

The LNW80 II computer which you own has been improved over the model delivered in 1982. This document will describe these differences between the LNW80 computer illustrated in the LNW80 MICROCOMPUTER OPERATIONS MANUAL and the unit which you have received. Please read SECTION 1 "THE BACK PANEL" before connecting peripherals to the LNW80 II. The following is a table of contents:

PAGE

1	SECTION 0 : HIGHLIGHTS OF THE LNW80 II NEW FEATURES
3	SECTION 1 : THE BACK PANEL
7	SECTION 2 : LNW80 II DETAILED SPECIFICATIONS
18	SECTION 3 : PROGRAMMABLE BAUD RATE FOR RS232
21	SECTION 4 : GRAPHICS AND COLOR
25	SECTION 5 : GAME I/O PORT
27	SECTION 6 : NEW I/O PORT & MEMORY LOCATIONS

HIGHLIGHTS OF THE LNW80 II NEW FEATURES

The LNW80 II has 96K of program memory, which is twice the memory of the LNW80 microcomputer. The extra RAM is used by the CP/M operating system to increase the available user RAM to a full 62K. This allows for larger programs, spreadsheets, and data. There are also some additional differences between the LNW80 II and the LNW80 computer in the layout of the back panel. The differences between your computer and the descriptions in SECTION 2 of your operations manual are fully discussed in SECTION ONE of this manual.

While remaining fully 100% compatible with the 1982 model of the LNW80 II, the newer model has the following improvements:

1. The low-res color graphics mode MODE 2 has been expanded from 128x192 pixels in 8 colors to 160x192 pixels.

2. Background color has been added to the color display. Since the earlier model of the LNW80 only had BLACK as a background color, the display will appear different on since the LNW80 II initializes with WHITE as the background color. Black can be set as a background color under software control from LNW BASIC.

3. 8 levels of video intensity have been added to the monochrome output when mode 2 is selected. This allows color programs to be run without a color monitor. The monochrome display is limited however to 128x192 pixels. Hardware inverse video by character has also been added to the LNW80 II.

4. Three additional pages of graphics memory may be added to the LNW80 II for a total of FOUR high res and color screens. This 4 screen multi-page graphics addition requires only 6-

4164 RAM IC's. One page of graphics RAM may be displayed while another page is being read from or written to. This makes switching from screens cleaner visually and allows the creative programmer the tools for animation.

5. The LNW80 II now has a small loudspeaker built-in. A volume control on the back panel allows the user to set the volume to the desired level. The sound output is compatible with most of the TRS80 compatible arcade-style games along with the SOUND command in LNW BASIC.

6. A game I/O port has been added to the LNW80 II. This port is electrically compatible with the Apple 2 game I/O port and will be fully supported by LNW BASIC. It is NOT however mechanically compatible with ALL Apple joysticks. Joysticks, graphics tablets and other game I/O accessories can now be connected to the LNW80 II. The TG PRODUCTS joystick for the Apple 2 is both electrically as well as mechanically compatible. Other brands may not mate without some form of extender cable.

7. The RS232 port now has SOFTWARE PROGRAMMABLE BAUD RATES AND CONFIGURATION. The hardware switches on the back panel have been replaced with a soft configuration switch (BASIC program supplied). This is provided so that those TRS80 programs which require the TRS80 Model 1 configuration switches for both baud rates as well as stop bits, word length and parity will run without any modification. It also provides compatibility with programs designed for the LNW80 II that use the configuration switches. Baud rates can now be set using LNW BASIC or from DOS without reaching behind to the back panel.

8. The RGB video connector now is electrically equivalent to the IBM PC. The RGB monitors no longer require pull up resistors on the RGB lines. In addition, outputs for positive sync, negative sync, and combined sync are provided on the same connector for use with other monitors.

9. The cable connectors for the Floppy Disk and Printer Port are reversed (the cable can now lay down as in the TRS80 expansion interface) for easier connection.

10. The NTSC color output now has a higher bandwidth for monochrome displays AND only displays either Mode 1 or 2 graphics. To select the high res output on this output and the text (64x16) display on the monochrome output, simply set the display to mode 0. If the 24x80 software driver is switched in and out under software control, TWO independent text displays may be displayed at the same time.

11. Two connectors are provided in the back of the computer for connection with the SUPER-MOD 2. This product is a readily available RF modulator often used with the Apple 2.

12. The LEVEL 2 basic interpreter has been enhanced:

1. Improved keyboard debounce (under non-disk only)
2. Multiple print @
3. Closer to the TRS80 2-chip ROM set
4. Better cassette I/O performance

13. Improved power supply for reduced internal temperature and increased reliability.

14. Changes to the video display which eliminates the only known incompatibility with some TRS80 programs and games (Sublogic aircraft simulator for example)

SECTION 1 : THE BACK PANEL

THE EDGE CARD CONNECTORS

A. FLOPPY DISK

The floppy disk connector is a 34 pin edge card which can be connected to the floppy disk flat cable connected to the daisy chained 5 1/4" minifloppy disk drives and the 8" disk drives (through the 34 to 50 pin cable adaptor). The cable is compatible with the type used in the TRS80 model 1 and the LNW80. In the LNW80 II, the cable lays DOWN (it was UP in the LNW80) when the cable's edge card connector is plugged in to the back panel edge card.

There is one more difference between the LNW80 II and LNW80. The LNW80 II will interface to one more additional disk drive. The drive select is on PIN 6 of the 34 conductor cable. (This corresponds to the same pin that the disk drive manufacturers are using for drive select number 4. In order to take advantage of this extra disk drive, the operating system must be able to recognize the additional drive. This will require a modification to your operating system. When LNW has the patches for the various operating systems it will be distributed to all of the authorized LNW dealers.

TECHNICAL NOTE: This extra drive select is driven by DATA BIT 4 on the memory location 37E0H. This is the memory location dedicated for the drive selects.

B. PARALLEL PRINTER PORT

The parallel printer port is electrically identical to the port on the LNW80. It is, as the Floppy Disk Drive Port, reversed physically. The PARALLEL PRINTER cable lays down as does the FLOPPY DISK CABLE.

C. EXPANSION PORT

The CPU expansion bus is electrically compatible with the bus on the LNW80. It is now located directly off the main CPU board which positions it directly below where it was located on the LNW80.

TECHNICAL NOTE: It should be pointed out that although the expansion bus is 100% compatible with the TRS80, the differences in implementation should be mentioned here for the hardware designer to consider when interfacing to the expansion bus.

1. On the LNW80 II, the data bus is received by high impedance PNP input hysteresis receivers for increased reliability and increased noise immunity. Floating lines may not necessarily be interpreted as a logic "one" depending on noise conditions.

2. The higher performance of the LNW80 II (4MHz) with respect to the 1.77 MHz of the TRS80 makes it susceptible to noise problems on the expansion bus at the higher CPU speed.

We recommend that when connecting USER supplied hardware to the expansion bus:

- a. Use a flat cable that is less than 6 inches in length.
- b. The flat cable should have a ground plane tied to the bus ground (pin 39)
- c. Do not attempt to access the internal or any external dynamic memories using the RAS, MUX and CAS lines on the expansion bus.

IF YOUR CABLE IS LONGER THAN 6 INCHES BUT LESS THAN 12 INCHES:

- a. Make sure that (b.) and (c.) above are followed.
- b. Pull the pins on your connecting connector such that RAS, CAS, and MUX are not connected to your cable.
- c. Receive the data bus, address bus, and all control lines with PNP input hysteresis receivers such as the 74LS240, 241, 242, 243, 244, and 245.
- d. If you have problems with unreliable operation, shorten your cable till reliable operation is again maintained.

DO NOT USE A CABLE LONGER THAN 12 INCHES FOR ANY REASON

VIDEO CONNECTORS

The LNW80 II has additional video connectors as compared with the LNW80. In addition, the output content of the COLOR VIDEO output has been changed. These changes do not reduce the compatibility between the LNW80 and LNW80 II, but now TWO completely different text screens can be displayed at the same time. The RCA type hi-fi jack on the side closest to the CASSETTE jack is the monochrome output while the other jack is the LOW-RES COLOR output.

TWO outputs are now provided (one for each video channel) for connection to an RF MODULATOR. The connectors provided are compatible with the SUPR-MOD 2 RF modulator designed for the APPLE 2. The connector closest to the RGB connector (the small black plastic connector just below the RS232 connector) is the connector for the LOW RES COLOR while the other connector supplies the B&W video information to the RF modulator.

The RGB connector now provided is a DB9 type which is compatible with the RGB connector on the IBM PC. The cables supplied for the AMDEK COLOR II and COLOR III now mate without requiring any special wiring. This DB9 connector also carries the signals for sync in both composite and separate form (both polarities provided) to ease the connection to non-standard monitors.

Refer to the LNW80 II DETAILED SPECIFICATIONS for additional information on the content, pinout and electrical specification of these connectors. For additional information on the new graphics and color features of the LNW80 II refer to SECTION 4 entitled GRAPHICS AND COLOR.

MISCELLANEOUS BACK PANEL CONNECTORS AND SWITCHES

A. RS232 CONNECTOR

The RS232 connector has been moved with respect to its location on the LNW80. The baud rate switches have been removed along with the configuration switches for word length, stop bits and parity. This does NOT make programs written for the LNW80 incompatible with the LNW80 II. A "phantom" software switch is located in the same software location as the old mechanical dip switch in the LNW80. This switch can then be set with a simple BASIC program. This software switch does require that it be set each time power is applied. Refer to SECTION 3 for more information on the programming of this switch and the RS232 port.

B. AUTO SWITCH

The AUTO SWITCH has been moved to the PC BOARD away from the power switch to avoid confusion and accidental engagement. Its "ON" (on the LNW80 "UP") function is still the same: Slow the CPU during disk I/O for old operating systems which did not support the higher CPU speed during disk I/O. The ON position is represented by the silkscreen drawing of the switch handle on the PC board (toward the label AUTO). The "OFF" position (down on the LNW80) is with the switch handle facing the printing "SW1" (to your left as viewed from the back panel). This switch need not be ON (to your right as viewed from the back panel) for CP/M or DOSPLUS 3.4. Refer to the LNW80 MICROCOMPUTER OPERATIONS MANUAL for more information on the operation of this switch.

C. CASSETTE JACK

The position and content of the cassette jack has not changed on the LNW80 II from the LNW80.

D. POWER SWITCH

The power switch on the LNW80 II has been changed from the LNW80. It is now a low profile switch in which the TOP of the switch is pressed to turn the unit ON. In order to switch the LNW80 II OFF, press the BOTTOM of the switch.

E. POWER SUPPLY FUSE

The fuse holder on the LNW80 II has been changed from the LNW80 computer. In order to check the fuse, use a flat screwdriver or small coin and turn the top in the COUNTERCLOCKWISE direction. To replace the fuseholder cover turn the cover in the CLOCKWISE DIRECTION while pressing it in to the fuseholder body.

F. LINE CORD

The line cord on the LNW80 II is removable and is shipped disconnected. Identify the correct orientation of the three conductor plug and plug the cord into the body of the computer pushing it firmly into place. Make sure the cable is seated as far as it will go into the power connector on the computer (to avoid an accidental power outage when the LNW80 II is moved slightly).

SECTION 2 : LNW80 II DETAILED DESCRIPTION AND SPECIFICATIONS

GENERAL

The LNW80 II base unit measures 16.5"W x 3.5"H x 22"D and weighs 26lbs. The base unit contains the CPU, Memory, Keyboard, Video and peripheral controllers, power supply, and cooling fan. All peripherals and accessories connect to the LNW80 II via connectors on the rear panel. The optional color or monochrome monitor fits easily on the large surface of the LNW80 II.

CENTRAL PROCESSING UNIT (CPU)

PROCESSOR: Z80A
FEATURES: 158 instructions (with all 78 of the 8080 CPU instructions)
CLOCK SPEED: 4MHZ
ROM WAIT STATES: 1 (250NS) (ROM MAY BE LOADED TO RAM)
RAM WAIT STATES: NONE

MEMORY

USER RAM: 96K BYTES
GRAPHICS RAM: 16K X 6 BITS (MAY BE UPGRADED TO 64K)
VIDEO RAM: 1K BYTES
ROM: 12K BYTES MICROSOFT BASIC-80 (LEVEL 2 COMPATIBLE)

KEYBOARD

73 KEY expanded professional typewriter style keyboard including:

1. 11 key numeric pad
2. Control key
3. Shift lock and caps lock keys
4. Localized cursor control keys (arrows)
5. Cassette speed switch (500/1000 baud)
6. Underline key
7. Upward compatible with the TRS-80 model 1

The keyboard also includes two RESET (RST) Keys which when pressed simultaneously causes a system master reset.

MICROSOFT BASIC-80 INTERPRETER

BASIC FUNCTIONS:

ABS	ASC	ATN
CDBL	CHR\$	CINT
COS	CSGN	ERL
ERR	EXP	FIX
FRE	FRE(\$)	INKEY\$
INP	INT	LEFT\$
LEN	LOG	MEM
MID\$	PEEK	POINT
POS	RIGHT\$	RND
SGN	SIN	SQR
STR\$	STRING\$	TAN
USR	VAL	VARPTR

BASIC STATEMENTS:

AUTO	CLEAR	CLOAD
CLOAD?	CLS	CONT
CSAVE	DATA	DEFDBL
DEFINT	DEFSGN	DEFSTR
DELETE	DIM	EDIT
END	ERROR	FOR..TO..STEP/NEXT
GOSUB	GOTO	IF...THEN...ELSE
INPUT	LET	LIST
LLIST	LPRINT	LPRINTTAB
LPRINTUSING	NEW	ONERROR GOTO
ON..GOSUB	ON..GOTO	OUT
POKE	PRINT	PRINT@
PRINT#	PRINTTAB	PRINTUSING
RANDOM	READ	REM
RESET	RESTORE	RESUME
RETURN	RUN	SET
STOP	SYSTEM	TROFF
TRON		

OTHER FEATURES:

AUTO LINE NUMBERING
FULL EDITING FEATURES
KEYBOARD ROLLOVER
16 DIGITS ACCURACY
UNLIMITED ARRAY DIMENSIONS
255 CHARACTER STRING LENGTH
UPWARD COMPATIBLE WITH DISK BASIC
100% TRS-80 MODEL 1 LEVEL 2 COMPATIBLE

VIDEO DISPLAY SPECIFICATIONS

TEXT MODES:

- 1. STANDARD CHARACTERS -64 Characters per line, 16 lines
- 2. LARGE CHARACTERS -32 Characters per line, 16 lines.

Each character is a 5x8 matrix in a 6x12 rectangle. The hardware character generator supports both upper and lower case (with descenders) for a total of 96 characters and symbols.

ADDITIONAL TEXT MODE FEATURES:

- A. FULL SCREEN INVERSE
- B. INVERSE VIDEO BY CHARACTER
- C. 8 LEVELS OF GRAY

GRAPHICS DISPLAY MODES:

GRAPHICS MODES	GRAPHICS RESOLUTION		COMMENTS
	TEXT MODE 1	TEXT MODE 2	
"0" LOW RES	128X48	64X48	+TEXT
"1" HIGH RES B&W	128X48+	64X48	+TEXT
	480X192	240X192	+TEXT
"2" LOW RES COLOR	160X192 (8)	80X192(8)	+TEXT NOTE1
"3" HI RES COLOR	480X192 pixels	240X192 pixels	
	color defined by: 128X16 (8)	64X16 (8)	

NOTE1: If text is displayed in text mode 1 (STANDARD CHARACTERS) and graphics mode 2 (LOW RES COLOR) then the display will exceed the bandwidth of NTSC COLOR and the text will not be readable. An RGB monitor will display this mode accurately however.

NUMBER OF COLORS IN MODE 2 AND 3 : 8
FOREGROUND AND BACKGROUND COLORS : WHITE
GREEN
YELLOW
RED
MAGENTA
BLUE
BLUE-GREEN
BLACK

NUMBER OF PAGES OF MODE 1, MODE2 DISPLAYS: 1 STANDARD
(4 OPTIONAL)

SOFTWARE CHARACTER GENERATION

Besides using the capabilities of MODE 1 and MODE 3 for graphics alone, these modes can be used to extend the TEXT DISPLAY modes. With the special character generation software supplied with the LNW80 II, the following additional Text modes are usable both at the operating system level and from basic:

STANDARD TEXT MODE	GRAPHICS TEXT MODE
1. 64 characters, 16 lines	80 characters, 16 lines OR 80 characters, 24 lines
2. 32 characters, 16 lines	40 characters, 16 lines OR 40 characters, 24 lines

In this software, each character is a 5x8 matrix in a 6x12 rectangle (16 lines) or 5x8 matrix in a 6x8 rectangle (24 lines).

VIDEO DISPLAY OUTPUTS:

STANDARD:

OUTPUT	SPECIFICATIONS
1. B&W VIDEO	IMPEDANCE: 75 OHM SIGNAL : 1.2V p-p (+/- .35V) SYNC : NEGATIVE CONNECTOR: RCA HI-FI TYPE
2. B&W VIDEO RF MODULATOR CONNECTOR	CONNECTOR: 4 PIN INLINE .1
SPACING	PIN 1 : GROUND PIN 2 : OUTPUT 1 (SEE ABOVE) PIN 3 : NOT CONNECTED MARKED WITH DOT-PIN 4 : +12 V (CURRENT LIMITED)
3. LOW RES COLOR OUTPUT	IMPEDANCE: 75 OHM SIGNAL : 1.2V p-p (+/- .35V) SYNC : NEGATIVE CHROMA : 3.579 MHz (NTSC) CONNECTOR: RCA HI-FI TYPE
4. LOW RES COLOR RF MODULATOR CONNECTOR	CONNECTOR: 4 PIN INLINE .1
SPACING	PIN 1 : GROUND PIN 2 : OUTPUT 3 (SEE ABOVE) PIN 3 : NOT CONNECTED MARKED WITH DOT-PIN 4 : +12 V (CURRENT LIMITED)
3. HIGH RES COLOR (RGB)	IMPEDANCE: 750 OHM SIGNAL : TTL OC WITH 750 OHM CONNECTOR: DB9
PULL UP	

CONNECTOR OUTPUTS	
PIN #	SIGNAL
1	GND
2	COMPOSITE SYNC POSITIVE
3	RED
4	GREEN
5	BLUE
6	HORIZONTAL SYNC (NEGATIVE)
7	VERTICAL SYNC (NEGATIVE)
8	HORIZONTAL SYNC (POSITIVE)
9	VERTICAL SYNC (POSITIVE)

The following matrix defines the display content of the three display outputs under the four display modes. An X indicates that the selected mode information is displayed. A blank in the matrix indicates that the display is not valid.

VIDEO OUTPUT	B&W VIDEO	LOW RES COLOR	RGB COLOR
MODE 0	X	MODEL	X
MODE 1	X	X	X
MODE 2	8 GRAY SCALES	X	X
MODE 3			X

The following chart details the recommended video peripherals which can be connected to the LNW80 II.

OUTPUT	OUTPUT DEVICE	COMMENTS
B&W VIDEO	1. MONOCHROME MONITOR	>10MHz bandwidth
	2 VIDEO COLOR MONITOR	32 & 40 CHARS/LINE ONLY
B&W VIDEO RF	MODULATOR CONNECTOR	
	1. TELEVISION SET	32 & 40 CHARS/LINE ONLY
	With user supplied SUPR-MOD2 RF modulator	
LOWRES COLOR	1. VIDEO COLOR MONITOR	32 & 40 CHARS/LINE TEXT 128X192 COLOR OK,NO TEXT
	2. MONOCHROME MONITOR	
LOW RES COLOR RF	MODULATOR CONNECTOR	
	1. COLOR TELEVISION	32 & 40 CHARS/LINE TEXT
	With user supplied SUPR-MOD2 RF modulator	128X192 LIMITED CLARITY
RGB COLOR	1. LOW RES RGB MONITOR	GOOD CLARITY IN LOW RES <320 lines horiz. resolution
	2. MEDIUM RES RGB MONITOR	EXCELLENT DISPLAY IN ALL DISPLAY MODES

FLOPPY DISK DRIVE INTERFACE

DRIVE TYPES: 5.25" AND 8" SHUGART compatible
NUMBER OR DRIVES: 4-Single sided or 4 dual-sided drives
INTERFACE: 34 Contact 5.25" floppy drive compatible
Optional 34 to 50 conductor cable adaptor
required to connect 8" disk drives.
DRIVE DENSITY: SINGLE OR DOUBLE
DATA SEPARATION: ANALOG PHASE LOCKED LOOP
MAXIMUM STORAGE: 4,740,000 BYTES ON 4 dual-sided 8" drives
3,550,000 BYTES 3 dual-sided (UNDER DOSPLUS

3.4)

OTHER FEATURES:

5.25" AND 8" DRIVES IN ANY MIX
SINGLE AND DOUBLE DENSITY IN ANY MIX
35,40,77,80 TRACK DRIVE SUPPORT
5.25" OR 8" SYSTEM DISK (DRIVE 0)
PRECISION WRITE PRECOMPENSATION

DOUBLE DENSITY STORAGE CAPACITY:

* FIVE INCH DRIVES (FORMATTED STORAGE PER DRIVE)

161,280 bytes -35 track ss
322,560 bytes -35 track ds
184,320 bytes -40 track ss
368,640 bytes -40 track ds
368,640 bytes -80 track ss
737,280 bytes -80 track ds

* EIGHT INCH DRIVES (FORMATTED STORAGE PER DRIVE)

591,360 bytes -77 track ss
1,182,720 bytes -77 track ds

*NOTE: Hardware is designed to interface to the fourth disk drive on pin 6 of 34 pin floppy disk port however not all the following operating systems provide support for this fourth disk drive.

COMPATIBLE DISK OPERATING SYSTEMS

DISK DRIVE SUPPORT

OPERATING SYSTEM	4MHZ	5.25" SD	5.25" DD	8" SD	8" DD	DUAL
CP/M 2.2	YES	D	S,D	D	S,D	YES
DOSPLUS 3.2S		S,D				YES
DOSPLUS 3.2D		D	S			YES
DOSPLUS 3.4D	YES	D	S,D	D	S,D	YES
DOSPLUS 3.5	YES	D	S,D	D	S,D	YES
DBLDOS		D	S,D			YES
T8-OS (CHROMEMCO)	YES	S	D	D	D	
LDOS 5.0		S,D				YES
LDOS 5.1	YES	S,D	S,D(1)	S,D(1)	D(1)	YES
MULTIDOS	YES	S,D	S,D			YES
NEWDOS 2.1		S,D				
NEWDOS+		S,D				
NEWDOS80 1.0		S,D	S,D			YES
NEWDOS80 2.0	YES	S,D	S,D	S,D	S,D	YES
NEWDOS80 3.0	YES	S,D	S,D	S,D	S,D	YES
OS-80		S,D	S,D			YES
TRSDOS 2.3		S,D				

NOTES: S- SYSTEM DISK, D- DATA DISK, 1 = LDOSPATCH REQUIRED
DUAL- DUAL SIDED DRIVE SUPPORT

PRINTER INTERFACE

TYPE: INDUSTRY STANDARD CENTRONICS 8 bit parallel
100% TRS-80 compatible

NOTE: The RS232C serial communication interface can be configured for operation with printers which require a Serial RS232 port. Routing the printer output from most application software requires that a program (listing supplied in the LNW80 II computer documentation) be resident (usually high memory) in memory. Software which uses its own printer driver software may not function with this arrangement.

CASSETTE INTERFACE

FORMAT: AMPLITUDE MODULATED
 TRS-80 MODEL 1 AND 3 (500 BAUD ONLY) COMPATIBLE
DATA RATE: BAUD RATE CPU SPEED
 500 1.77MHz
 1000 4.00MHz
RECORDER
TYPE: INEXPENSIVE BATTERY OR LINE POWERED PORTABLE

RS232-C ASYNCHRONOUS SERIAL INTERFACE

TYPE: FULL DUPLEX
HANDSHAKING: FULLY SUPPORTED UNDER SOFTWARE CONTROL
BAUD RATES: SOFTWARE PROGRAMMABLE AT THE FOLLOWING RATES:
 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800,
 2000, 2400, 3600, 4800, 7200, 9600, 19200.
PARITY: Even, odd, or disabled (software selectable)
WORD LENGTH: 5,6,7,8 BITS (software selectable)
STOP BITS : 1, 1.5, 2 (software selectable)
CONNECTOR: FEMALE DB25, mounted on the rear panel
CONFIG: factory configured to connect TO DATA
 COMMUNICATION equipment (modems). Proper cable
 wiring will allow connection of DATA TERMINAL
 EQUIPMENT (serial printers and other LNW80 II
 computers)

TERMINAL EMULATION CAPABILITY

A large amount of dumb and intelligent terminal software is available to run on the LNW80 II. A listing of a dumb terminal program is supplied in the LNW80 II documentation.

EXPANSION PORT

This 40 pin CPU bus has all the ADDRESS, DATA, and control lines to expand the capabilities of the LNW80 II. This bus is electrically equivalent to the "SCREEN PRINTER" bus on the TRS-80 model 1. Here are just some of the products which connect to the EXPANSION BUS and are available from independent hardware suppliers:

- * Exatron Stringy Floppy
- * Eprom add-on memory/ programmers
- * Corvus Hard Disk/ Constellation
- * Battery-powered clock calender
- * Data aquisition equipment
- * Industrial controllers
- * Speech synthesizers
- * Voice recognition equipment
- * Orchestra 85-stereo, multi-voice, music synthesizer

PLUS ANY ACCESSORY designed to connect to the TRS-80 model 1 screen printer port.

REAL TIME CLOCK

TYPE: INTERRUPT "heartbeat" type
 FREQUENCY: 40 HZ

NOTE: The real time clock feature is not available on the cassette only systems without one of the following programs.

GAME I/O PORT

TYPE:	APPLE COMPATIBLE 16 PIN SOCKET			
PINOUT:	PIN #	FUNCTION	DATA BIT	37E4 RD
	1	+5V DC		
	2	SWITCH 1	2	
	3	SWITCH 2	3	
	4	NO CONNECT		
	5	NO CONNECT		
	6	PADDLE 0 (X1)	4	
	7	PADDLE 2 (Y2)	6	
	8	GROUND		
	9	NO CONNECT		
	10	PADDLE 1 (Y1)	7	
	11	PADDLE 3 (X2)	5	
	12-16	NO CONNECT		

PADDLE TYPE: RESISITIVE 150K OHM (TYPICAL)
 PERIOD AT 150K OHM RESISTANCE : 18 MSEC (APPROXIMATE)

AUDIO SPEAKER

The 500 mW speaker is driven from the output of the cassette interface at port location FF (hex) when the cassette relay is not energized. The cassette relay is turned on/off with data bit 2 of port FF (hex) and the signal is output to data bits 0 and 1. Refer to the LNW80 TECHNICAL REFERENCE MANUAL for more information on the cassette interface output. LNW BASIC supports the audio speaker with the SOUND command as do the TRS30 compatible games. The volume control for this speaker is located on the back panel and may be adjusted with a small slotted screwdriver.

SECTION 3 : PROGRAMMABLE BAUD RATE FOR THE RS232 PORT

The LNW80 II now fully supports the software programmable baud rates as did the TRS80 Model 1 serial interface. In order to set the baud rates, an 8 bit value must be output to port location E9H. The lower nibble (4 bits) of the data output to port E9H sets the receive baud rate and the top nibble will set the transmit baud rate. In other words, the 8 bit code is the sum of 1)the 4 bit code for the transmit frequency multiplied by 16 AND 2)the 4 bit code for the receive frequency multiplied by 1. The following example will program 300 baud for both the transmit and receive frequencies:

1. Transmit: the four bit code for 300 baud is 5 (hex).
 $5 \times 16 = 80$ (decimal)
2. Receive: again the four bit code is 5 (hex).
 $5 \times 1 = 5$
 Therefore: $80+5 = 85$ (decimal)

To program the BRG (baud rate generator) we would simply type while in the command mode in disk basic or enter in our basic program:

OUT &HE9,85

The following table lists the 4 bit codes for the BR1941 at port E9H:

4 Bit Code	Transmit or Receive Baud Rate	16xClock Frequency
0H	50	0.8 KHZ
1H	75	1.2 KHZ
2H	110	1.76 KHZ
3H	134.5	2.1523 KHZ
4H	150	2.4 KHZ
5H	300	4.8 KHZ
6H	600	9.6 KHZ
7H	1200	19.2 KHZ
8H	1800	28.8 KHZ
9H	2000	32.081 KHZ
AH	2400	38.4 KHZ
BH	3600	57.6 KHZ
CH	4800	76.8 KHZ
DH	7200	115.2 KHZ
EH	9600	153.6 KHZ
FH	19,200	316.8 KHZ

TRS80 MODEL I COMPATIBLE SERIAL CONFIGURATION

In the original TRS80 model 1 serial interface there was a set of 8 switches used to configure the RS232 port baud rates, parity, stop bits and word length. These switches did not actually make the configuration change, but instead gave the RS232 software a port which could be read back to see what the operator wanted the configuration set to. The LNW80 computer had the 5 switches which corresponded to the settings for parity,

word length and stop bits. The BAUD rates were set with two sets of 8 switches - one for transmit and one for receive. On the LNW80 II, the 2 sets of BAUD RATE switches do not exist (they can now be programmed in software) and the 5 configuration switches do not physically exist as mechanical switches but DO EXIST as a soft switches. This set of 8 soft switches (5 for configuration and 3 for baud rates) when programmed will appear to the existing software as the original TRS80 switches. In other words, to set the switches we must first run a program to set the switches to their settings. In addition, the switches must be SET again each time power is applied to the computer. The BASIC program which follows illustrates how the "soft" switches are set.

IT SHOULD BE MENTIONED HERE THAT DOSPLUS 3.4 CAN SET THE SWITCHES UNDER THE RS232 COMMAND WHICH CAN THEN SAVE THE DEFAULT RS232 VALUES TO THE DISK TO BE LOADED EACH TIME THE UNIT IS POWERED. LNW BASIC ALSO HAS THE RS232 COMMAND FOR CONFIGURATION PURPOSES. DO NOT FORGET, HOWEVER THAT MANY PROGRAMS WRITTEN FOR THE TRS80 READ THE CONFIGURATION SWITCHES AND SET THE BAUD RATE AND CONFIGURATION REGARDLESS OF WHAT YOU HAVE DONE IN LNW BASIC OR DOSPLUS.

TECHNICAL NOTE:

In order to set the configuration switches, follow this procedure:

1. Poke to memory location 37E4H with an 8
2. Output an 8 bit value to port location E9H with the switch settings according to the following table:

E9H CONFIGURATION SWITCH SETTINGS

NOTE: 0 means the switch is ON and 1 means the switch is OFF.

Baud Rate	Switch 1	Switch 2	Switch 3
110	0	0	0
150	1	0	0
300	0	1	0
600	1	1	0
1200	0	0	1
2400	1	0	1
4800	0	1	1
9600	1	1	1

Parity Enable	Switch 4
Enable	0
Disable	1

Stop Bits	Switch 5
One stop bit	0
Two stop bit	1

Word Length	Switch 6	Switch 7
5 bit word	0	0
6 bit word	0	1
7 bit word	1	0
8 bit word	1	1

Parity Select	Switch 8
Odd	0
Even	1

3. Now poke memory location 37E4H with a 0. The switches will now be set.

SOFT SWITCH SETTING PROGRAM

It should be pointed out that this program does not actually set the configuration of the RS232 port but it instead sets the phantom "soft" switches that can be read by the TRS80 Model 1 RS232 software drivers. It does however set the baud rates in order to be compatible with the software designed for the LNW80 or LNW80 II computers.

```

3 POKE &H37E4,8:OUT &HE9,162:POKE &H37E4,0
4 SS=INP(&HE9)
5 CLS:PRINT"TRS80 MODEL 1 COMPATIBLE RS232 CONFIGURATION SWITCH
SETTING":PRINT"PROGRAM ORIGINAL SETTINGS ARE FOR:":PRINT"
300 BAUD":PRINT"          PARITY EVEN":PRINT"          7 BIT WORD
LENGTH":PRINT"          1 STOP BIT"
6 GOTO 100
7 SS=INP(&HE9)
10 INPUT"SWITCH NUMBER TO BE CHANGED";SW
20 IF SW>8ORSW<0THENGOTO10
30 PRINT"SET SWITCH";SW;" TO A 1 (OFF) OR 0 (ON)";
40 INPUT ST:IFST=0THENGOTO50ELSEIFST=1THENGOTO60ELSEGOTO40
50 SS=SSAND(255-(2*(SW-1))):PRINTSS:GOTO100
60 PRINTSS:SS=SSOR(2*(SW-1)):GOTO100
100 FOR X=1TO8:PRINT"SWITCH NUMBER
";X;:IF(SSAND(2*(X-1)))=2*(X-1)THENPRINT"OFF (1)"ELSEPRINT"ON
(0)"
110 NEXTX
120 PRINT"VALUE OUTPUT TO SOFT SWITCH:":PRINTSS;:POKE &H37E4,8:
OUT &HE9,SS: POKE &H37E4,0 ' NOW THE SWITCH IS SET
121 B=SSAND7
122 RESTORE:FOR Z=0TOB:READBR:NEXTZ
123 OUT &HE9,BR ' SET THE BAUD RATE IN CASE THE SOFTWARE WON'T
124 PRINT"    VALUE OUTPUT TO BRG:":PRINTBR
125 GOTO 7
129 DATA 34,68,85,102,119,170,204,238

```

SECTION 4 : GRAPHICS AND COLOR

There are several changes in the graphics and color in the LNW80 II over the LNW80. They will be discussed according to the mode in which they apply. It should be pointed out that all of these features are fully supported by VERSION 4.0 of LNW BASIC.

MULTI-PAGE GRAPHICS AS AN OPTION

The special feature of the LNW80 II that stands out is the MULTI-PAGE GRAPHICS OPTION. The standard 16K of graphics RAM can be upgraded to 64K to allow the addition of 3 other full MODE 1 and MODE 2 displays (and MODE 3 pixel on/off). Port 95 is used to define the graphics page that is being accessed (read from or written to) and the page that is displayed. Data bits 4 and 5 define the page accessed for read and write while data bits 6 and 7 define the page displayed.

PAGE DISPLAYED	D7	D6
0	0	0
1	0	1
2	1	0
3	1	1

PAGE ACCESSSED	D5	D4
0	0	0
1	0	1
2	1	0
3	1	1

In order to install the option, the 6-16K (4116) RAMS must be removed from the CPU board (locations U106-U111) and replaced with 6- 4164 RAMS. The 4164 parts used should be 200ns or faster and should be of the 128 cycle refresh variety. Brands such as Motorola, NEC, Hitachi, and Fujitsu will work and TI parts will NOT WORK. These RAMS are available from your computer dealer. If he does not stock them they can be ordered directly from LNW. Pin 1 of each IC should be bent under the part so it does not get plugged into the IC socket. In addition move jumper straps at:

JUMPER HEADER	WAS	SHOULD BE CHANGED TO:
J3	2-3	1-2
J11	1-2	2-3

If the jumper strap on your computer is soldered, simply unsolder the end strap wire and connect the center strap to the correct pin. The DOT marked on the circuit board indicates the position of pin 1.

To test the option type in the following program under LNW BASIC:

```
10 MODE 2
20 FORI=0TO3
25 X=1 'FIRST DATA BIT
30 OUT 95,I*16 'MOVE THE PAGE TO INPUT TO
35 PCLSX
40 X=2*X: 'SHIFT OVER ONE BIT EACH TIME
50 FORI=0TO3
60 OUT 95,I*64 'MOVE DISPLAY TO NEXT PAGE
70 GOSUB 100 ' DELAY A LITTLE BIT
80 NEXTI
90 GOTO 50 ' RUN CONTINUOUSLY
100 FORX=1TO100:NEXTX:RETURN
```

What you should see is full screen of vertical lines moving to the right over and over again in a loop. Version 4.0 of LNW BASIC has full support for the multipage option.

MODE 0 DISPLAY

A. TWO INDEPENDENT TEXT DISPLAYS

In mode 0, the low res and 64x16 text mode of the LNW80 II, the video content of the LOW RES COLOR OUTPUT will be the MODE 1 high res display. Since the bandwidth of this output has been extended, the display is quite clear on a high resolution monochrome monitor. If one of the graphics controlled 80 column display programs are used, both the HIGH RES B&W OUTPUT and the LOW RES COLOR OUTPUT can have full text displays independent of each other.

B. INVERSE VIDEO BY CHARACTER

When DATA BIT 7 of the video configuration port (254) is set to a "1", then the INVERSE VIDEO BY CHARACTER MODE is set. This mode turns off all mode 0 graphics and instead displays all the graphics characters as inverse counterparts of the standard character set. To see how this works try the following BASIC program:

```
10 OUT 254,128 ' sets the inverse mode
20 PRINT"THIS SHOULD NOT BE INVERTED"
30 FORX=1TO7:READA$:A=ASC(A$)-64:PRINTCHR$(A+128);:NEXTX
35 GOTO 35
40 DATA "I","N","V","E","R","S","E"
```

The -64 on line 30 is such that the ascii characters will be properly adjusted to the graphics characters and not the space compression codes. This is not necessary when poking directly

into the video memory. It still does seem inconvenient to manually change each character to a graphics code. It can be done automatically by outputting a decimal 4 to port 95. Try typing in the following program to see how easy it is:

```
5 CLS
10 OUT 254,128
20 PRINT"THIS SHOULD NOT BE INVERTED"
25 OUT 95,4
30 PRINT"THIS SHOULD BE INVERSE";
35 GOTO 35
```

After typing in the above program and typing RUN, enter <BREAK> after the program has displayed the inverse line. You will note that every thing is now being inverted. Type:

```
OUT 95,0
```

The screen is now non-inverse.

MODE 1 DISPLAY

Mode 1 graphics have not been changed other than it is also output to the LOW RES COLOR output during mode 0.

MODE 2 DISPLAY

Mode 2 (LOW RES COLOR) has been changed in several ways:

1. It has been expanded to extend into the extension region to add 32 horizontal pixels to the display. LNW BASIC 4.0 NOW EXTENDS TO 160 HORIZONTAL.

The relationship between the pixel and the graphics memory is as follows:

2. Eight levels of intensity (gray levels) can be seen on the monochrome output during mode 2 graphics. This allow color programs to be seen clearly (not just NTSC dots as on the APPLE 2 or IBM PC) in black and white. The display is limited to 128x192 pixels. The extension region graphics will not be seen in this mode. Gray levels can be used for text highlighting under LNW BASIC by using the LINE COMMAND with the block and fill options. To compute the horizontal and vertical positions for the LINE X1,Y1,X2,Y2,SET,BF command:

```
X1=((CHARACTER POSITION start)*6)
X2=((CHARACTER POSITION end)*6)+5
Y1=((LINE start)*12)
```

```
Y2=((LINE end)*12)+11
```

```
CHARACTER POSITION = 0 TO 63
```

```
LINE = 0 TO 15
```

3. BACKGROUND COLORS HAVE BEEN ADDED

On power up and RESET the LNW80 II will have the background color forced to the color WHITE (0). In order to set the background color, set data bits 4, 5, and 6 of port 254 to the 3 bit code for the color desired. For example:

```
10 MODE 2
15 INPUT"BACKGROUND COLOR";C
20 A=INP(254)
30 A=A+16*C
40 OUT 254,A
```

LNWBASIC 4.0 takes full advantage of the background color feature. BACKGROUND COLOR applies to all color display modes including MODE 3

SECTION 5 : GAME I/O PORT

The game I/O interface is set up so as to allow the user to plug in most Apple 2 compatible joysticks. J7 inside the back panel provides for this connection. The game I/O interface (the small 16 pin IC socket located just inside the back panel of the LNW80 II under the FLOPPY DISK edge card) allows two switches and four resistive type joysticks to be input. A write to 37E4H with data bit 3 set will strobe the internal quad one-shot. Depending on the setting of the external joysticks, these one-shot devices will give a variable time delay. Software can then sample the one-shots pulse widths thus determining the X1, X2 and Y1, Y2 joystick positions. LNW BASIC provides full support for the joystick resistive inputs and the two switches can be sampled via a PEEK command in BASIC (&H37E4). If data bit 2 is set then switch one is set and if data bit 3 is set then switch 2 is set. Refer to SECTION # : 3 "LNW80 II DETAILED SPECIFICATIONS" for more information concerning the pinout of the 16 pin GAME I/O connector.

TECHNICAL NOTES:

WRITE 37E4H DEFINITION

The following table describes the definition for data bits 0-7 on a write to 37E4H.

D0 - Reserved
D1 - Reserved
D2 - Reserved
D3 - Game I/O strobe and serial configuration status.
D4 - Reserved
D5 - Reserved
D6 - Reserved
D7 - Reserved

READ 37E4H DEFINITION

The following table describes the definition for data bits 0-7 in a read to 37E4H.

D0 - Reserved
D1 - Reserved
D2 - Switch 1 for game I/O.
D3 - Switch 2 for game I/O.
D4 - X1 Pulse width for the game I/O Joystick.
D5 - X2 Pulse width for the game I/O Joystick.
D6 - Y2 Pulse width for the game I/O Joystick.

D7 - Y1 Pulse width for the game I/O Joystick.

SECTION 6 : NEW I/O PORT AND MEMORY LOCATIONS

JOYSTICK - MEMORY LOCATION 37E4

D3 - STROBE (NEGATIVE EDGE) FOR WRITES (GAME I/O STROBE)

READ 37E4

D2	SWITCH 1 FOR GAME I/O
D3	SWITCH 1 FOR GAME I/O
D4	X1 PULSE WIDTH FOR GAME I/O JOYSTICK
D5	X2 PULSE WIDTH FOR GAME I/O JOYSTICK
D6	Y2 PULSE WIDTH FOR GAME I/O JOYSTICK
D7	Y1 PULSE WIDTH FOR GAME I/O JOYSTICK

PORT 254 --- OUT

D0	INVERSE VIDEO
D1-D2	DISPLAY MODE
D3	GRAPHICS ACCESS ENABLE
D4 - D6	BACKGROUND COLORS
D7	WHEN SET ENABLES INVERSE CHARACTER MODE

(PORT D5, D2 THEN TURNS THE INVERSE CHARACTER ON OR OFF).

PORT 254 --- IN

READS STATUS OF ALL DATA BITS

PORT 95 --- OUT

D0, D1	- RESERVED (SHOULD REMAIN "0"s)
D2	- TURNS ON INVERSE CHARACTER WHEN SET, OFF WHEN RESET (TO CONTROL INVERSE CHARACTER ON OR OFF PORT 254 DATA BIT 7 MUST BE ENABLED.)
D3	- RESERVED (SHOULD REMAIN "0")
D4, D5	- USED IN MULTIPAGE GRAPHICS OPTION - DEFINES PAGE THAT IS BEING ACCESSED FOR READ OR WRITE OPERATION.
D6, D7	- USED IN MULTIPAGE GRAPHICS OPTION - DEFINES GRAPHICS PAGE BEING DISPLAYED

PORT 95 --- IN (RESERVED)

The following list of I/O port addresses have been reserved for future use by LNW and should not be used for any reason on the LNW80 II. They are being reserved for future system functions.

RESERVED PORT ADDRESS (HEX) :

1F
3F
5F
7F
F8
FA
FC
FE

SYSTEM MEMORY CONTROL PORT 1FH

The LNW80 II Computer System utilizes one more additional I/O Port that is not used on the LNW80 or the TRS-80 Model I Computer. This port location is used to bank RAM and ROM.

PORT MAP LOCATION 1FH

D0=1 CP/M mode where the lower 16K is swapped with the top 16K.

D1=1 Bank in 0-16K as RAM except for the areas that are memory mapped I/O, keyboard, video RAM. (0- approx. 14K)

D2=1 Disable all interrupts.

D3=1 RESERVED (Do not use).

D4=1 Replace memory mapped I/O with RAM. This RAM is otherwise unused in the memory map of the LNW80 II.

D5=1 Disable additional 32K banked in RAM.

D6=1 Bank in additional 32K RAM.

D7=1 Write protect 0-12K of memory.

Example 1 (D1,D7 are =1)

Block move the Level II BASIC ROM to RAM and write protect the 0-12K of RAM:

```

DI
LD      DE,7000H
LD      HL,0
LD      BC,3000H
LDIR                                ;BLOCK MOVE ROM TO 7000H
LD      A,02H                      ;BANK IN RAM
OUT     (1FH),A
LD      DE,0
LD      HL,7000H
LD      BC,3000H
LDIR                                ;BLOCK MOVE ROM CODE TO 0-12K
LD      A,82H                      ;D7 AND D1 ARE =1
OUT     (1FH),A                    ;WRITE PROTECT 0-12K
JP      402DH                      ;DOS REENTRY LOC

```

Example 2 (D0=1)

48K CPM MODE

SPECIAL NOTICE: HI-RES RAM IS STILL AT 0-16K

```
LD      A,1          ;D0=1
OUT     (1FH),A      ;CPM MODE
```

MEMORY MAP BECOMES;

0-C000H	RAM
C000H-EFFFH	LEVEL II ROM
F000H-F6FFH	NOT USED
F700H-F7FFH	MEMORY MAP I/O
F800H-FBFFH	KEYBOARD
FC00H-EFFFH	VIDEO

EXAMPLE 3 (D0,D1=1)

```
LD      A,3          ;D0,D1=1
OUT     (1FH),A      ;CPM MODE W/ EXTRA RAM
```

MEMORY MAP BECOMES;

64 CPM MODE

0H-F6FFH	RAM
F700H-F7FFH	MEMORY MAP I/O
F800H-F8FFH	KEYBOARD
F900H-FBFFH	RAM
FC00H-FFFFH	VIDEO

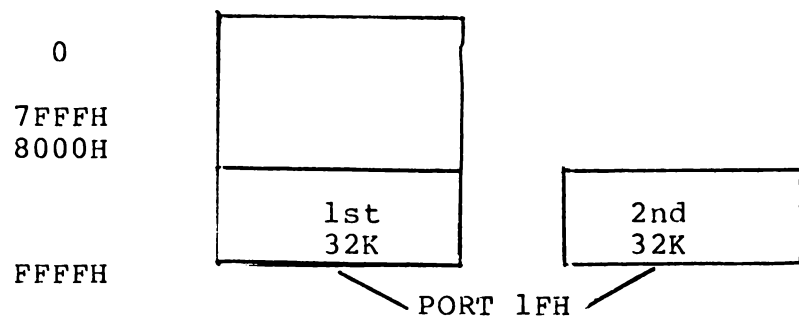
EXAMPLE 4 (D6=1)

96 TRS-80 COMPATIBLE MODE

THIS MODE WILL BANK IN AN ADDITIONAL 32K BYTES OF RAM MEMORY MAPPED FROM 8000H-FFFFH.

```
LD      A,40H        ;D6=1
OUT     (1FH),A      ;BANK SWITCH
```

MEMORY MAP



Document "LNW80 MODEL 2 DESCRIPTION AND FEATURES 2/83"

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Aug 17th, 2025