted at the end of an FEC broadcast. Normally, this option should remain ON.

CMD $8041/$8051: When ON, Channel Statistics and narrow Channel spectra data status messages are automatically sent when each Clover Control Block (CCB) arrives. When OFF, status messages are only sent in response to the REQUEST CHANNEL SPECTRA ($8070) and REQUEST CHANNEL STATISTICS ($8072) commands.

CMD $8042/$8052: When ON, the DSP4100 responds to any received ARQ link request and starts an ARQ link. When OFF, the DSP4100 does not respond to a connect request but does send ARQ LINK REQUEST status message ($8027) to the application program.

CMD $8044/$8054: When ON, the local station adaptively selects the best Clover waveform for the current conditions. When OFF, the format is set by the PC application program using the SET CLOVER WAVEFORM ($8064) command. If this parameter is OFF when a remote Clover station is called, then both the local and the remote station will be set to manual mode. Note that this parameter can change during a link, but only the remote Clover station format will be affected.

CMD $8046/$8056: When ON, LINK STATE ($8073) and CLOVER WAVEFORM FORMAT reports ($8075) are sent to the PC application program whenever the link state changes. When OFF, LINK STATE and CLOVER WAVEFORM FORMAT reports are only sent in response to the corresponding commands.

CMD $8047/$8057: When ON, all buffered transmit data not yet sent and acknowledged is discarded when the link disconnects. When OFF, the buffered data is not discarded at link disconnect.

CMD $8049/$8059: When ON, transmit data characters are echoed to the OUTPUT FIFO as each data block is prepared for transmission. The data stream identification status messages ($8030 and $8031) indicate whether the characters that follow are receive data characters or transmit data characters. When OFF, no transmit data characters are echoed, and only receive data characters are passed to the PC application program.

CMD $804A/$805A: When ON, CONNECT STATUS messages MONITORED ARQ ($8022), MONITORED CQ ($8026), and MONITORED ARQ CALL TO ($8028) are passed to the PC when these Clover signals are received. When OFF, only MONITORED FEC ($8021) and ARQ LINK REQUEST ($8027) are passed to the PC; other monitored status messages ($8022, $8026, $8028) are blocked when not linked.

CMD $804B/$805B: When ON, the NORMAL Clover tones are used and FSK is transmitted with MARK sent as the MARK frequency. When OFF, the Clover tones and FSK tones are REVERSED. Note that a station using NORMAL tones and LSB can link with a second station running REVERSE tones and USB. However, if both stations are running LSB or USB, then they must also be using the same tones to link properly.

CMD $804C/$805C: This command applies to FSK Baudot and ASCII codes only. When ON, the RX polarity is set the same as TX (either NORMAL or REVERSE, see $804B/$805B). When OFF, the RX polarity is the reverse of the TX polarity. The startup setting for this parameter is ON; RX polarity equals TX polarity.

CMD $804D/$805D: This command applies to FSK modes only. When ON the FSK signal tuning offset is periodically reported with the FSK Frequency Offset Status message ($807E). When OFF, the FSK tuning status is not automatically reported.

CMD $804E/$805E: This command applies to CLOVER modes only. When ON, the CCBs contain only 5 characters instead of the normal 6, and NULL characters can be transmitted in the CCBs. When OFF, the CCBs contain 6 characters and NULL characters are discarded in CCB chat mode. While 5 character CCBs can be decoded by a station set for 6 character CCBs, there will be one or more corrupted characters in the output. Both ends of the link should have 5 character CCB ON or OFF to work properly. When AT command mode is enabled, CLOVER is set to 5 character CCBs automatically.

CMD $80C0/$80D0: In Baudot code, select US Baudot code when OFF and CCITT #2 code when ON.

CMD $80C1/$80D1: Enable SYNC idle in Baudot and ASCII code. Baudot and ASCII use the LTRS and NULL characters, respectively, as the SYNC idle character.

CMD $80C2/$80D2: Enable WRU. The WRU message, loaded with Load WRU Text command ($8094), will be transmitted in AMTOR code when a FIGS-D character is received.

CMD $80C3/$80D3: Enable USOS in Baudot mode. When ON, any space character in the receive data stream forces the case to LTRS. When OFF, a LTRS shift character must be received to shift case.

CMD $80C4/$80D4: Enable Lower Case in AMTOR code. When ON, the APLINK upper/lower case method is employed to send and receive both upper and lower case letters and additional punctuation characters. When OFF, all letters are treated as upper case.

CMD $80C5/$80D5: Pass LTRS/FIGS to application program in AMTOR. When ON and Lower Case is disabled ($80C4), all LTRS and FIGS characters are passed to the PC application in the receive data stream. When OFF, these shift characters are removed from the RX data stream. Note: The LTRS character is "<" ($4C) and the FIGS character is ">" ($4E).

CMD $80C6/$80D6: Enable Auto-Relink in AMTOR. When ON, the MASTER station will attempt to re-link with the SLAVE station if the link drops out due to received errors. When OFF, the MASTER station immediately returns to AMTOR Standby if the link drops out.

CMD $80C7/$80D7: Allow CCIR 476 FEC in AMTOR Standby mode. When ON, AMTOR Standby will switch to AMTOR FEC whenever a valid FEC phasing sequence is detected. When OFF, the phasing sequence is ignored.

CMD $80C9/$80D9: Enable P-MODE Huffman compression. When ON, P-MODE may use Huffman data compression on transmit data. When OFF, Huffman compression is disabled. Note that this only controls the transmit data direction. The P-MODE receive routine always accepts and decodes Huffman compressed data packets even if this option is OFF.

CMD $80CA/$80DA: Enable PTT. When ON, PTT operates normally in all modes. When OFF, the DSP4100 continues to operate normally but PTT will remain inactive and OPEN circuited.

CMD $80CB/$80DB: When ON, the FSK output is NORMAL where the MARK is a short to ground (LOW) and the SPACE is TTL HIGH or OPEN CIRCUIT (DSP4100 board jumper option). If OFF, the MARK and SPACE states are reversed. Except for the direct FSK keyed output, no other DSP4100 operation is effected by this command.

CMD $80CC/$80DC: When ON in P-MODE ARQ mode, the "+?" transmit character sequence is used as an OVER command as in AMTOR ARQ mode. When OFF, all ASCII characters are passed to the remote P-MODE station unchanged, and the NORMAL OVER command ($800C) must be used to change from ISS to IRS.

CMD $80CD/$80DD: When ON in RTTY mode, the FSK receive shift is increased by 30 Hz. Typically, this changes the RX shift from 170 Hz to 200 Hz to permit better copy of 200 Hz shift signals. When OFF, the RX and TX shift are set to the same value. NOTE: this command is only active in the DXP38.

3.4 Set Parameter Commands

The Set Parameter commands load various operational parameters. Each command requires one option selection byte.

CMD		DESCRIPTION	RANGE	DEFAULT
$8060 <OPT>	C	Set Robust link retry maximum	1 - 255	2
$8061 <OPT>	C	Set Normal link retry maximum MSB = 1 for short cycle time	1 - 127 0:1200, 1:896 ms	9 1200ms
$8062 <OPT>	C	Set CCB retry maximum	1 - 255	9
$8063 <OPT>	C	Set Voice-band sub-channel select	1 - 5	4
$8064 <OPT>	C	Set Clover waveform format		$DD
$8065 <OPT>	C	Set Bias set	0 - 3	1 (normal)
$8066 <OPT>	C	Set Highest Auto-ARQ Waveform	0 - 5	0
$8067 <OPT>		Set SCAN mode	0 - 3	0
$8068 <OPT>	C	Set Chat Count	0 - 255	1
$8069 <OPT>		Set Secondary Port Rate	0 - 7	0
$806A <OPT>		Set Primary Port Rate	0 - 7	4 (9600)
$806B <OPT>		Set Secondary Port Configuration	0 - 15	0
$806C <OPT>		Set RX Gain	1=0, 2=+6, 3=+12 dB	1
$806D <OPT>		Set Secondary Control Signals	(see description)	-
$806F <OPT>		Switch to AT command mode	(see description)	-

CMD		DESCRIPTION	RANGE	DEFAULT
$80E0 <OPT>	F	Set Control Delay	0 - 255	50
$80E1 <OPT>	F	Set Transmit Delay	0 - 255	10
$80E2 <OPT>	F	Set Audio Delay	0 - 255	2
$80E3 <OPT>	F	Set PTT Delay (* 100ms)	0 - 255	20
$80E4 <OPT>	F	Set Baudot speed	0-5:45,50,57,75,100,110	0
$80E5 <OPT>	F	Set ASCII speed	0-5:45,50,57,75,100,110	5
$80E6 <OPT>	F	Set FSK ATC Filter	0=OFF, 1=ON	0
$80E7 <OPT>	F	Set AMTOR Quality Level	0 - 5	3
$80E8 <OPT>	F	Set Print Squelch Level	0 - 99	68
$80E9 <OPT>	F	Set Time-out	32/128; 0 to disable	32
$80EA		(reserved)		
$80EB <OPT>	F	Set filter BW	0=55, 1=75, 2=100 Hz	-
$80EC <OPT>	F	Set MARK/SPACE (4 bytes, MARK then SPACE)	send each with high byte first, then low	2125/2295 2100/2300
$80ED <OPT>	F	Set PTT OFF Delay (* 100 ms)	0 - 255	20
$80EE <OPT>	F	Allow cross code connects	bit2=P-MODE, bit1=AMTOR, bit0=CLOVER	7

where: <OPT> = $80nn; nn is the new parameter setting
(C) means CLOVER only
(F) means FSK only

CMD		DESCRIPTION	RANGE	DEFAULT
$80F0 <OPT>	F	Set P-MODE Speed	0=100, 1=200, 2=auto	2
$80F1 <OPT>	F	Set P-MODE CS Delay	0 - 255	30
$80F2 <OPT>	F	Set P-MODE Max Up	0 - 255	3
$80F3 <OPT>	F	Set P-MODE Max Try	0 - 255	2
$80F4 <OPT>	F	Set P-MODE Max Down	0 - 255	6
$80F5 <OPT>	F	Set P-MODE Max Errors	0 - 255	80
$80F6 <OPT>	F	Set P-MODE FEC Rate	0=100, 1=200	0
$80F7 <OPT>	F	Set P-MODE FEC Repeat	0 - 255	2
$80F8 <OPT>	F	Set P-MODE Memory ARQ	0 - 255	30
$80FE <OPT>	C	Set CLOVER Mask	high/low byte	00 00
$80FF <OPT>	S	Set CRC Mask	high/low byte	00 00

where: <OPT> = $80nn; nn is the new parameter setting
(C) means CLOVER only
(F) means FSK only
(S) means proprietary commercial DSP4100 version only

CMD $8060: Set the Robust link retry maximum count. This parameter sets the number of Robust link CCBs are transmitted during a link attempt. 0 disables the retry counter. The default is 2.

CMD $8061: Set the Normal link retry maximum count. This parameter sets the number of Normal link bursts are transmitted during a link attempt. 0 disables the retry counter. The default is 9. The most significant bit selects the Normal link transmit cycle time. The cycle time can be set to 1200 ms (MSB=0) or 896 ms (MSB=1). The long cycle time may be required for DX stations.

CMD $8062: Set the Clover Control Block (CCB) retry maximum count. This parameter sets the number of consecutive link errors allowed before the link is dropped. 0 disables the counter: The default is 9.

CMD $8063: Set the Voice-band sub-channel selection (for CLOVER 500 only). The number entered sets the low frequency bound of the sub-channel to (N*500) Hz. The default is 4 or 2000Hz to 2500Hz.

CMD $8064: Set the Clover waveform format. This command sets the Clover transmit format when the Clover adaptive format option is turned OFF. The form of the <OPT> word is the same as the CLOVER WAVEFORM FORMAT ($8075) status response. The default is length 255, QPSM, 75% ($DD). Note that the Clover format can be changed when linked. In adaptive ARQ mode, this command is ignored. In manual ARQ mode this command sets the remote station Clover format. In FEC mode this command sets the local station transmit mode.

CMD $8065: Set Clover waveform bias. This parameter selects the Reed-Solomon encoder rate or error correction capability and how rapidly the Clover waveform adaptive format adjustment acts. When set for FAST bias, the format will move to higher data rates more rapidly than when set for ROBUST. When band conditions are stable, FAST may be used successfully. In changing conditions, the ROBUST setting will work better. The default setting is NORMAL.

CMD	DESCRIPTION	R-S Coder Rate
$8065 $8000	Set ROBUST bias	60%
$8065 $8001	Set NORMAL bias	75%
$8065 $8002	Set FAST bias	90%
$8065 $8003	Set 100% bias	100% (R-S disabled)

Note: the BIAS setting *must not change* during a link since it will cause the link to fail.

CMD $8066: Set Highest Clover ARQ Waveform. In AUTO-ARQ mode, the Clover receiving station sets the transmit waveform for the remote sending station based on signal conditions. In very good conditions, it will select 16P4A, and in poor conditions, it might select QPSM. This command permits an application program to set the maximum data rate waveform that the link will use. When set to 0, the default setting, the maximum waveform can be 16P4A. If set to 1 or 2, the maximum waveform will be 8P2A. The default setting is 0.

CMD	Highest ARQ Waveform
$8066 $8000	16P4A
$8066 $8001	16PSM (not used)
$8066 $8002	8P2A
$8066 $8003	8PSM
$8066 $8004	QPSM
$8066 $8005	BPSM

CMD $8067: Set the SCAN control output mode. The NORMAL mode holds the SCAN control output low for the entire ARQ link. The PULSED mode pulses the SCAN control output low for 0.4 seconds at the start and the end of a link. The default setting is NORMAL with reelase delay ($8000).

If the delayed release is enabled ($8000 and $8001) the SCAN control output remains active for approximately 25 seconds after the end of an ARQ link. With no delay, the SCAN control output becomes inactive as soon as the link ends.

In all cases, the SCAN output is active whenever the DSP4100 is transmitting, including FEC, calling CQ, and answering a CQ.

CMD	DESCRIPTION
$8067 $8000	Set NORMAL SCAN mode with release delay
$8067 $8001	Set PULSED SCAN mode with release delay
$8067 $8002	Set NORMAL SCAN mode with no release delay
$8067 $8003	Set PULSED SCAN mode with no release delay

CMD $8068: Set the Chat Count. The Chat Count is the number of full chat mode CCBs transmitted before changing to ARQ block mode transmission. If this parameter is set to 0, then all transmissions will use the 20 second ARQ data block transmission mode. The default setting is 1.

CMD $8069: Set the Secondary port data rate. The secondary port can be set to any of the rates in the following table. Note that the start up default for the secondary port is 0 or disabled.

CMD	SECONDARY PORT RATE
$8069 $8000	Disable Port (default)
$8069 $8001	1,200 BPS
$8069 $8002	2,400
$8069 $8003	4,800
$8069 $8004	9,600
$8069 $8005	19,200
$8069 $8006	38,400
$8069 $8007	57,600

CMD $806A: Set the Primary port data rate. This command is echoed at the old rate, then the primary port rate immediately changes to the new rate. The rate table is the same as the table for $8069 above. The new primary port rate remains in effect until the next hardware reset or the next $8069 command. NOTE: the DSP4100 always sets the primary port rate to 9600 bps at reset.

CMD $806B: Set the Secondary Port character length, parity, and number of stop bits. The port configuration is set using the following table. The default configuration is 8N1 ($8000).

	Bit 15	...	7	6	5	4	3	2	1	0
<OPT> =	1	...	0	0	0	0	CHAR_LEN	PARITY	PAR_ENABLE	STOP_BIT

7 bit char	1	...	.	.	.	.	1			
8 bit char	1	...	.	.	.	.	0			
EVEN Parity	1	...	.	.	.	.	.	1	1	
ODD Parity	1	...	.	.	.	.	.	0	1	
NO Parity	1	...	.	.	.	.	.	0	0	
2 Stop bits	1	...	.	.	.	.	.	.	.	1
1 Stop bit	1	...	.	.	.	.	.	.	.	0

CMD $806C: Set RX Gain. This command sets the fixed RX audio gain in the modem codec. The default is 0 dB gain. The gain can be changed at any time. Whenever the RX gain is changed, the new setting is stored in non-volatile memory, and that gain setting is restored when the unit is reset.

CMD	RX GAIN
$806C $8001	0 dB (default)
$806C $8002	+6 dB
$806C $8003	+12 dB

CMD $806D: Set Secondary Port Control Signals. This command is used to set the DSP4100 secondary port DCD, CTS, and RX BREAK status.

	7	6	5	4	3	2	1	0
<OPT> =	Set DCD	DCD	x	Set BREAK	BREAK	x	Set CTS	CTS

DCD ON	1	1	.	.	.		
DCD OFF	1	0	.	.	.		
BREAK ON	.	.	1	1	.		
BREAK OFF	.	.	1	0	.		
CTS ON	.	.	.	.	1	1	
CTS OFF	.	.	.	.	1	0	

CMD $806F: Switch to AT command mode. This command is used to switch from the 8000 command mode to the AT command mode. HAL document E2010 describes the AT command mode.

CMD	DESCRIPTION
$806F $8001	Switch to AT command mode

CMD $80E0: Set Control Delay. In CCIR 476 and 625, this delay is the number of ms delay added by the IRS before transmitting the CS characters. The default setting is 50 ms.

CMD $80E1: Set Transmit Delay. In CCIR 476 and 626, this is the delay in ms between PTT closing and the start of the audio tones. The default setting is 10 ms.

CMD $80E2: Set Audio Delay. In CCIR 476 and 625, this is the delay in ms between the start of audio tones and the start of the first data bit. The default setting is 2 ms.

CMD $80E3: Set PTT Delay. In Baudot and ASCII codes, this is the delay in 100 ms units between PTT closing and the start of character transmission. If SYNC is enabled, sync characters will fill this interval. The default setting is 20 (20 * 100 = 2000 ms).

CMD $80E4: Set Baudot speed. Select the Baudot data rate from the table below. The default setting is 0 (45 bps).

CMD	BAUDOT SPEED
$80E4 $8000	45 (default)
$80E4 $8001	50
$80E4 $8002	57
$80E4 $8003	75
$80E4 $8004	100
$80E4 $8005	110

CMD $80E5: Set ASCII speed. Select the ASCII data rate from the same table shown above. The default setting is 5 (110 bps).

CMD $80E6: Set FSK ATC Filter. The FSK demodulator in the DSP4100 includes an automatic threshold correction filter algorithm that can be enabled for all FSK modes except P-MODE. This command is not available on the DXP38.

CMD	DESCRIPTION
$80E6 $8000	Disable FSK ATC (default)
$80E6 $8001	Enable FSK ATC

CMD $80E7: Set AMTOR Quality Level. The AMTOR Quality is a number between 1 and 5 that selects the maximum amount of jitter, in ms, permitted on ISS station B/Y transitions. The IRS will ignore triplets with transitions that fall outside this limit. The Quality setting is an attempt to add increased error detection capabilities to standard CCIR 476 transmissions. The default settings is 3.

CMD $80E8: Set Print Squelch Level. In Baudot and ASCII, the print squelch level sets the minimum audio level required before RX data is detected. Raising the print squelch level can reduce the amount of noise induced characters generated in the RX data stream. The default setting is 68.

CMD $80E9: Set AMTOR Time-out. This time-out sets the number of 450 ms cycles transmitted during an AMTOR call before returning to standby. In addition, it sets the number of errors allowed before dropping a link. The default setting is 32 cycles.

CMD $80EB: Set filter BW. This command sets the receive MARK and SPACE filter bandwidths and the low pass filter output bandwidth. For CCIR 476, 75 Hz (option 1) is recommended. For P-MODE, 100 Hz (option 2) is suggested. For Baudot, 55 Hz (option 0) is recommended.

CMD $80EC: Set MARK/SPACE Frequency. This command sets the MARK and SPACE frequencies for transmit and receive. The frequency may be set to any value between 300 and 3000 Hz. The defaults are 2125/2295 for the ham version and 1785/1615 for the commercial versions. This command has the following format:

$80EC $80hm $80lm $80hs $80ls

where: hm lm are the MARK frequency high and low bytes (in Hz).
hs ls are the SPACE frequency high and low bytes (in Hz).

CMD $80ED: Set PTT OFF Delay. In Baudot and ASCII codes, this command sets the delay in 100 ms units after the last character is transmitted until PTT turns OFF and the DSP4100 returns to Receive mode. The default setting is 20 (20 * 100 = 2000 ms).

CMD $80EE: Allow cross code connects. In AMTOR Standby and P-MODE Standby, link requests are recognized in both P-MODE and CCIR 476 format. When in AMTOR Standby, the P-MODE link request is recognized only if Option Bit 2 is 1. When in P-MODE Standby, the AMTOR link request is recognized only if Option Bit 1 is 1. The Clover Bit 0 is currently reserved for later versions. The default setting is 7 for the ham version and 0 for the commercial versions.

CMD $80F0: Set P-MODE Speed. This command sets the P-MODE ARQ speed to 100, 200 or AUTO. The default setting is 2 (AUTO).

CMD $80F1: Set P-MODE CS Delay. This command sets the CS signal delay in ms for the IRS station. The default setting is 30 ms.

CMD $80F2: Set P-MODE Max Up. Max Up is the number of correct 100 baud data blocks that must be received without error before the IRS station signals the ISS to change to 200 baud. The default setting is 3.

CMD $80F3: Set P-MODE Max Try. Max Try is the maximum number of blocks transmitted after a change 200 without receiving an ACK. If Max Try is exceeded, the ISS station falls back to 100 baud. The default setting is 2.

CMD $80F4: Set P-MODE Max Down. Max Down is the number of corrupted 200 baud data blocks received in a row before the IRS signals a change to 100 baud. The default setting is 6.

CMD $80F5: Set P-MODE Max Errors. This parameter is the maximum number of corrupted blocks received before dropping the link. This parameter also sets the number of transmissions when calling a remote station before abandoning the attempt. The default setting is 80.

CMD $80F6: Set P-MODE FEC Rate. FEC Rate sets the P-MODE FEC transmit rate. The default setting is 0 (100 baud).

CMD $80F7: Set P-MODE FEC Repeat. This command sets the number of times each P-MODE FEC data block is repeated. The default setting is 2.

CMD $80F8: Set P-MODE Memory ARQ. This command sets the number of data blocks accumulated for Memory ARQ reconstruction. The default setting is 30.

CMD $80FE: Set CLOVER CRC mask; <OPT> has two bytes: high byte then low byte. The default setting is 0. Note that the CLOVER CRC must be same for two stations to link and pass data. If the CRCs are different, the stations cannot link.

CMD $80FF: Set P-Mode CRC mask; <OPT> has two bytes: high byte then low byte. This command is available only in a special commercial version.

3.5 Status Request Commands

The Status Request commands cause the DSP4100 to return the requested status information.

CMD		DESCRIPTION
$8070	C	Request Channel spectra data (narrow)
$8071		Request Selcal state
$8072	C	Request Channel statistics
$8073	C	Request Clover Link state
$8074	C	Request Voice-band sub-channel
$8075	C	Request Clover waveform format
$8076		Request DSP software version
$8077		Request Control Processor software version
$8078		Request EPROM version
$8079		Request EPROM checksum
$807A		(reserved for FSK status messages)
$807B		Request Product ID
$807C		Request Input FIFO fill level
$807D		Request LED status
$807E	F	Request FSK tuning offset

CMD		DESCRIPTION
$80A0		Request Hardware Revision number
$80A1		Request S28 Firmware waveform and build
$80A2		Request LOD firmware waveform and build
$80A3		Request secondary port signals
$80A4		Request Serial Number

NOTE: (C) means CLOVER only
(F) means FSK only

In response to the commands listed above, the DSP4100 sends the following status messages. The "NR" column shows the number of words returned in addition to the status word.

STATUS		NR	DESCRIPTION
$8070		8	Channel spectra data (narrow)
$8071		1	Selcal state
$8072	C	14	Channel statistics
$8073	C	1	Link state
$8074	C	1	Voice-band sub-channel
$8075	C	4	Clover waveform format
$8076		2	DSP software version
$8077		2	Control Processor software version
$8078		2	BOOT version
$8079		2	BOOT checksum
$807A	F	1	FSK CHANNEL status (FSK Modes Only)
$807B		2	Product ID
$807C		2	Input FIFO fill level
$807D		1	LED Status
$807E	F	1	FSK Frequency Offset
$807F		2	Command Error

NOTE: (C) means CLOVER only
(G) means FSK only

STATUS		NR	DESCRIPTION
$80A0		2	Hardware Revision Level
$80A1		2	S28 Firmware Info
$80A2		3	LOD Firmware Info
$80A3		1	Secondary port signals
$80A4		0-22	Unit Serial Number

NOTE: (C) means CLOVER only
(F) means FSK only

STATUS $8070: The narrow channel spectra data are formatted as unsigned bytes, from low to high frequency in steps of 62.5 Hz over the selected 500 Hz voice-band sub-channel. The data samples are in 0.5 dB units with $FE representing the maximum input level for undistorted signals. $FF represents input overload.

The above description of Status $8070 applies only when the DSP4100 is not actively engaged in a CLOVER mode – "standby" conditions. When any mode of CLOVER is active, $8070 returns non zero bytes only in positions 1, 3, 5, and 7, which correspond to the center frequencies of the four CLOVER tone pulses. In FSK modes, these bytes correspond to the four tuning bar frequencies: T1, MARK, SPACE, and T4.

If Reports of Channel Statistics is ON ($8051) this status message is generated 8 times per second when no Clover mode is active and a Clover carrier is detected. When a Clover mode is active, this status message is generated once for each CCB and data block received.

STATUS $8071: The Selcal output status is sent automatically after any change if the EXPANDED LINK STATE REPORTS ($8056) option is ON. When OFF, the state is sent when the REQUEST SELCAL STATE ($8071) command is issued.

STATUS	DESCRIPTION
$8071 $8000	Selcal OFF
$8071 $8001	Selcal ON or ACTIVE

STATUS $8072: Clover Channel statistics response includes parameters for both the local and remote CLOVER station. The local statistics are reported first, and the remote statistics follow. Both local and remote reports have the data format shown below:

BYTE NR	DATA FORMAT	UNIT	DESCRIPTION
1	Unsigned byte	0.5 dB	Average power in passband
2	Unsigned byte	0.5 dB	SNR of Clover signal
3	Unsigned byte	0.5 dB	Excess transmitter power
4	signed byte	1 Hz	frequency offset (+/- 30 Hz. Max)
5	Unsigned byte	1 byte/sec	Data throughput
6	Unsigned byte		Phase dispersion (0 to 80)
7	Unsigned byte	%	Error correction used (0 – 100) If > 100, the decode failed

STATUS $8073: Clover Link state response is sent automatically after any change if the EXPANDED LINK STATE REPORTS ($8056) option is ON. When OFF, the state is sent when the REQUEST LINK STATE ($8073) command is issued.

STATUS		DESCRIPTION
$8073 $8000		Channel idle
$8073 $8001		Channel occupied with non-Clover signal
$8073 $8042		Linked stations monitored
$8073 $8064		Attempting normal link
$8073 $8065		Attempting robust link
$8073 $8066		Calling ARQ CQ
$8073 $8078		Clover Control Block (CCB) send retry
$8073 $8079		Clover Control Block (CCB) receive retry
$8073 $807D		Clover Control Block (CCB) received successfully
$8073 $808A		TX data block sent
$8073 $808B		RX data block received ok (precedes data block)
$8073 $808C		TX data block re-sent
$8073 $808D		RX data block decode failed (precedes data block)
$8073 $808E		TX idle
$8073 $808F		RX idle
$8073 $809C		Link failed: CCB send retries exceeded
$8073 $809D		Link failed: CCB receive retries exceeded
$8073 $809E		Link failed: protocol error
$8073 $80A0		Receiving FEC SYNC sequence

Status $8073 $809C: The Clover Control Block (CCB) SEND RETRY EXCEEDED status message is sent when the CCB has been transmitted the set number of times without an acknowledge.

Status $8073 $809D: CCB RECEIVE RETRY EXCEEDED status message is sent when a CCB has not been successfully received after a set number of attempts.

Status $8073 $809E: The protocol error status is sent when the link fails due to a protocol error.

STATUS $8074: The Voice-band Sub-channel status message returns a single word indicating the lower frequency boundary of the current sub-channel.

STATUS	DESCRIPTION
$8074 $800n	Low frequency boundary of channel is (n*500) Hz

STATUS $8075: The Clover waveform format status message returns four words. The first word is the transmit format, the second is transmit level, the third is the receive format, and the final word is the remote transmit level. This status is reported automatically when EXPANDED LINK STATE REPORTS ($8056) option is ON. Power reports are formatted as an unsigned byte from 0 to 100 representing the percentage of the transmitter's maximum power currently being used.

Note that the Clover waveform format reported with this status message is either the format of the ARQ data blocks, when operating in block mode, or the CCB data format, when in CCB chat mode. During ARQ block transmission, a waveform report is generated with each data block received. Otherwise, a report is generated for each CCB received.

STATUS	DESCRIPTION
$8075 $80lm $80lp $80rm $80rp	Current Clover waveform and power level Local mode lm = LL MMMM DD Local power lp = lp% Remote mode rm = LL MMMM DD Remote power rp = rp%

LL	Length of Codeblock
00	17
01	51
10	85
11	255

MMMM	MODULATION FORMAT	ABREV	SPEED
0000	(reserved)		
0001	4 independent channel OOK	CWID	125
0010	dual-diversity pulse-freq-position	2DFSM	125
0011	quad-diversity 2 phase	4DPSM	250
0100	2 chan parallel pulse-freq-position	FSM	250
0101	Dual diversity 2 phase	2DPSM	250
0110	4 channel parallel 2 phase	BPSM	500
0111	4 channel parallel 4 phase	QPSM	2,000
1000	4 channel parallel 8 phase	8PSM	2,000
1001	4 channel parallel 8 phase 2 ampl	8P2A	4,000
1010	4 channel parallel 16 phase	16PSM	4,000
1011	4 channel parallel 16 phase 2 ampl.	16P4A	6,000

DD	EFFICIENCY	ERROR CORRECTING CAPABILITY
00	60%	20% - Robust Bias
01	75%	12% - Normal Bias
10	90%	5% - Fast Bias
11	100%	0% - No error correction

POWER	DESCRIPTION
$80pp	Current transmit power level pp% (0 to 100)

STATUS $8076: The DSP software version is returned as two binary numbers. The major version is the first byte, and the revision level is the second byte.

STATUS	DESCRIPTION
$8076 $8003 $8001	DSP LOD Version 3.1

STATUS $8077: The Control Processor software version is returned as two binary numbers. The major version number is the first byte, and the revision level is the second byte.

STATUS	DESCRIPTION
$8077 $8005 $8001	S28 Version 5.1

STATUS $8078: The BOOT software version is returned as two binary numbers. The major version number is the first byte, and the revision level is the second byte.

STATUS	DESCRIPTION
$8078 $8002 $8001	BOOT Version 2.1

STATUS $8079: The BOOT checksum always returns 00 00.

STATUS	DESCRIPTION
$8079 $8000 $8000	Flash checksums OK

STATUS $807A: This status reports changes in FSK operating modes. All of the current status reports are shown below. The status is reported only when it changes.

STATUS	DESCRIPTION
$807A $8000	IDLE (AMTOR/P-MODE)
$807A $8001	TFC (AMTOR/P-MODE)
$807A $8002	RQ (AMTOR/P-MODE)
$807A $8003	ERR (AMTOR/P-MODE)
$807A $8004	PHS (AMTOR/P-MODE)
$807A $8005	OVER (AMTOR/P-MODE) (not implemented)
$807A $8006	FSK TX (RTTY)
$807A $8007	FSK RX (RTTY)
$807A $8008	P-MODE100 (P-MODE)
$807A $8009	P-MODE200 (P-MODE)
$807A $800A	HUFFMAN ON (P-MODE)
$807A $800B	HUFFMAN OFF (P-MODE)
$807A $800C	P-MODE STANDBY (LISTEN ON)
$807A $800D	P-MODE STANDBY (LISTEN OFF)
$807A $800E	ISS (AMTOR/P-MODE)
$807A $800F	IRS (AMTOR/P-MODE)
$807A $8010	AMTOR STANDBY (LISTEN ON)
$807A $8011	AMTOR STANDBY (LISTEN OFF)
$807A $8012	AMTOR FEC TX (AMTOR)
$807A $8013	AMTOR FEC RX (AMTOR)
$807A $8014	P-MODE FEC TX (P-MODE)
$807A $8015	FREE SIGNAL TX (AMTOR)
$807A $8016	FREE SIGNAL TX TIMED OUT (AMTOR)

STATUS $807B: The DSP4100 Product ID is returned as two 8 bit bytes, high byte first.

STATUS	DESCRIPTION
$807B $8041 $8000	HAL Product ID (4100)

STATUS $807C: The DSP4100 Input FIFO fill level is returned in two bytes, high byte first.

STATUS	DESCRIPTION
$807C $80nn $80mm	Input FIFO contains nnmm commands and data

STATUS $807D: The LED Status message returns the current DSP4100 front panel LED status.

STATUS	DESCRIPTION
$807D $80ll	ll = 0 0 STBY CALL LINK ERROR TX RX

STATUS $807E: The FSK Frequency Offset status message returns the relative tuning offset for the FSK signal currently being received. This status is only valid when receiving a signal, and it is forced to zero when the local station is operating as AMTOR or P-MODE ISS. The FSK tuning status is automatically updated after the Enable FSK Tuning Status ($805D) command is issued.

STATUS	DESCRIPTION
$807E $80ff	-100 < ff < +100 Hz FSK tuning offset

STATUS $807F: The Command Error status message is returned whenever an invalid command is received or when command parameters are out of range. The invalid command is sent as the second word then the error type follows.

STATUS	DESCRIPTION
$807F $80xx $80yy	Error in command $80xx of type $80yy

ERROR TYPE	DESCRIPTION
$807F $80xx $8030	Invalid or unimplemented command code
$807F $80xx $8031	Invalid parameter value
$807F $80xx $8032	Not allowed when connected
$807F $80xx $8033	Not allowed when disconnected
$807F $80xx $8034	Not valid in this mode
$807F $80xx $8035	Not valid in this code
$807F $8096 $8036	EEPROM write error

STATUS $80A0: The Request Hardware Revision level command returns board type and revision number.

STATUS	DESCRIPTION
$80A0 $80mm $80nn	Hardware Revision mmnn (16 bit value)

where: Bit 15 = 1 for DSP4100/2K and 0 for DSP4100
Bit 3:0 = Board hardware revision level

STATUS $80A1: The Request S28 Firmware info command returns waveform and build type.

STATUS	DESCRIPTION
$80A1 $80mm $80nn	S28 Firmware Info mmnn (16 bit value)

where: Bit 15:8 = Clover Waveform type: 'H'($48) = Clover 2000; ' '($20) = Clover 500
Bit 7:0 = Firmware Type ($00 = HAL)

STATUS $80A2: The Request LOD Firmware info command returns waveform and build type.

STATUS	DESCRIPTION
$80A2 $80mm $80nn	LOD Firmware Info mmnn (16 bit value)

where: Bit 15:8 = Clover Waveform type: 'H'($48) = Clover 2000; ' '($20) = Clover 500
Bit 7:0 = Firmware Type ($00 = HAL)

STATUS $80A3: The secondary port control signals and status are returned with this command.

STATUS	DESCRIPTION
$80A3 $80ss	Secondary port status

where: ss = TX_BREAK 0 SRTS 0 CTRL 0 0 0

STATUS $80A4: The Request serial number returns a 0 to 22 character serial number followed by an $8000 terminator.

STATUS	DESCRIPTION
$80A4 [$80ss . . . $80ss] $8000	Serial Number (0 to 22 bytes)

3.6 Connect Status Reports

The DSP4100 issues the following status reports when the indicated connected status change occurs. If Enable Monitor Status is OFF ($804A), then $8022, $8026, and $8028 are blocked.

CONNECT STATUS		DESCRIPTION
$8020 <CALL> $8000	C	Linked to <CALL>
$8021 <CALL> $8000	C	Monitored FEC CCB from <CALL>
$8022 <CALL> $8000	C	Monitored ARQ CCB from <CALL>
$8023 $8000		Link disconnected normally
$8024 $8000		Link failed (any of the link errors)
$8025 $8000		Signal Lost (LOS)
$8026 <CALL> $8000	C	Monitored ARQ CQ from <CALL>
$8027 $800c	C	ARQ Link Request for MYCALL(c=0)/MYALTCALL(c=1)
$8028 <CALL> $8000	C	Monitored ARQ Call to <CALL>
$8029 $8000	F	Linked 476
$802A <CALL> $8000	F	Linked 625 to <CALL>
$802B <CALL> $8000	F	Linked P-MODE to <CALL>
$802C <CALL> $8000	F	Receiving Selective FEC to <CALL>
$802D <TYPE> $8000	F	ARQ Link Request received
$802E <TYPE> $8000	F	Monitor FSK Signal

NOTE: <CALL> is 1 to 8 characters of the form $80cc
(C) means CLOVER only
(F) means FSK only

STATUS $8020: The LINKED status message is returned when a Clover link is established with <CALL>. This link can be either locally or remotely requested.

STATUS $8021: The MONITORED FEC status message is returned when a Clover FEC transmission is received from <CALL>.

STATUS $8022: The MONITORED ARQ status message is returned when a Clover transmission is monitored from <CALL>.

Status $8023: The LINK DISCONNECTED status message is sent when a link is terminated normally by command locally or remotely.

Status $8024: The LINK FAILED status message is sent when a link is terminated by a retry or protocol error. In addition, this status is returned in response to an Immediate Abort.

STATUS $8025: The DSP4100 has lost the remote Clover station signal.

STATUS $8026: The MONITORED ARQ CQ status message is returned when a Clover CQ transmission is received from <CALL>.

STATUS $8027: The ARQ LINK REQUEST status message indicates an incoming link request to either MYCALL ($8027 $8000), or MYALTCALL ($8027 $8001). If CONNECT ENABLE is ON ($8052) the DSP4100 responds to the link request immediately. If CONNECT ENABLE is OFF ($8042), this status message indicates that a remote Clover station is calling, but the DSP4100 will not respond until the CONNECT ENABLE ON ($8052) command is issued.

STATUS $8028: The MONITORED ARQ CALL TO status message is returned when the DSP4100 receives a ROBUST ARQ call to another station. Note that no status message is returned for monitored NORMAL connect requests.

STATUS $8029: The Linked 476 message indicates the start of a CCIR 476 linked session.

STATUS $802A: The Linked 625 message indicates the start of a CCIR 625 linked session to <CALL>.

STATUS $802B: The P-MODE Linked message indicates the start of a P-MODE linked session to <CALL>.

STATUS $802C: The Receiving Selective FEC message indicates the start of a selective FEC broadcast to <CALL>.

STATUS $802D: The ARQ Link Request status message is sent when a link request is received. If CONNECT ENABLE is ON ($8052), then the local DSP4100 will respond to the link request. If OFF, the link request is ignored, but will be reported.

STATUS	DESCRIPTION
$802D $8001 $8000	CLOVER Link Request (not implemented)
$802D $8002 $8000	AMTOR CCIR-476 Link Request
$802D $8003 $8000	AMTOR CCIR-625 Link Request
$802D $8004 $8000	P-MODE Link Request

STATUS $802E: The Monitor FSK signal status message signals the detection of a valid signal in one of the following codes:

STATUS		DESCRIPTION
$802E $8001 $8000		CLOVER
$802E $8002 $8000		AMTOR
$802E $8003 $8000		AMTOR FEC
$802E $8004 $8000		P-MODE
$802E $8005 $8000		P-MODE FEC
$802E $8006 $8000		AMTOR SEL-FEC

3.7 Stream Switch Status Reports

When the echo as sent option is enabled ($8059) the DSP4100 sends both echoed transmit data characters and receive data characters from the remote Clover station to the application program. So that the application program knows how to process these characters, the DSP4100 uses a data stream switch status message to signal the source for the data characters that follow. Even if echo as sent is not enabled ($8049), the stream switch status message may appear in the receive data sent to the application program.

STATUS		DESCRIPTION
$8030		Switch to Receive Data characters
$8031		Switch to Transmit Data characters
$8032		Switch to RX data from secondary port
$8033		Send TX data to modem
$8034		Send TX data to secondary port

STATUS $8030: All data characters that follow this status message are receive data characters. Note that this status message may be repeated even if there are no transmit data characters to echo.

STATUS $8031: All data characters that follow this status message are echoed transmit data characters. Note that this status message may be repeated.

STATUS $8032: All data characters that follow this status message are RX data characters from the secondary port connector.

CMD $8033: All data characters sent to the serial port after this command are passed to the modem until a $8034 stream switch command is received.

CMD $8034: All data characters sent to the serial port after this command are passed to the secondary port until a $8033 stream switch command is received.

4. OPERATION EXAMPLES

In this section, several simple examples illustrate the basic operation of the PC to DSP4100 interface protocol including parameter setting and calling.

4.1 Setting Operational Parameters

In the following example, MYCALL is loaded, and several parameters are set.

PC		DSP4100	DESCRIPTION
$8013	→		Set MYCALL
$804B	→		K
$8039	→		9
$8043	→		C
$8057	→		W
$8000	→		$00
	←	$8013	Acknowledge MYCALL
$8055	→		Set CWID ON
	←	$8055	Acknowledge CW ON
$8046	→	$8046	Set expanded link state reports OFF
	←	$8046	Acknowledge link state reports OFF
$8067	→		Set SCAN mode
$8001	→		to PULSED
	←	$8067	Acknowledge SCAN mode

4.2 CLOVER Linking Procedure

The following examples show a successful normal link attempt from the MASTER or CALLING end.

PC		DSP4100	DESCRIPTION
$8054	→		Enable adaptive Clover format
	←	$8054	Acknowledge command
$8057	→		Enable TX buffer clear on disconnect
	←	$8057	Acknowledge command
$8011	→		Normal Clover link to
$804B	→		K
$8039	→		9
$8047	→		G
$8057	→		W
$8054	→		T
$8000	→		$00
	←	$8011	Acknowledge link request
	←	$8020	Linked with
	←	$804B	K
	←	$8039	9
	←	$8047	G
	←	$8057	W
	←	$8054	T
	←	$8000	$00
	←	$0048	‘H’ data from remote
	←	$0049	‘I’
$0042	→		‘B’ data to remote
$0059	→		‘Y’
$0045	→		‘E’
$8007	→		Request Normal Disconnect
	←-	$8007	Acknowledge Normal Disconnect
	←-	$8023 $8000	Link Disconnected

Shown below is the same link from the SLAVE or CALLED end:

PC		DSP4100	DESCRIPTION
	←	$8027 $8000	Connect request
	←	$8020	Linked to
	←	$804B	K
	←	$8039	9
	←	$8043	C
	←	$8057	W
	←	$8000	$00
$0048	→		‘H’ data to master
$0049	→		‘I’
	←	$0042	‘B’ data from master
	←	$0059	‘Y’
	←	$0045	‘E’
	←	$8023 $8000	Link disconnected

4.3 Link Failed

The following example assumes the link is already established and a change in conditions causes the link to fail because of retry count.

PC		DSP4100	DESCRIPTION
$0045	→		'E' data to remote
	←	$8025 $8000	Signal lost
	←	$8025 $8000	Signal lost
	←	$8034 $8000	Link failed

When the link fails, all buffered transmit data is discarded and the DSP4100 returns to the IDLE state.

4.4 Begin FEC Transmission

Listed below is a typical sequence for beginning and ending an FEC transmission.

PC		DSP4100	DESCRIPTION
$8064	→		Manually set Clover waveform
$802A	→		FEC waveform selected
	←	$8064	Acknowledge command
$8012	→		Begin FEC transmission
$8000	→		
	←	$8012	Acknowledge command
$0042	→		'B' data to remote
$0059	→		'Y'
$0045	→		'E'
$8007	→		Request normal disconnect
	←	$8007	Acknowledge normal disconnect

4.5 Calling CLOVER ARQ CQ

Illustrated below is an ARQ CQ sequence.

PC		DSP4100	DESCRIPTION
$8014	→		Start Clover CQ
$8000	→		
	←	$8027 $8000	Link request
	←	$8014	Acknowledge command
	←	$8020	Linked to
	←	$804B	K
	←	$8039	9
	←	$8047	G
	←	$8057	W
	←	$8054	T
	←	$8000	$00

4.6 Answering CLOVER ARQ CQ

Shown below is an example of responding to a remote Clover CQ.

PC		DSP4100	DESCRIPTION
	←	$8026	Monitored Clover CQ from
	←	$804B	K
	←	$8039	9
	←	$8047	G
	←	$8057	W
	←	$8054	T
	←	$8000	$00
$8015	→		Answer Clover CQ
$8000	→		
	←	$8015	Acknowledge command
	←	$8020	Linked to
	←	$804B	K
	←	$8039	9
	←	$8047	G
	←	$8057	W
	←	$8054	T
	←	$8000	$00

4.7 P-MODE Linking

Shown below is a typical P-MODE call command sequence.

PC		DSP4100	DESCRIPTION
$8083	→		Select P-MODE Standby mode
	←		Acknowledge command
$8019	→		Start normal link to
$804B	→		K
$8039	→		9
$8047	→		G
$8057	→		W
$8054	→		T
$8000	→		$00
	←	$8019	Acknowledge command
	←	$802B	P-MODE link to
	←	$804B	K
	←	$8039	9
	←	$8047	G
	←	$8057	W
	←	$8054	T
	←	$8000	$00
	←	$807A $800E	Signal ISS
$8048	→		'H' data to remote
$8049	→		'I'
"+?"	→		OVER
	←	$807A $800F	Signal IRS
	←	$0042	'B' data from remote
	←	$0059	'Y'
	←	$0045	'E'
	←	$8023 $8000	Link disconnected

Shown below is the same link from the SLAVE or CALLED end:

PC		DSP4100	DESCRIPTION
	←	$802D $8002 $8000	P-MODE link request
	←	$802B	P-MODE linked to
	←	$804B	K
	←	$8039	9
	←	$8043	C
	←	$8057	W
	←	$8000	$00
	←	$807A $800F	Signal IRS
	←	$0048	'H' data from remote
	←	$0049	'I'
	←	$807A $800E	Signal ISS
$0042	→		'B' data to remote
$0059	→		'Y'
$0045	→		'E'
$8007	→		Request normal disconnect
	←	$8007	Acknowledge command
	←	$8023 $8000	Link disconnected

4.8 P-MODE FEC Transmission

Shown below is a typical P-MODE FEC command sequence.

PC		DSP4100	DESCRIPTION
$801C	→		Select P-MODE FEC transmit
$8000	→		
	←	$801C	Acknowledge command
	←	$807a $8012	Signal P-MODE FEC transmit
$0041	→		'A'
$004B	→		'B'
$004C	→		'C'
$8007	→		Request normal disconnect
	←	$8007	Acknowledge command

APPENDIX A: Command/Status Summary

IMMEDIATE COMMANDS

CMD		DESCRIPTION
$8000	P	Load LOD file
$8001	P	Load S28 file
$8002		Check Unit Error Status
$8003	F	Check System Clock
$8004	C	Close PTT and transmit Clover waveform
$8005		Open PTT and stop transmit test
$8006		Immediate Abort (Panic Kill)
$8007		Normal disconnect (wait for ACK)
$8008		Software reset - restore all program defaults
$8009		Hardware Reset - equivalent to power on reset
$800A		Send CW ID
$800B		Close PTT and transmit Single Tone
$800C	F	Normal OVER (AMTOR,P-MODE)
$800D	F	Force RTTY TX (Baudot/ASCII)
$800E	F	Go to RTTY RX (Baudot/ASCII)
$800F		Go to LOD/S28 file loader

CMD		DESCRIPTION
$8080		Switch to CLOVER mode
$8081	F	Select AMTOR Standby
$8082	F	Select AMTOR FEC
$8083	F	Select P-MODE Standby
$8084		Switch to FSK modes
$8085	F	Select Baudot
$8086	F	Select ASCII
$8087	F	Forced OVER (AMTOR, P-MODE)
$8088	F	Forced END (AMTOR, P-MODE)
$8089	F	Force LTRS shift
$808A	F	Force FIGS shift
$808B	F	Send MARK tone
$808C	F	Send SPACE tone
$808D	F	Send MARK/SPACE tones
$808E	F	Received first character on line
$808F	F	Close PTT only (no tones)

NOTE: (C) means CLOVER only
(F) means FSK only
(P) means flash programming mode only

TRANSMIT COMMANDS

CMD STRING		DESCRIPTION
$8010 <CALL> $8000	C	Robust Link to <CALL> using MYCALL
$8011 <CALL> $8000	C	Normal Link to <CALL> using MYCALL
$8012 $8000	C	Begin FEC transmission
$8013 <MYCALL> $8000		Set local MYCALL to <MYCALL>
$8014 $8000	C	Start ARQ CQ
$8015 $8000	C	Answer ARQ CQ
$8016 <CALL> $8000	F	Call 476 to <CALL>
$8017 <CALL> $8000	F	Call 625 to <CALL>
$8018 <CALL> $8000	F	Start AMTOR SEL-FEC to <CALL>
$8019 <CALL> $8000	F	Call P-MODE to <CALL>
$801A <CALL> $8000	F	Call P-MODE LP to <CALL>
$801B $8000		(reserved)
$801C $8000	F	Begin P-MODE FEC transmit
$801D $8000	F	Begin AMTOR FEC transmit
$801E <MYALTCALL> $8000	C	Set local MYALTCALL to <MYALTCALL>
$801F <MYALTCALL> $8000	C	Robust Link to <CALL> using MYALTCALL

CMD		DESCRIPTION
$8090 <CALL> $8000	F	Set MYCALL 476 to <CALL>
$8091 <CALL> $8000	F	Set MYCALL 625 to <CALL>
$8092 <CALL> $8000	F	Set GROUP call to <CALL>
$8093 <CALL> $8000	F	Set Alternate MYCALL 476 to <CALL>
$8094 <WRU> $8000	F	Load WRU text (79 char max)
$8095		(reserved)
$8096 <ADR><D> $8000	F	Write EEPROM data byte
$8097 <ADR><L> $8000	F	Read EEPROM data bytes

NOTE: <CALL>, <MYCALL> and <MYALTCALL> are 1 to 8 chars of the form $80cc
(C) means CLOVER only
(F) means FSK only

PARAMETER ON/OFF COMMANDS

CMD OFF/ON		DESCRIPTION	DEFAULT
$8040/$8050	C	Enable FEC Sputter	ON
$8041/$8051	C	Reports of Channel Statistics	OFF
$8042/$8052		Connect Enable	ON
$8043/$8053		(reserved)	OFF
$8044/$8054	C	Adaptive Clover Waveform Format Adjust	ON
$8045/$8055		(reserved)	OFF
$8046/$8056	C	Expanded Link State Reports	OFF
$8047/$8057		Clear TX Buffer on Disconnect	ON
$8048/$8058		(reserved)	OFF
$8049/$8059		Echo As Sent	OFF
$804A/$805A		Enable Monitor Status	ON
$804B/$805B	F	Normal Tones	ON
$804C/$805C	F	FSK RTTY RX Polarity same as TX	ON
$804D/$805D	F	Enable FSK frequency offset reports	OFF
$804E/$805E	C	Enable 5 character CCB mode	OFF

CMD		DESCRIPTION	DEFAULT
$80C0/$80D0	F	CCITT #2 (ON) or US Baudot (OFF)	ON
$80C1/$80D1	F	Enable SYNC Idle (RTTY)	OFF
$80C2/$80D2	F	Enable WRU (Baudot/AMTOR/P-MODE)	OFF
$80C3/$80D3	F	Enable USOS (Baudot)	ON
$80C4/$80D4	F	Enable lower case (AMTOR)	ON
$80C5/$80D5	F	Pass LTRS/FIGS (AMTOR: when lower case OFF)	OFF
$80C6/$80D6	F	Enable auto-relink (AMTOR)	ON
$80C7/$80D7	F	Allow AMTOR FEC Receive (AMTOR)	ON
$80C8/$80D8		(reserved)	
$80C9/$80D9	F	Enable P-MODE HUFFMAN Compression (P-MODE)	ON
$80CA/$80DA	F	Enable PTT (when OFF, PTT is held OFF)	ON
$80CB/$80DB	F	FSK Output NORMAL (Mark = LOW)	ON
$80CC/$80DC	F	Enable +? Over (P-MODE)	ON
$80CD/$80DD	F	Enable WIDE FSK shift (RTTY)	OFF

NOTE: (C) means CLOVER only
(F) means FSK only

SET PARAMETER COMMANDS

CMD		DESCRIPTION	RANGE	DEFAULT
$8060 <OPT>	C	Set Robust link retry maximum	1 - 255	2
$8061 <OPT>	C	Set Normal link retry maximum MSB = 1 for short cycle time	1 - 127 0:1200, 1:896 ms	9 1200ms
$8062 <OPT>	C	Set CCB retry maximum	1 - 255	9
$8063 <OPT>	C	Set Voice-band sub-channel select	1 - 5	4
$8064 <OPT>	C	Set Clover waveform format		$DD
$8065 <OPT>	C	Set Bias set	0 - 3	1
$8066 <OPT>	C	Set Highest Auto-ARQ Waveform	0 - 5	0
$8067 <OPT>		Set SCAN mode	0 - 3	0
$8068 <OPT>	C	Set Chat Count	0 - 255	1
$8069 <OPT>		Set Secondary Port Rate	0 - 7	0
$806A <OPT>		Set Primary Port Rate	0 - 7	4 (9600)
$806B <OPT>		Set Secondary Port Configuration	0 - 15	0
$806C <OPT>		Set RX Gain	1=0, 2=+6, 3=+12 dB	1
$806D <OPT>		Set Secondary Control Signals	(see description)	-
$806F <OPT>		Switch to AT command mode	(see description)	-

CMD		DESCRIPTION	RANGE	DEFAULT
$80E0 <OPT>	F	Set Control Delay	0 - 255	50
$80E1 <OPT>	F	Set Transmit Delay	0 - 255	10
$80E2 <OPT>	F	Set Audio Delay	0 - 255	2
$80E3 <OPT>	F	Set PTT Delay (* 100ms)	0 - 255	20
$80E4 <OPT>	F	Set Baudot speed	0-5:45,50,57,75,100,110	0
$80E5 <OPT>	F	Set ASCII speed	0-5:45,50,57,75,100,110	5
$80E6 <OPT>	F	Set FSK ATC Filter	0=OFF, 1=ON	0
$80E7 <OPT>	F	Set AMTOR Quality Level	0 - 5	3
$80E8 <OPT>	F	Set Print Squelch Level	0 - 99	68
$80E9 <OPT>	F	Set Time-out	32/128; 0 to disable	32
$80EA				
$80EB <OPT>	F	Set filter BW	0=55, 1=75, 2=100 Hz	-
$80EC <OPT>	F	Set MARK/SPACE (4 bytes, MARK then SPACE)	send each with high byte first, then low	2125/2295 2100/2300
$80ED <OPT>	F	Set PTT OFF Delay (* 100 ms)	0 - 255	20
$80EE <OPT>	F	Allow cross code connects	bit2=P-MODE, bit1=AMTOR, bit0=CLOVER	7

where: <OPT> = $80nn; nn is the new parameter setting
(C) means CLOVER only
(F) means FSK only

CMD		DESCRIPTION	RANGE	DEFAULT
$80F0 <OPT>	F	Set P-MODE Speed	0=100, 1=200, 2=auto	2
$80F1 <OPT>	F	Set P-MODE CS Delay	0 - 255	30
$80F2 <OPT>	F	Set P-MODE Max Up	0 - 255	3
$80F3 <OPT>	F	Set P-MODE Max Try	0 - 255	2
$80F4 <OPT>	F	Set P-MODE Max Down	0 - 255	6
$80F5 <OPT>	F	Set P-MODE Max Errors	0 - 255	80
$80F6 <OPT>	F	Set P-MODE FEC Rate	0=100, 1=200	0
$80F7 <OPT>	F	Set P-MODE FEC Repeat	0 - 255	2
$80F8 <OPT>	F	Set P-MODE Memory ARQ	0 - 255	30
$80FE <OPT>	C	Set CLOVER Mask	high/low byte	00 00
$80FF <OPT>	S	Set CRC Mask	high/low byte	00 00

where: <OPT> = $80nn; nn is the new parameter setting
(C) means CLOVER only
(F) means FSK only
(S) means proprietary commercial DSP4100 version only

STATUS REQUEST/STATUS RESPONSE REPORTS

CMD		DESCRIPTION
$8070	C	Request Channel spectra data (narrow)
$8071		Request Selcal state
$8072	C	Request Channel statistics
$8073	C	Request Clover Link state
$8074	C	Request Voice-band sub-channel
$8075	C	Request Clover waveform format
$8076		Request DSP software version
$8077		Request Control Processor software version
$8078		Request EPROM version
$8079		Request EPROM checksum
$807A		(reserved for FSK status messages)
$807B		Request Product ID
$807C		Request Input FIFO fill level
$807D		Request LED status
$807E	F	Request FSK tuning offset

CMD		DESCRIPTION
$80A0		Request Hardware Revision number
$80A1		Request S28 Firmware waveform and build
$80A2		Request LOD firmware waveform and build
$80A3		Request secondary port signals
$80A4		Request Serial Number

NOTE: (C) means CLOVER only
(F) means FSK only

CONNECT STATUS REPORTS

CONNECT STATUS		DESCRIPTION
$8020 <CALL> $8000	C	Linked to <CALL>
$8021 <CALL> $8000	C	Monitored FEC CCB from <CALL>
$8022 <CALL> $8000	C	Monitored ARQ CCB from <CALL>
$8023 $8000		Link disconnected normally
$8024 $8000		Link failed (any of the link errors)
$8025 $8000		Signal Lost (LOS)
$8026 <CALL> $8000	C	Monitored ARQ CQ from <CALL>
$8027 $800c	C	ARQ Link Request for MYCALL(c=0)/MYALTCALL(c=1)
$8028 <CALL> $8000	C	Monitored ARQ Call to <CALL>
$8029 $8000	F	Linked 476
$802A <CALL> $8000	F	Linked 625 to <CALL>
$802B <CALL> $8000	F	Linked P-MODE to <CALL>
$802C <CALL> $8000	F	Receiving Selective FEC to <CALL>
$802D <TYPE> $8000	F	ARQ Link Request received
$802E <TYPE> $8000	F	Monitor FSK Signal

NOTE: <CALL> is 1 to 8 characters of the form $80cc
(C) means CLOVER only
(F) means FSK only

STREAM SWITCH STATUS REPORTS

STATUS		DESCRIPTION
$8030		Switch to Receive Data characters
$8031		Switch to Transmit Data characters
$8032		Switch to RX data from secondary port
$8033		Send TX data to modem
$8034		Send TX data to secondary port

APPENDIX B: Firmware Loading Procedure

The DSP4100 stores the LOD and S28 files in flash memory. At any time either the LOD or the S28 file or both can be updated using standard $8000 commands. To speed up the loading process, it is possible to temporarily change the serial port interface rate to 57600 bps ($8069 $8007) before flash memory programming without effecting the stored primary port data rate. Shown below is the sequence of steps required to download new LOD and S28 file versions.

PC		DSP4100	DESCRIPTION
$8069 $8007	→		Change to 57600 bps
	←	$8069	Acknowledge command
			(switch to 57600 bps)
$800F	→		Start the file loading procedure
	←	$800F	Acknowledge command
$8000	→		Start LOD file download
	←	$8000	Acknowledge command
[LOD file]	→		Send LOD file bytes
	←	$8002 $800A	LOD file OK
$8001	→		Start S28 file download
	←	$8001	Acknowledge command
[S28 file]	→		Send S28 file bytes
	←	$8002 $800A	S28 file OK DSP4100 is ready for operation
$8009	→		Hardware reset

When sending the LOD and S28 file to the DSP4100, each byte in the file is transmitted as a single byte, including any $80 and $81 bytes. The DSP4100 serial protocol is not active when loading the flash memory.

When file loading is complete, the PC must issue the Hardware Reset command ($8009) to reset the DSP4100 and start up with the new files. The DSP4100 Loader only recognizes the following commands: $8000, $8001, and $8009.

When the type of file is selected with the Load LOD ($8000) or Load S28 ($8001) command, the DSP4100 immediately bulk erases that area of the flash memory. If the erase operation fails, the DSP4100 transmits an Erase Error ($8002 $800D) status message at the end of the erase operation. Otherwise, it echoes the file select command, and the PC can immediately start sending the LOD or S28 file. Since both the LOD file and the S28 file have a fixed format, the DSP4100 detects the end of the file automatically. When the transfer is complete, the DSP4100 calculates the CRC over the block just loaded, stores that CRC, then verifies that the CRC is correct. Once the verification is complete, the DSP4100 sends a completion status message indicating either OK ($8002 $800A) or Write Error ($8002 $800E) status.

Presented below are examples of these two failure conditions:

PC		DSP4100	DESCRIPTION
$800F	→		Start the file loading procedure
	←	$800F	Acknowledge command
$8000	→		Start LOD file download
	←	$8002 $800D	Flash Erase Error!
$8009	→		Hardware reset

PC		DSP4100	DESCRIPTION
$800F	→		Start the file loading procedure
	←	$800F	Acknowledge command
$8000	→		Start LOD file download
	←	$8000	Acknowledge command
[LOD file]	→		Send LOD file bytes
	←	$8002 $800E	Flash Write Error!
$8009	→		Hardware reset

APPENDIX C: AT DIAL COMMANDS

The DSP4100 and DXP38 modems include a simple AT dial up command interface that will let these units work with standard dial up modem terminal and email programs. This appendix summarizes the AT command operation.

C.1 AT Command Activation

The DSP4100 can be configured to start up in either 8000 command mode, the factory default setting, or AT command mode. To switch the DSP4100 to AT command mode, the following command must be issued:

PC		DSP4100	DESCRIPTION
$806F $8001	→		Switch to AT command mode
	←	"NOW USING AT COMMAND SET"	Acknowledge command

After the "NOW USING…" acknowledgement message is transmitted on the serial port, the DSP4100 will perform a hard reset to activate AT command mode. From this point on, only AT commands will be recognized by the DSP4100. Note that the AT command mode only supports Clover operation.

When the Switch to AT Mode ($806F $8001) command is received, the DSP4100 checks the AT dialing parameters saved in non-volatile memory. If the checksum over the saved values indicates that the parameters are correct as stored, those parameters are loaded when AT command mode starts. If the checksum fails, the factory default values are used.

To switch back to the 8000 command mode, the following AT command must be issued:

PC		DSP4100	DESCRIPTION
AT$Z<cr>	→		Switch to 8000 cmd mode
	←	"SWITCHING TO $8000 COMMAND SET"	Acknowledge command

After the "SWITCHING…" message is returned, the DSP4100 will perform a hard reset to activate 8000 command mode. From this point on, only 8000 commands will be recognized by the DSP4100.

C.2 AT Commands

The DSP4100 uses a limited number of AT commands to control Clover operation. The parameters entered by these AT commands are stored in non-volatile memory so that they do not need to be re-entered when the DSP4100 is next turned ON.

AT COMMAND	DESCRIPTION	DEFAULT
AT$Acallsign	Set MYCALL to “callsign”; max 8 letters/numbers	
AT$Bnnn	Set ROBUST RETRY count to nnn; 1 to 255 valid	10
AT$Cnnn	Set CCB RETRY count to nnn; 1 to 255 valid	9
AT$Dnnn	Set CHAT COUNT to nnn; 0 to 255 valid	1
AT$En	Set CLOVER BIAS to n; 0=ROBUST, 1=NORMAL, 2=FAST	1
AT$Fnnnnn	Set CLOVER MASK to nnnnn; o to 65536 valid	0
AT$Hn	Enable ECHO AS SENT; 0=OFF, 1=ON	0
AT$J	Restore FACTORY DEFAULT settings	
AT$Kn	Set RX GAIN to n; 1=0 dB, 2=6 dB, 3=12 dB	1
AT$Z	Switch to 8000 command mode	
AT&V	Show all parameter settings	
ATDTcallsign	Start CLOVER CALL to “callsign”; max 8 letters/numbers	
ATS0=n	Set RINGS TO ANSWER to n; 0=OFF and 1 to 9 valid	0

The AT&V command is the only way to display the current parameter settings. Unlike the typical modem AT command set, issuing the command without an argument *does not* show the current setting. A typical AT&V summary is shown below:

AT&V<cr> → [Show parameter settings]

MYCALL($Ac..c): KFL1234
ROBUST RETRY ($B[1-255]): 10
CCB RETRY ($C[1-255]):1
CHAT COUNT ($D[0-255]): 1
CLOVER BIAS ($E[0-2]): 1(NORMAL)
CLOVER MASK ($Fnnnnn): CLEAR
ECHO AS SENT ($H[0/1]): 0(OFF)
RX GAIN ($K[1-3]): 1(0 dB)
RINGS TO ANSWER (S0=[0-9]): 0

If the Clover Mask is set to some value other than 0, the “CLEAR” status message is changed to “SET”, but the actual setting is not displayed.

C.3 AT Mode EEPROM Details

The AT dialing parameters are stored in the non-volatile EEPROM memory on the DSP4100 board. Stored in the EEPROM array is an AT enable flag followed by a parameter save area and a twy byte checksum value. To avoid switching to the AT command mode accidentally, the following procedure is repeated whenever the DSP4100 performs a hard reset.

```
IF
   AT enable flag, EEPROM[2], is not equal 1
THEN
   Start 8000 command mode
ELSE IF
   EEPROM[3..4] equals “AT”   AND
   Checksum over EEPROM[3] to EEPROM[21] matches EEPROM[22..23]
THEN
   Start AT command mode
ELSE
   Set EEPROM[2] to 0
   Start 8000 command mode
```

Note that the only way for AT command mode to start is if the AT enable flag in location EEPROM[2] is set to 1, the string “AT” starts the parameter array, and the checksum from EEPROM[3] to EEPROM[21] matches the value saved in EEPROM[22..23].

The checksum is a simple 16 bit rotate and XOR calculation. The initial value of the checksum is set to $FFFF then for each byte of the EEPROM array, the sum is rotated left one bit and the EEPROM byte is XOR’d with the low byte of the sum. The calculated checksum value is stored, high byte first, in EEPROM[22] and EEPROM[23]. When testing the EEPROM array for valid parameters, the checksum is calculated using the bytes from EEPROM[3] to EEPROM[21], then that value is XOR’d with the high and low bytes found in EEPROM[22] and EEPROM[23]. If there is no error, then result will be $0000, and the checksum is correct.

APPENDIX D: Baudot to ASCII Conversion Tables

This appendix lists the conversion from Baudot to ASCII used in AMTOR mode. Note that the conversion table depends on the Enable Lower Case parameter ($80C4/D4).

D.1 BAUDOT to ASCII Conversion Table (Lower Case OFF)

BAUDOT	CCIR	LTRS	FIGS
0x00	0x6a	NULL	NULL
0x01	0x56	E	3
0x02	0x6c	LF	LF
0x03	0x47	A	-
0x04	0x5c	SP	SP
0x05	0x4b	S	‘
0x06	0x4d	I	8
0x07	0x4e	U	7
0x08	0x78	CR	CR
0x09	0x53	D	$
0x0a	0x55	R	4
0x0b	0x17	J	BEL
0x0c	0x59	N	,
0x0d	0x1b	F	!
0x0e	0x1d	C	:
0x0f	0x1e	K	(

BAUDOT	CCIR	LTRS	FIGS
0x10	0x74	T	5
0x11	0x63	Z	+
0x12	0x65	L	)
0x13	0x27	W	2
0x14	0x69	H	#
0x15	0x2b	Y	6
0x16	0x2d	P	0
0x17	0x2e	Q	1
0x18	0x71	O	9
0x19	0x72	N	?
0x1a	0x35	G	&
0x1b	0x36	> (1)	> (1)
0x1c	0x39	M	.
0x1d	0x3a	X	/
0x1e	0x3c	V	=
0x1f	0x5a	< (1)	< (1)

NOTE: (1) LTRS and FIGS characters do not send this printable character unless the Pass LTRS/FIGS parameter is ON ($80D5). When OFF, the LTRS and FIGS just changes character shift.

D.2 ASCII to BAUDOT Conversion Table (Lower Case OFF)

ASCII	HEX	BAUDOT	...	ASCII	HEX	BAUDOT
NULL	0x00	NULL		A,a	0x41, 0x61	A
ENQ	0x05	FIGS-D		B,b	0x42, 0x62	B
BELL	0x07	FIGS-J		C,c	0x43, 0x63	C
LF	0x0a	LF		D,d	0x44, 0x64	D
CR	0x0d	CR		E,e	0x45, 0x65	E
SPACE	0x20	SPACE		F,f	0x46, 0x66	F
!	0x21	FIGS-F		G,g	0x47, 0x67	G
#	0x23	FIGS-H		H,h	0x48, 0x68	H
$	0x24	FIGS-D		I,i	0x49, 0x69	I
&	0x26	FIGS-G		J,j	0x4a, 0x6a	J
‘	0x27	FIGS-S		K,k	0x4b, 0x6b	K
(	0x28	FIGS-K		L,l	0x4c, 0x6c	L
)	0x29	FIGS-L		M,m	0x4d, 0x6d	M
+	0x2b	FIGS-Z		N,n	0x4e, 0x6e	N
,	0x2c	FIGS-N		O,o	0x4f, 0x6f	O
-	0x2d	FIGS-A		P,p	0x50, 0x70	P
.	0x2e	FIGS-M		Q,q	0x51, 0x71	Q
/	0x2f	FIGS-X		R,r	0x52, 0x72	R
0	0x30	FIGS-P		S,s	0x53, 0x73	S
1	0x31	FIGS-Q		T,t	0x54, 0x74	T
2	0x32	FIGS-W		U,u	0x55, 0x75	U
3	0x33	FIGS-E		V,v	0x56, 0x76	V
4	0x34	FIGS-R		W,w	0x57, 0x77	W
5	0x35	FIGS-T		X,x	0x58, 0x78	X
6	0x36	FIGS-Y		Y,y	0x59, 0x79	Y
7	0x37	FIGS-U		Z,z	0x5a, 0x7a	Z
8	0x38	FIGS-I				
9	0x39	FIGS-O				
:	0x3a	FIGS-C				
<	0x3c	LTRS				
=	0x3d	FIGS-V				
>	0x3e	FIGS				
?	0x3f	FIGS-B				

APPENDIX E: DSP4100/DXP38 LOD and S28 File Formats

Both the DSP4100 and DXP38 require two different operating system files, one for the DSP code, the LOD file, and a second for the 68000 code, the S28 file. Both formats are standard file formats created by the compilers, assemblers, and linkers used to build the operating system code module. In the DSP4100 applications, where the code is stored in internal flash memory, the LOD and S28 files are only loaded when a new version is released, and they may be updated individually. In this appendix, the format for both files is summarized.

E.1 DP4100 LOD File Format

A sample of the DSP4100 LOD file is included below. The first line contains the version number (4 hex digits), the waveform (2-digits), the build type (2-digits) and checksum (4-digits) for this file. Subsequent LOD file sections begin with a memory section ID sequence followed by an offset address. The bootstrap loader in the DSP4100 modems recognize only the LOD section types shown below (_DATA X, _DATA Y, _DATA P, and _END). Any other section label will cause a load error. The version number stored on the first line must be upper case HEX digits; any other characters will cause a load error. The checksum at the end of the first line is a 16 bit sum of all the bytes in the file after the hex values have been converted to binary. If the checksum does not match, file loading will fail. The offset at the end of the _END line is read as the start address for this load file. All lines after the _END line in the file are ignored.

```
_830048000B5A

_DATA X 007240
733333 733333 733333 733333
_DATA X 0072C0
C08000 808001 C08001 008000 408001 808000 408000 008001 7FC4E1 D4D5E6
AB2F94 000000 17C002 4AC24F EB6C93 F0B04E 68DFD7 684DC5 CDEF27 09CA68
_DATA Y 0072A0
000000 0000A0 000000 0000A0
_DATA Y 007740
000021 000023 000025 000027 003E00 003E00 003E00 003E00 003E50 003E50
003E50 003E50
_DATA P 004000
60F400 002053 384000 340000 06D800 002007 07D884 075C84 60F400 002222
70F400 000140 64F400 003E00 06D800 002011 07D884 4C5C00 60F400 002362
...
_END 004100
```

E.2 DXP38 LOD File Format

A sample of the DXP38 LOD file is included below; it is basically an Intel HEX format file. The first line contains the version number (4 hex digits) for this file, and the file version number must be upper case hex characters. The LOD file has two sections; the first is the program section and the second is the data section.

```
_0101
:20000000FF800020FF800674FF800000FF800000000000000000000000000000004A
:2000200000000000000000000000000000000000FF800703FF80070EFF800722FF8000007C
...
:2012600002FF0304030A030E03130317031A031D031F032103230324032400080000D0015F7
:201280000021003400520082000CE01460205033305120809 0CBD14301FFF00000000000080
:00000001FF
:20000000000000000000000000000000000000000000000000000000000000000000000000E0
:20002000000000000000000000000000000000000000000000000000000000000000000000C0
...
:200C80000000400100010C00080014000800 0C001F0B0EB6D4AC217C004E5E6F834263470B0
:200CA000C000101D00FA0F46109A11EE1342107C120C040500000000000000000000000047
:00000001FF
```

E.3 S28 File Format

A sample of the current S28 file is shown below. The DSP4100 and DXP38 use a standard Motorola S2 file record format for the 68000 S28 file except for the first line. The first line of the S28 file contains a version number for the file in upper case hex characters so that a PC application program can locate the file version before loading.

The DSP4100 and DXP38 recognize the following S2 record types: S0 (comment record), S2 (load record), and S8 (end record).

```
_0501
S00600004844521B
S2130089E0007C070048E7F0F852790004080052C0
S2130089EF790004080252790004080452790004 43
S2130089FE0806303C00108079000408083 3C000DB
 ...
S21301023F034EB9000101B0508FB4806C0290835A
S21301024E908244804A046C0244804CDF001E4EAE
S20701025D5E4E7577
S80400800279
```

APPENDIX F: Command Index

In the following table, all DSP4100 commands are listed in command order. The page number indicates where each command is described.

HAL DSP MODEM SERIAL INTERFACE SPECIFICATIONS

HAL Communications Corp.

Engineering Document E2005 Rev. D

January 13, 2006

Revision History:

Rev. D 1/13/2006

Remove commands not supported by commercial Clover 2000 V5.1 firmware
Remove 8043/8053 Clover auto-power control – the option was removed and set OFF
Remove 8045/8055 CW ID every 10 min – the option was removed and set OFF
Remove 8048/8058 Listen mode – the option was removed and set OFF
Change 8027 response – now shows incoming call to MYCALL and MYALTCALL
Change 80Ax commands to reflect current status reports
Add new 801E command – set MYALTCALL
Add new 801F command – start Robust link attempt from MYALTCALL

Rev. C 9/11/2000

The 806A command no longer stores the new primary port data rate in eeprom
The 806C command description now shows that the RX gain setting is stored in eeprom.
A new Appendix with the AT command set details was added.

Rev. B 4/3/2000

Initial Release