PVK11-G

GRAPHIC DISPLAY CONTROLLER

USER MANUAL

WEBSTER
COMPUTER
CORPORATION

PVK11-G GRAPHIC DISPLAY CONTROLLER

USER MANUAL

Version 1.0

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This manual is intended to provide complete information on the PVK11-G graphic display controller.

Related chapters are grouped together into 6 defined sections.

HARDWARE

Chapter 1 gives a general description of the PVK11-G, its purpose and its use.

Chapter 2 details the specifications of the PVK11-G.

OPERATIONS

Chapter 3 is intended to give first time terminal users general information about terminals, operating systems and graphics concepts, as well as a description of the function and meaning of the controls and indicators on the terminal. Programmers and other experienced users may wish to skip this chapter.

Chapter 4 details all the features which can be changed or set by the Operator via Setup mode. In addition, Appendix C provides a Baud Rate Selection table.

PROGRAMMING

Chapter 5 describes the character encoding and the character sets associated with the PVK11-G.

Chapter 6 describes the operation of the keyboard, including how to generate control codes. It also specifies the codes generated by the special keys and the auxiliary keypad.

Chapter 7 contains all the details needed for controlling the display and switching between the various modes via escape sequences. It describes fully how the PVK11-G interprets control codes and escape sequences received from the host system.

ENGINEERING

Chapter 8 describes the logic of the PVK11-G.

Chapter 9 details the internal circuits of the PVK11-G.

MAINTENANCE

Chapter 10 tells you everything you need to know about installing, powering on and interconnecting the PVK11-G.

Chapter 11 is a first level troubleshooting guide. When problems occur and you suspect the PVK11-G is faulty, please read this chapter.

APPENDICES

Appendix A ASCII Chart
Appendix B Programming Summary
Appendix C Baud Rate Selection Table

CHAPTER 1
PVK11-G General Description

The PVK11-G is a video terminal logic module which plugs into the Qbus. It connects to a non-composite video monitor and a keyboard to provide DEC VT100 emulation. Also supported are ANSI 8-bit escape sequences and a major subset of DEC's VT200 series functionality. The PVK11-G emulates Tektronix 4010 terminals together with a subsetted VT100 capability.

Qbus Interface

The PVK11-G plugs directly into any Qbus slot. Positive 12V power from the Qbus is fed through to the video monitor for those monitors which require it, and 5V power is routed to the keyboard via the keyboard connector.

From its menu-driven setup page, the PVK11-G can optionally drive the Qbus B EVENT L line at 50 or 60 Hz, can pulse B DCOK H in order to initiate system bootstrap, and can control the halt-on-break function. The S RUN L signal is monitored in order to provide a RUN indicator using one of the keyboard status LEDs. A completely functional work-station can be configured without recourse to any front panel switches or indicators.

Serial Interface

A single 10-way flat cable connection mates directly with a DEC standard serial line controller such as DLVJ1 and MXV11, or the Webster PCLV11-J. Flow control is via the XON/XOFF protocol. From the setup page, communication baud rate may be selected from 50, 75, 110, 134.5, 150, 200, 300, 600, 1050, 1200, 1800, 2000, 2400, 4800, 7200, 9600, 19200 or 38400 baud, and split baud rates of 600/75, 1200/75 or 2400/75 are also available. Character length can be 7 or 8 bits, while parity may be set to none, even, odd, space, or mark.

Video Interface

All connections to the video monitor are made via a 10-way flat cable. Separate signals are provided for horizontal sync, vertical sync and video. Available as an accessory is the PRC1 adaptor which provides convenient connection to the standard 10-way edge connector used in non-composite monitors.

Keyboard Interface

Connection to the keyboard is via a 10-way flat cable comprising serial transmit data, serial receive data, power and ground. All 256 8-bit codes can be generated from the keyboard.

Communications protocol is asynchronous 300 baud TTL with 8 data bits, 1 stop bit, and no parity.

Indicators

At the rear of the module are two LED indicators signalling various modes of board diagnostic failure.

Special Characteristics

The PVK11-G provides full vector plotting capability over a screen resolution of 800 x 600 pixels. When auto-scaling is enabled the 1024 x 768 pixels of the Tek 4010 are mapped on to the physical screen, allowing the use of applications written for 4010 displays. Graphic input for crosshair positioning is via the keyboard cursor control keys. Several enhancements to the 4010 emulation are also provided, including selective erase, variable character size, variable writing mode (on, off, complement and replace), point plot, and incremented point plot.

In text mode, the PVK11-G provides a major subset of VT100 emulation. This mode of operation is optimized for high readability through the use of dot-stretching and high resolution characters. The format is fixed at 24 lines of 80 characters. There is one programmable video attribute, which is always reverse video. The cursor is always a reverse video block, but can be blinking, non-blinking or invisible. Specific VT100 features not implemented are smooth scroll, 132 columns, double-size characters and underscore.

CHAPTER 2
PVK11-G Specifications

Bus interface	DEC Qbus
Bus loading	1 AC, 1 DC
Electrical	5 Volt 2.0 Amp
Emulation	TEK 4010, VT100 subset
Characters per line	80
Lines per screen	24
Video dot clock	19.734 MHz
Hsync frequency	18975 Hz
Hsync polarity	Positive TTL
Vsync frequency	60 Hz
Vsync polarity	Positive or Negative TTL
Recommended Phosphor	P39
Recommended Keyboard	Keytronic P2441
Serial line interface	RS232
Keyboard interface	Async 300 baud TTL, 8 data bits, 1 stop bit, no parity
Recommended keyboard	Keytronic P2441 or equivalent
Connectors:	
Video and keyboard	20-way IDC
Serial line	10-way IDC
Indicators	1 red LED and 1 green LED for diagnostic purposes
Physical	226mm x 132mm

CHAPTER 3
How to Use the PVK11-G

Generally, when you press a key on the keyboard, the effect is simply the transmission of one or more codes to the host system. Within the host system there is usually a software system called the operating system. Application programs can communicate with the user through the operating system, and can use the operating system for such functions as maintaining file storage and printing reports. Thus the operating system is the interface between you and the computer, and your terminal is the interface between you and the operating system. Figure 3-1 shows the position of the keys and indicators on the keyboard.

There are five graphic modes available in addition to text mode :

Alphagraphic Mode

In alphagraphic mode, printable characters are shown on the screen in one of four sizes. A blinking underline cursor appears at the position of the next character. Certain control codes can be used to position the cursor and for other functions described below.

Vector Mode

In vector mode, all printable characters are interpreted in a special way and define the endpoints for straight lines which will be drawn on the screen. Various line styles can be selected via special escape sequences.

Point Plot Mode

Printable characters are interpreted in a similar way to vector mode, except that instead of drawing a line, a single point is plotted at the endpoint specified.

Incremental Point Plot Mode

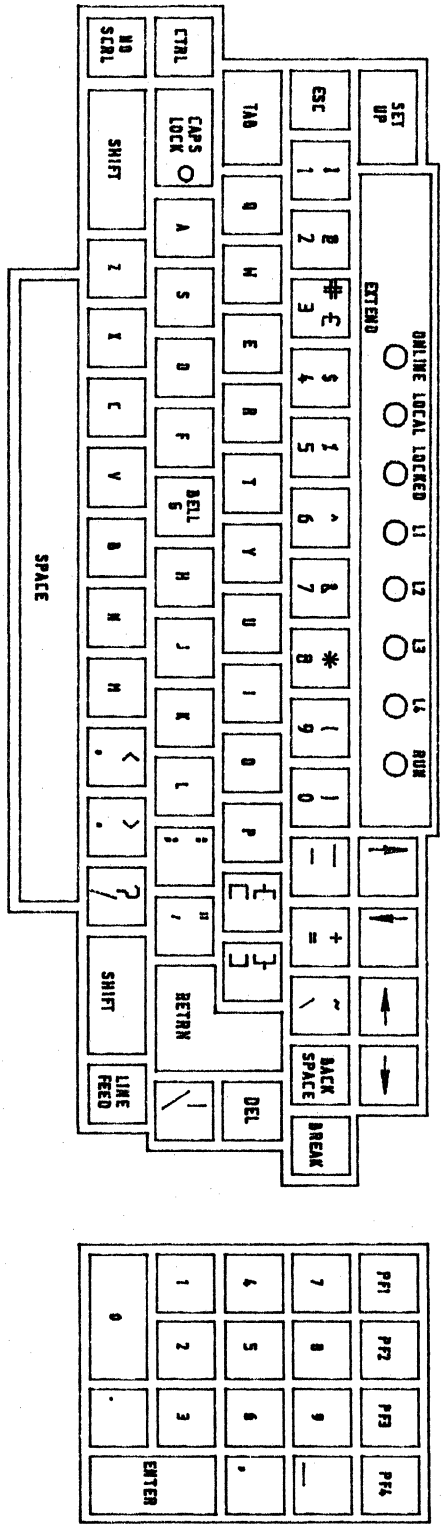
In this mode, certain printable characters translate into single pixel displacements in various directions. A single point is plotted for each character received.

Graphic Input Mode

Graphic input mode is used to send coordinate pairs back to the host computer. A half intensity crosshair appears on the screen and its position can be controlled via the arrow keys and the auxiliary keypad keys. When a main keyboard key is pressed, the current coordinates of the crosshair are sent to the host, and the terminal enters alphagraphic mode.

KEYBOARD LAYOUT

FIGURE 3-1



3.1 Main Keyboard Keys

Only keys that have a special meaning or function are described.

Key	Action
SETUP	SETUP puts the terminal in Setup mode. The current display is saved and replaced by a Setup menu. When you press SETUP again the saved characters are restored and the terminal resumes normal operation. Setup mode allows you to change various terminal functions in order to make the terminal better suit your personal preference and to work correctly with your computer and operating system. The setup functions are fully described in Chapter 4.
Arrow Keys	The four arrow keys are used mainly in text editing and menu operations for moving the cursor around the screen. These keys transmit special code strings called escape sequences to the host. The host usually responds by sending special codes back to the terminal to move the cursor. In Setup mode, these keys have different functions. The Up and Down arrows are used to increase and decrease the screen contrast, or to select one of the predefined option values within a menu item. The Left and Right arrows are used to move the cursor left and right when setting or clearing tab stops. In graphic input mode these keys move the crosshair up, down, left or right.
ESC	ESC (Escape) transmits a control code to the host. This code usually tells application programs that the characters that follow have a special meaning. This code is automatically transmitted as part of the special code strings called escape sequences.
BACK SPACE	BACK SPACE transmits a control code to the host. If the host echoes this code back to the terminal, it will have the effect of moving the cursor one space to the left. If the cursor is already at the left margin, this code will have no effect.

BREAK

BREAK is a multifunction key. BREAK or SHIFT-BREAK causes the terminal to send a special signal to the host system. BREAK sends a short Break signal (approximately 0.5 second) and SHIFT-BREAK sends a long Break signal (approximately 3 seconds). The use of this key is only effective if "Halt on Break" is set to On in Setup mode, Page 3.
CTRL-BREAK causes the terminal to send its Answerback message to the host computer.

TAB

TAB transmits a control code to the host. If the host echoes this code back to the terminal, then the terminal will move the cursor to the next previously stored Tab position on the right. You can view, set or clear Tab settings in Setup mode. The host can also alter the Tab settings within the terminal.

DEL

DEL (Delete) transmits a special character code to the host. If the host echoes this code back to the terminal it will have no effect. However many operating systems recognise this special character and respond to it by sending Backspace space Backspace to the terminal. This effectively deletes the most recently typed character from the screen.

CTRL

CTRL (Control) does not transmit any codes to the host. It is used to modify the action of many of the other keys. To use it you first press the CTRL key, and while holding it down you press another key. When the second key is pressed the modified function occurs. Usually this consists of sending a control code to the host. The combination of these two keys is called "Control Key". For example if you press the S key while holding down CTRL, the combination is called "Control S". This would cause the terminal to send the "Control S" code to the host.

Most operating systems recognise at least some of the possible "Control" codes. Often CTRL-C is used to abort programs or functions within the operating system. CTRL-U may be used to erase all the characters typed on a line prior to entering a carriage return. The effect of the CTRL-U is the same as deleting each character back to the start of the current line. Note also that many of the control codes can be generated by other keys on the keyboard. For example, CTRL-M is the same as pressing the RETRN key, and CTRL-I is the same as pressing the TAB key.

CTRL-3

This combination, in Extended ANSI mode, provides the Extend function by causing the next character sent to have its most significant bit set, changing keyboard transmission from the normal C0 characters (8-bit codes with top bit = 0) to C1 or (8-bit codes with top bit = 1).

CAPS LOCK

CAPS LOCK is used to lock only the alphabetic keys (A-Z) in upper case. When in this mode a miniature red lamp shows on the CAPS LOCK key. This key does not transmit any codes to the host.

RETRN

RETRN (Return) causes one or two control codes to be sent to the host. The host uses this to terminate or enter an operating system command.

In graphics modes, enters alphagraphic mode from any other graphic mode, and when in alphagraphic mode, moves the alphagraphic cursor to the currently defined left margin.

In text mode moves the cursor to the start of the next line on the screen.

NO SCRL

NO SCRL (No Scroll) alternately sends CTRL-S and CTRL-Q to the host. Some operating systems use this to suspend and resume transmission to the terminal. If your host system supports this type of operation, you can stop information scrolling off the screen by pressing NO SCRL. When you press NO SCRL again, the information can continue scrolling. NO SCRL mode is indicated by the ONLINE and LOCAL indicator lamps flashing alternately.

SHIFT

For keys with more than one symbol imprinted on the keycap, SHIFT selects the upper symbol, and for the A-Z keys SHIFT selects upper case (capital letters).

LINE FEED

LINE FEED transmits a control code to the host. If the host echoes this code back to the terminal, the terminal will move the cursor down one line, scrolling up if necessary. The terminal can be set to also move the cursor to the start of the new line. The host also uses this to terminate or enter an operating system command.

3.2 Auxiliary Keypad Keys

Key	Action
PF1 - PF4	These keys all transmit escape sequences to the host. The interpretation of these codes is dependent on the application program and operating system in use. In Setup mode these keys are used to select one of the four Setup pages. PF1 selects Page 1, PF2 selects Page 2, PF3 selects Page 3, and PF4 selects Page 4.
0-9 . , - ENTER	These keys send codes to the host. The host can program these keys to have the same meaning as the corresponding keys on the main keyboard, or to transmit special escape sequences which have a specific meaning to the application program. In Setup mode the ENTER key is used to terminate several functions. These are the Answerback Message and Set/Clear Tabs. In graphic input mode the crosshair can be moved using eight of the numeric keys (auxiliary keypad only) in the following way: 1 down left 2 down 3 down right 4 left 6 right 7 up left 8 up 9 up right In addition, in graphic input mode, the number 5 key (auxiliary keypad only) has a special function. When pressed, any text displayed in ANSI or VT52 mode will be blanked. This allows a clear view of the graphic image when text and graphics overlay the same area. Pressing the 5 key again will restore the text.

3.3 Keyboard Indicator Lamps

There are eight indicator lamps on the keyboard which are used to indicate special conditions. Four of them are controlled by the terminal itself and the other four are controlled by commands from the host system.

Indicator	System State
ONLINE	When this indicator is on, it means that there is a direct communication path between your terminal and the host. Characters you type on the keyboard are sent to the host system. Characters from the host system are displayed on your screen.
LOCAL	If the LOCAL indicator is on it means that the communication path between your terminal and the host system no longer exists, and characters you type on the keyboard are displayed directly on the screen.
ONLINE/LOCAL Flashing	When a Control S has been sent to the host, either by pressing <CTRL>S or by pressing the NO SCRL key, the Online and Local lights rapidly flash alternately to indicate the suspended condition.
LOCKED	This lamp indicates that the terminal's keyboard buffer is full, and that subsequent keystrokes will be ignored. The keyclick sound will cease as a warning. It is possible for the host system to cause the terminal to "lock". If this happens you can clear the condition by pressing SETUP twice. Normally the keyboard locked condition will clear automatically.
L1 - L4	These four lamps may be used to indicate various operating modes or options within an application program, and are controlled by commands from the host system. The application program can switch any combination of these lamps.
RUN	When this lamp is illuminated it indicates that the S RUN L line on the QBus is pulsing, and thus provides an indication that the LSI-11 CPU is running.

CHAPTER 4
PVK11-G Setup Function

The PVK11-G provides a special mode of operation called the Setup mode. When the terminal is in setup mode, certain configurations can be changed and then subsequently saved using the Store function in a non-volatile memory. A non-volatile memory can retain information even when power is disconnected.

The setup mode consists of 4 pages of menus, with each page displaying up to 10 features. Each feature is displayed with its current status shown (if relevant).

4.1 Using Setup Mode

You can use the Setup mode any time the terminal is powered on. To enter setup mode, simply press the SETUP key. To select a particular feature, you press the number key (on the main part of the keyboard), corresponding to that feature. The auxiliary keypad number keys do not function in setup mode.

The following operating instructions are common to all 4 Setup Pages:

1. Select another page.

   Setup pages are selected with the program function (PF) keys. The PF keys 1, 2, 3 and 4 each select a different setup page. PF1 selects Setup Page 1, PF2 selects Setup Page 2, PF3 selects Setup Page 3 and PF4 selects Setup Page 4. When a terminal first enters setup mode, Page 1 is automatically selected.

2. Change the screen contrast.

   In setup mode, the up arrow increases the display contrast and the down arrow decreases the display contrast. The up and down arrows can have a different function within certain page items, and if one of these is being changed you must complete the item manipulation before you can use the arrow keys to change the contrast.

3. Change a value.

   Where the facility is available, the up and down arrows allow you to change the current value of a page item. Simply press the up arrow once to advance to the next value, or the down arrow to go back to the previous value.

4. Select alternate value

For some features, typing the item number from the menu acts as a switch. In these cases, the switch may be On or Off with regard to that menu item, or it may alternate between a number of possible values. For example, if you are looking at Setup Page 2, option 5, successively pressing number "0" will cause the default value for Emulation mode to change from "ANSI" to "Extended ANSI" to "VT52" to "ANSI"..... etc.

5. Select a different default value

After changing the default value of a page item (as in paragraph 3 or 4 above), the new value may be made permanent for your terminal by pressing the "store" key (item number 4) on Setup Page 1. If this is not done, the original default value for that item will be re-instated when the terminal is reset or turned off.

6. Exit setup mode.

To put the terminal back into normal mode, press the SETUP key again.

7. Keystroke errors.

To correct a keystroke error, you must exit the current operation by pressing ENTER and/or SETUP, and begin it again. Pressing a key which is clearly irrelevant to the option selected, eg., choosing an alpha key when only a numeric option is valid, will be ignored by the terminal and requires no error correction.

Setup Page Format

Each setup page occupies the entire screen display and all current screen data is temporarily invisible. All four setup pages display a format as shown in this example of Setup Page 1.

```
                              SETUP 1

PF1 = Setup Page 1     0
PF2 = Setup Page 2     1 = Answerback message       [xxxxxxxxxxxxxx]
PF3 = Setup Page 3     2 = Set/Clear tabs
PF4 = Setup Page 4     3
Uparrow = brighter     4 = Store
Downarrow = dimmer     5 = Recall
Setup = Exit setup     6 = Select general defaults
                       7 = Select tab defaults
                       8 = Reset terminal
                       9 = Screen saver            [off]


  T       T       T       T       T       T       T       T       T
  9       17      25      33      41      49      57      65      73
```

This format is explained on the following page.

Explanation

Setup [number] : A number to identify the current setup page.

Seven messages, which define the seven setup functional keys, are always displayed on the left-hand side of the screen when a setup page is first selected (see the example above). In some cases, when you select a particular numbered option from a page, an instructional message displays in reverse video, and the first six of these seven messages subsequently clear from the screen. This means that you cannot use any PF key to select a new page, or the up and down arrows to change the display contrast, until either the ENTER or SETUP key is pressed to complete the selected option.

The next column features a numbered list of the menu options available on the Setup Page selected. Certain numbers have not been allocated and are reserved for future use. Some features display a current value in [square brackets].

The two bottom lines comprise a ruler showing the number of columns set for the screen (80) and the current tab settings.

An Example of Using Setup

Let us assume that you wish to change the screen contrast to make it brighter, and the emulation mode from ANSI to VT52.

Press SETUP	The terminal enters Setup mode
Press Uparrow	Keep pressing this key until the characters on the screen are bright enough. If you have made the screen too bright, press Downarrow to make it dimmer.
Press numeric key 0	(Use the main keypad "0" only). The default options ANSI, Extended ANSI and VT52 are displayed by successively pressing this key. When the option shown is the mode you want, move on to the next step.
Press numeric key 4	You have now saved the new values of the two features you changed (brightness and emulation modes) as permanent defaults. You may change these values at any time by a similar process.
Press SETUP	The terminal exits Setup mode and returns to the operating mode.

4.2 The Setup Pages

These are the features available for all four setup pages. Where multiple options/values apply, they are bounded by square brackets.

Page	Options
Page 1	
0 (Not used)	
1 = Answerback message	[xxxxxxxxxxxxxxxxxxxx]
2 = Set / Clear tabs	
3 (Not used)	
4 = Store	
5 = Recall	
6 = Select general defaults	[see text]
7 = Select tab defaults	[see text]
8 = Reset terminal	
9 = Screen saver	[on/off]
Page 2	
0 (Not used)	
1 (Not used)	
2 = Cursor mode	[Blinking block/block/invisible]
3 = Margin bell	[on/off]
4 = Keyclick	[on/off]
5 = Emulation mode	[ANSI/extended ANSI/VT52]
6 = Transparent mode	[on/off]
7 = Auto wrap	[on/off]
8 = Auto newline	[on/off]
9 (Not used)	
Page 3	
0 = Halt on break	[on/off]
1 (Not used)	
2 = Communications mode	[online/local echo/local]
3 = (Not used)	
4 = Boot	
5 = Event clock	[on/off]
6 = Baud rate (Tx, Rx)	[50,50 thru 38400,38400]
7 (Not used)	
8 = Parity	[none/even/odd/space/mark]
9 = Bits per character	[7/8]
Page 4	
0 = Text cursor keys	[enabled/disabled]
1 = Crosshair size	[short/long]
2 = Autoscaling	[on/off]
3 = Space character	[destructive/non destructive]

A description of each setup feature follows.

Setup Page 1

1 Answerback Message

Allows a message of up to 20 characters to be entered into the terminal.

xxxxxxx The current answerback message will be cleared and the next 20 characters you type will be entered into the answerback memory. If you type less than 20 characters, press ENTER to complete the operation. "????????????????????" is the general default value.

2 Set/Clear Tabs

Allows you to set or clear tab stops currently set in the ruler which appears at the bottom of the screen. If any tab stops have been set, a letter T appears over that column in the line above the ruler. Use the left and right arrows to select the tab column you wish to alter. Use the uparrow to set, or the downarrow to clear, a tab at that column and press ENTER to complete the operation.

4 Store

Stores most current settings for the setup pages in the non-volatile memory. The previous contents of the non-volatile memory are lost, and the new contents of the non-volatile memory are retained when the terminal is re-set, or even when power is removed.

5 Recall

Recalls previously stored settings from all setup pages. This means that you can select alternate values or use the general defaults for particular jobs and then easily recall what was previously stored.

6 Select General Defaults

These are factory-set values which remain constant each time this option is selected. These values represent a commonly used configuration, and are automatically selected in the event of a non-volatile memory failure. (Use the Store/Recall procedure to produce your own permanent default settings which remain independent of the general defaults).

```
Page 1    1 = Answerback message  [??????????????????]
          9 = Screen saver        [on]

Page 2    2 = Cursor mode         [blinking block]
          3 = Margin bell         [off]
          4 = Keyclick            [on]
          5 = Emulation mode      [ANSI]
          6 = Transparent mode    [off]
          7 = Auto wrap           [off]
          8 = Auto newline        [off]

Page 3    0 = Halt on break       [on]
          2 = Communications mode [online]
          5 = Event clock         [off]
          6 = Baud rates (Tx, Rx) [9600,9600]
          8 = Parity              [none]
          9 = Bits per character  [8]

Page 4    0 = Text cursor keys    [enabled]
          1 = Crosshair size      [short]
          2 = Auto Scaling        [off]
          3 = Space Character     [off]
          (Space character is non-destructive)
```

7 Select Tab Defaults

Allows you to quickly set the tab stops to the normal setting, which is one tab stop every 8 columns, beginning at column 9.

8 Reset Terminal

Completely resets all terminal functions to those values current after the last "store" operation. Any setup features programmed but not stored will be lost. Certain self tests are executed and the screen is cleared. This function also automatically exits Setup mode.

9 Screen Saver

Screen protection feature which stops a constant image displaying on the screen.

On	If the terminal is not used for a period of approximately 100 seconds the display clears. Press SETUP twice or any other key (except CTRL, SHIFT, or CAPS LOCK) to recall the details. The screen will also reappear if any character is received from the host. General default value.
Off	Disables the screen saver function.

Setup Page 2

2 Cursor Mode

Selects the cursor style.

Blinking Block	A blinking block cursor. General default value.
Block	A non-blinking block cursor.
Invisible	A cursor that you cannot see on the screen.

(Note that the Invisible Cursor cannot be saved).

3 Margin Bell

Selects whether or not the terminal generates a bell signal when approaching the right margin of the screen.

On	Bell tone is enabled.
Off	Bell tone is disabled. General default value.

4 Keyclick

Selects whether or not the keyboard generates a click sound when a key is pressed.

On	Enables the key click. General default value.
Off	Disables the key click.

5 Emulation Mode

Selects what type of terminal your terminal emulates.

ANSI	The terminal emulates the DEC VT100 + AVO. General default value.
Extended ANSI	The terminal emulates the DEC VT100 + AVO, and also responds to extra escape sequences and controls.
VT52	The terminal emulates the DEC VT52.

6 Transparent Mode

Causes or suppresses the visibility of control characters on the screen. Used primarily for debugging purposes.

On	Allows control characters to be visible on the screen.
Off	Does not allow control characters to appear on the screen. General default value.

7 Auto Wrap

Selects the screen character-wrap display.

On	Causes any characters received after the 80th column on a line to appear at the start of the next line.
Off	Causes any characters received after the 80th column on a line to be lost. General default value.

8 Auto Newline

Selects whether the RETRN key generates a carriage return only or a carriage return and a line feed.

On	When a line feed (LF) code is received from the host, the terminal automatically appends a carriage return (CR) to it. If the RETRN key is pressed the terminal sends the characters CR and LF.
Off	A received line feed (LF) code causes only vertical movement of the cursor and when the RETRN key is pressed only a carriage return (CR) code is sent. General default value.

Setup Page 3

0 Halt on Break

Enables or disables the BREAK key from stopping the computer.

On	Allows the BREAK key, when pressed, to stop the computer, and sends it into console ODT mode. General default value.
Off	Disables the BREAK key from stopping the computer.

2 Communications Mode

Selects the communication mode between the keyboard, the terminal and the host.

Online	Keystrokes are sent to the host, which has the responsibility of sending codes back to the terminal. But the terminal can still receive, so that any characters received from the host will be processed normally. General default value.
Local Echo	Any characters typed on the keyboard will automatically appear on the screen as well as

	being sent to the host. Any characters received from the host will be processed normally as above.
Local	The terminal is logically disconnected from the host and all keystrokes are immediately executed within the terminal.

4 Boot

The terminal automatically exits from Setup mode and is forced into Online mode. The Qbus B DCOK L signal is then asserted, causing bootstrap to take place from the first online device.

5 Event Clock

This is a line-time clock for the processor.

Off	Does not drive the B EVENT L line. (Default.)
On	Pulses the B EVENT L line at 50Hz or 60Hz depending on the vertical frequency.

6 Baud Rate

The speed at which the terminal transmits and receives characters from the host.

38,400	Transmits and receives at 38400 baud.
50	Transmits and receives at 50 baud. For other possible values between the above limits refer to the Baud Rate Selection table (Appendix C).

8 Parity

Parity controls the addition of an error control bit to each character:

None	No parity check.
Even	Generates even parity.
Odd	Generates odd parity.
Space	Generates parity bit = 0.
Mark	Generates parity bit = 1.

9 Bits Per Character

The number of bits per character.

7	Generates 7 bits per character. Cannot transmit extended codes.
8	Generates 8 bits per character.

Setup Page 4

0 Text Cursor Keys

Enabled	Normal operation.
Disabled	Cursor keys will be inactive except during graphic input mode.

1 Crosshair Size

Short	Generates a small crosshair.
Long	Generates a full screen crosshair.

2 Auto Scaling

On	Causes the incoming coordinates to be divided by 1.28 before vectors or points are drawn. The screen appears to have 768 lines each containing 1024 pixels.
Off	Disables scaling. The screen becomes 800 lines of 600 pixels each.

3 Space Character

Destructive	In alphagraphics mode, the space character overwrites other characters, deleting them from the screen.
Non destructive	In alphagraphics mode, the space character merely moves the cursor.

CHAPTER 5
PVK11-G Character Encoding

This chapter describes the character encoding and the character sets associated with the PVK11-G.

5.1 Code Tables

The PVK11-G uses an 8-bit encoding scheme and a 7-bit (C1) code extension technique.

7-Bit ASCII Code Table

The PVK11-G processes characters according to the codes shown in Table 5-1. There are 128 positions corresponding to 128 character codes which are arranged in a matrix of 8 columns by 16 rows. Each row represents a possible value of the four least significant bits, and each column represents a possible value of the three most significant bits. Each character is shown with its binary, octal, decimal, and hexadecimal values.

The PVK11-G processes a received character based on the type of character as defined by ANSI. With the exception of Delete all control characters are in columns 0 and 1 of the table, and with the exception of Space (SP) all other characters are graphic characters. SP can be either a control character or a graphic character.

Graphic characters are characters that are displayed on the screen when received. The character displayed depends on the character set selection. Control characters are non-displayed single-byte codes that perform specific functions in data communications and text processing. The control characters that the PVK11-G understands are described in Chapter 7.

7-BIT ASCII CODE TABLE

TABLE 5-1

ROW	b4 b3 b2 b1	0 (b7 b6 b5 = 0 0 0)		1 (0 0 1)		2 (0 1 0)		3 (0 1 1)		4 (1 0 0)		5 (1 0 1)		6 (1 1 0)		7 (1 1 1)	
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 XON	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 XOFF	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

KEY

CHARACTER	ESC	33	OCTAL
		27	DECIMAL
		1B	HEX

7-BIT CODE

BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT Ø

3 MOST SIGNIFICANT BITS DECIMAL VALUE IS COLUMN IN CODE TABLE

4 LEAST SIGNIFICANT BITS DECIMAL VALUE IS ROW IN CODE TABLE

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Special Graphics Set

The Special Graphics Set (Table 5-2) consists of about two thirds of the ASCII graphic characters in addition to special symbols and short line segments which allow a limited range of pictures to be created.

Specific commands described in Chapter 7.2 allow the Special Graphics Set to be mapped into GL, replacing the ASCII Graphics Set. It is preferable to switch the mapping between ASCII Graphics and Special Graphics in GL as Special Graphics has most of the ASCII graphic characters. This mapping is compatible with an ANSI terminal.

U.K. National Set

The U.K. National Set (Table 5-3) has only one character that is different from the ASCII Graphics Set. This is the English Pound sign, which replaces the number sign (#) in column 2 (row 3). This set can only be used in VT52 or ANSI modes.

Table 5-2

SPECIAL GRAPHICS SET

ROW	B4 B3 B2 B1	0 (B7 B6 B5 = 0 0 0)		1 (0 0 1)		2 (0 1 0)		3 (0 1 1)		4 (1 0 0)		5 (1 0 1)		6 (1 1 0)		7 (1 1 1)	
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	♦	140 96 60	— SCAN 3	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 XON	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	▒	141 97 61	— SCAN 5	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	␋	142 98 62	— SCAN 7	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 XOFF	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	␌	143 99 63	_ SCAN 9	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	␍	144 100 64	┼	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	␊	145 101 65	┤	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	␤	146 102 66	⊥	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	±	147 103 67	┬	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	␉	150 104 68	├	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	␋	151 105 69	≤	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	┘	152 106 6A	≥	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	┐	153 107 6B	π	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	┌	154 108 6C	≠	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	└	155 109 6D	£	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	┼	156 110 6E	·	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	BLANK	137 95 5F	⎺ SCAN 1	157 111 6F	DEL	177 127 7F

← C0 CODES → ← GL CODES →

SPECIAL GRAPHICS

KEY

CHARACTER	ESC	33	OCTAL
		27	DECIMAL
		1B	HEX

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Table 5-3

UK NATIONAL CHARACTER SET

ROW	COLUMN	0		1		2		3		4		5		6		7	
	BITS b8 b7 b6 b5 b4 b3 b2 b1	0 0 0 0		0 0 0 1		0 0 1 0		0 0 1 1		0 1 0 0		0 1 0 1		0 1 1 0		0 1 1 1	
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 XON	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 XOFF	23 19 13	£	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	'	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

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KEY

CHARACTER	ESC	33	OCTAL
		27	DECIMAL
		1B	HEX

5.3 Control Functions

Control functions tell the terminal how to handle data. They can be expressed as single-byte codes, which are the C0 and C1 control characters, or as multi-byte codes. Multi-byte control codes are called escape sequences, control sequences, and device control strings.

Escape Sequences

An escape sequence is a sequence of one or more ASCII Graphic characters preceded by the C0 character ESC. ANSI standards allow two-byte escape sequences to be used as 7-bit code extensions to express each of the C1 control codes. As an example the C1 characters CSI, SS3, and IND can be expressed as follows:

C1 Character	7-Bit Extension Equivalent (escape sequence)
CSI	ESC [
SS3	ESC o
IND	ESC D

Any C1 control character can be expressed as a two-character escape sequence, where the second character of the sequence has a code that is 40 (hexadecimal) or 64 (decimal) less than that of the C1 character.

Control Sequences

A control sequence is a sequence of one or more ASCII graphic characters preceded by CSI. CSI can also be expressed as the 7-bit code extension ESC [. Therefore all control sequences can be expressed as escape sequences if the second character code is [. The following two sequences are equivalent sequences that perform the same function.

CSI ? 7 h	Causes graphic display characters entered past the right side of the screen to appear at the start of the next line.
ESC [? 7 h	As above.

Device Control Strings

A device control string is a delimited string of characters which is used in a data stream as a logical entity for control purposes. The string consists of an introducer, a data command string and a terminator.

5.4 Extended ANSI Mode

When operating in extended ANSI mode, the following conventions apply:

Codes Transmitted to the Terminal

The application can use the C0 and C1 control codes as well as the 7-bit C1 code extensions. The terminal interprets GL codes according to the graphic character mapping currently being used.

Codes Transmitted by the Terminal

Codes transmitted by a terminal come either from the keyboard or possibly in response to a command issued from the host. In extended ANSI mode, the terminal always transmits all GL graphic codes exactly as they are generated, regardless of whether the application handles 8-bit codes properly or not. However, to transmit 8-bit codes with the top bit **set**, the "EXTEND" key must be pressed.

5.5 Transparent Mode

This mode, which allows you to display control codes as graphic characters for debugging purposes, can only be invoked via Setup.

When the terminal is in Transparent mode, all control functions are displayed and most are prevented from being executed. The only exceptions are that LF, FF, and VT cause a new line (CRLF), and XOFF (DC3) and XON (DC1) maintain flow control if enabled. LF, FF, and VT are displayed before CRLF is executed, and DC1 and DC3 are displayed after execution.

CHAPTER 6
PVK11-G Transmitted Codes

This chapter summarises all the codes that the terminal transmits to a program. Key codes generated in VT52 mode are listed if they differ from those generated in the ANSI-compatible modes.

6.1 Main Keyboard Set

The main keyboard set consists of standard keys which are used to generate letters, numbers and symbols, and function keys which are used to generate special function codes.

Standard Keys

The standard keys generate alphanumeric characters either singly or in combination with other keys. The chart on the following page shows how to generate the 32 ASCII control codes from the keyboard.

How to Generate the 32 ASCII Control Codes from the Keyboard

Char	Hex	Decimal	Octal	Key(s)
NUL	00	0	000	CTRL @ or CTRL-2
SOH	01	1	001	CTRL A
STX	02	2	002	CTRL B
ETX	03	3	003	CTRL C
EOT	04	4	004	CTRL D
ENQ	05	5	005	CTRL E
ACK	06	6	006	CTRL F
BEL	07	7	007	CTRL G
BS	08	8	010	CTRL H or BACK SPACE
HT	09	9	011	CTRL I or TAB
LF	0A	10	012	CTRL J or LINE FEED
VT	0B	11	013	CTRL K
FF	0C	12	014	CTRL L
CR	0D	13	015	CTRL M or RETRN
SO	0E	14	016	CTRL N
SI	0F	15	017	CTRL O
DLE	10	16	020	CTRL P
DC1 (XON)	11	17	021	CTRL Q or NO SCRL
DC2	12	18	022	CTRL R
DC3 (XOFF)	13	19	023	CTRL S or NO SCRL
DC4	14	20	024	CTRL T
NAK	15	21	025	CTRL U
SYN	16	22	026	CTRL V
ETB	17	23	027	CTRL W
CAN	18	24	030	CTRL X
EM	19	25	031	CTRL Y
SUB	1A	26	032	CTRL Z
ESC	1B	27	033	CTRL [or ESC
FS	1C	28	034	CTRL \
GS	1D	29	035	CTRL]
RS	1E	30	036	CTRL ^ or CTRL-6
US	1F	31	037	CTRL _ (CTRL-Underline)

Refer to Appendix A for the full ASCII chart.

Keys Affected by the Control Key

Key	Action Taken When Pressed with CTRL
A - Z	Generate codes SOH ---> SUB
BREAK	Send Answerback Message
3	Print Screen
6	Send RS
[	Send ESC
]	Send GS
\	Send FS
@	Send NUL
_	Send US

In all cases CTRL-key is the same as CTRL-SHIFT-key.

Function Keys

All keys listed here generate the single ASCII codes indicated on the key caps, unless otherwise stated.

SETUP	Used to enter and exit Setup mode.
CTRL	Used in the same manner as the SHIFT key to change the meaning of certain keys.
NO SCRL	Alternatively sends XON and XOFF, which causes transmission from the host to stop and resume.
SHIFT	Used in the same manner as the SHIFT key on a typewriter.
CAPS LOCK	Causes the letters A - Z to always be transmitted as upper case.
BREAK	Transmits a short line break.
SHIFT-BREAK	Transmits a long line break.
CTRL-BREAK	Transmits the Answerback message.
CTRL-3	Extend function. Causes next keyboard character to be transmitted with the most significant bit set to a 1 instead of the normal 0.

BACKSPACE — The cursor will move one space to the left. If the cursor is already at the left margin, BACKSPACE will have no effect.

TAB — Moves the cursor to the next previously stored tab position to the right.

LINEFEED — The terminal will move the cursor down one line, scrolling up if necessary.

RETRN — Causes one or two control codes to be sent to the host system. The host usually uses this to terminate or enter an operating system command, and to move the cursor to the start of the next line.

Codes Generated by the Cursor Keys

Key	VT52 Mode		ANSI/Extended ANSI Mode	
	(Normal)	(Application)	(Normal)	(Application)
Uparrow	ESC A	ESC A	CSI A	SS3 A
Downarrow	ESC B	ESC B	CSI B	SS3 B
Rightarrow	ESC C	ESC C	CSI C	SS3 C
Leftarrow	ESC D	ESC D	CSI D	SS3 D

Note: SS3 code (Single Shift 3) is ESC O (Capital O)

6.2 Auxiliary Keypad Set

The following chart lists the character codes generated by the keypad keys in VT52 and the ANSI modes.

Key	VT52 Mode		ANSI/Extended ANSI Mode	
	(Normal)	(Application)	(Normal)	(Application)
0	0	ESC ? p	0	SS3 p
1	1	ESC ? q	1	SS3 q
2	2	ESC ? r	2	SS3 r
3	3	ESC ? s	3	SS3 s
4	4	ESC ? t	4	SS3 t
5	5	ESC ? u	5	SS3 u
6	6	ESC ? v	6	SS3 v
7	7	ESC ? w	7	SS3 w
8	8	ESC ? x	8	SS3 x

6.2 Auxiliary Keypad Set (cont.)

Key	VT52 Mode		ANSI/Extended ANSI Mode	
	(Normal)	(Application)	(Normal)	(Application)
9	9	ESC ? y	9	SS3 y
-	-	ESC ? m	-	SS3 m
,	,	ESC ? l	,	SS3 l
.	.	ESC ? n	.	SS3 n
*	ENTER	CR	ESC ? M	CR SS3 M
PF1	ESC P	ESC P	SS3 P	SS3 P
PF2	ESC Q	ESC Q	SS3 Q	SS3 Q
PF3	ESC R	ESC R	SS3 R	SS3 R
PF4	ESC S	ESC S	SS3 S	SS3 S

* In keypad normal mode, ENTER generates the same codes as RETRN. You can change the code generated by RETRN with the Line feed/New Line Mode in Setup. When reset, the Line feed/New Line mode causes RETRN to generate a single control character (CR). When set, the mode causes RETRN to generate two control characters (CR, LF).

CHAPTER 7
PVK11-G Received Codes

This chapter contains all the details needed for controlling the display, and switching between the various modes via escape sequences. It describes how the terminal interprets control codes and escape sequences received from the host system. A summary of the control and escape sequences appears in Appendix B.

7.1 Control Characters

N.B. : Chapter 7.14 (Graphics Programming) contains additional information on the following C0 control codes :
CAN, FS, GS, RS, US, EM.

The following tables show how the terminal interprets C0 and C1 control codes received from the host. The PVK11-G does not recognise all C0 and C1 control codes. Those marked as 'No action taken' are simply ignored. Refer to paragraph 7.15 for graphics specific programming details.

C0 (ASCII) Control Characters Recognised by PVK11-G

Char	Name	Hex	Decimal	Octal	Action Taken
NUL	Null	00	0	000	No action taken.
SOH		01	1	001	No action taken.
STX		02	2	002	No action taken.
ETX		03	3	003	No action taken.
EOT		04	4	004	No action taken.
ENQ	Enquiry	05	5	005	Generates the answerback message.
ACK		06	6	006	No action taken.
BEL	Bell	07	7	007	Generates bell tone.
BS	Backspace	08	8	010	Moves cursor one character position to the left. If cursor is at left margin, no action is taken.
HT	Horizontal Tab	09	9	011	Moves cursor to next tab stop, or to right margin if no more tab stops.

Char	Name	Hex	Decimal	Octal	Action Taken
LF	Line feed	0A	10	012	Generates a line feed or a new line operation.
VT	Vertical Tab	0B	11	013	Generates a line feed or a new line operation.
FF	Form Feed	0C	12	014	Generates a line feed or a new line operation.
CR	Carriage Return	0D	13	015	Moves cursor to left margin on current line.
SO	Shift Out	0E	14	016	Invokes G1 character set into GL.
SI	Shift In	0F	15	017	Invokes G0 character set into GL.
DLE		10	16	020	No action taken.
DC1	Device Control 1	11	17	021	Understood as XON. Causes terminal to resume transmission after XOFF.
DC2		12	18	022	No action taken.
DC3	Device Control 3	13	19	023	Understood as XOFF. Stops terminal transmission until XON is received.
DC4		14	20	024	No action taken.
NAK		15	21	025	No action taken.
SYN		16	22	026	No action taken.
ETB		17	23	027	No action taken.
CAN	Cancel	18	24	30	If received during an escape or control sequence, aborts the sequence and no error character is displayed. If received during a device control string, the DCS is terminated and no error character is displayed.
EM		19	25	031	No action taken.

Char	Name	Hex	Decimal	Octal	Action Taken
SUB	Substitute	1A	26	032	If received during an escape or control sequence, aborts the sequence and causes a reverse question mark to be displayed. If received during a device control sequence, the DCS is terminated and a reverse question mark is displayed.
ESC	Escape	1B	27	033	Begins an escape sequence. Terminates any escape, control or device control sequence which is in progress.
FS		1C	28	034	No action taken.
GS		1D	29	035	No action taken.
RS		1E	30	036	No action taken.
US		1F	31	037	No action taken.
DEL	Delete	FF	255	177	Ignored on input.

C1 Control Characters Recognised by PVK11-G

Char	Name	Hex	Decimal	Octal	Action Taken
IND	Index	84	132	204	Moves cursor down one line in same column. If cursor is at bottom margin, screen performs a scroll up.
NEL	Next line	85	133	205	Moves cursor to first position on next line. If cursor is at bottom margin, screen performs a scroll up.
SSA		86	134	206	No action taken.
ESA		87	135	207	No action taken.
HTS	Horizontal Tab	88	136	210	Sets one horizontal tab stop at the column where the cursor is.
HTJ		89	137	211	No action taken.
VTS		8A	138	212	No action taken.
PLD		8B	139	213	No action taken.
PLU		8C	140	214	No action taken.

Char	Name	Hex	Decimal	Octal	Action Taken
RI	Reverse Index	8D	141	215	Moves cursor up one line in same column. If cursor is at top margin, screen performs a scroll down.
DCS	Device Control String	90	144	220	Processed as opening delimiter of a device control string for device control use.
PU1		91	145	221	No action taken.
PU2		92	146	222	No action taken.
STS		93	147	223	No action taken.
CCH		94	148	224	No action taken.
MW		95	149	225	No action taken.
SPA		96	150	226	No action taken.
EPA		97	151	227	No action taken.
CSI	Control sequence Introducer	9B	155	233	Processed as control sequence introducer.
ST	String terminator	9C	156	234	Processed as closing delimiter of a string opened by DCS.
OSC		9D	157	235	No action taken.
PM		9E	158	236	No action taken.
APC		9F	159	237	No action taken.

The following shows the equivalent 7-bit code extension for each 8-bit C1 code recognised by the PVK11-G. The code extensions require one more byte than the C1 codes. Chapter 5 describes when to use C1 codes and when to use 7-bit code extensions.

Char	Code Extension
IND	ESC D
NEL	ESC E
HTS	ESC H
RI	ESC M
SS2	ESC N
SS3	ESC O
DCS	ESC P
CSI	ESC [
ST	ESC \

7.2 Character Set Selection

The PVK11-G's graphic representations consist of the following character sets:

ASCII Graphics
Special Graphics
U.K. National

These character sets are fully described in Chapter 5.2.

Character Set Designation

As illustrated in Figure 7-1, character set selection sequences are used to designate the graphic sets as G0 or G1. Locking shifts (LS0, LS1) are then used to map one of these sets into GL. The designation of the character set remains static unless the terminal receives a different character set selection sequence. All terminal locking shifts remain active until the terminal receives another locking shift.

Default mapping in Extended ANSI Mode is ASCII Graphics in GL.

Character Set	Sequence	Designation
ASCII Graphics	ESC (B	G0 (Default)
	ESC) B	G1
Special Graphics	ESC (0	G0
	ESC) 0	G1
U.K. National (ANSI mode only)	ESC (A	G0
	ESC) A	G1

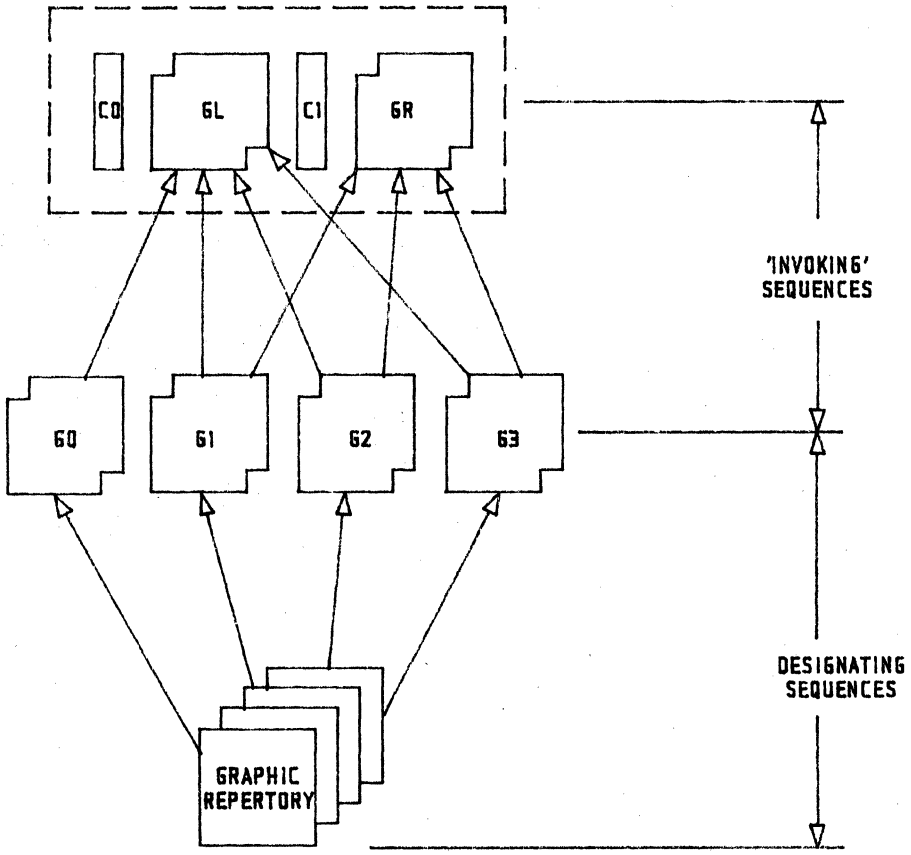
Using Lock Shifts to Invoke a Character Set

G0 or G1 can be invoked into GL by using the Lock Shift control functions.

LS0 - Lock Shift G0	SI	Invoke G0 into GL (default).
LS1 - Lock Shift G1	SO	Invoke G1 into GL.

CHARACTER SET SELECTION

FIGURE 7-1



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7.3 Terminal Modes

Some terminal modes control features which can be set up by the user, and are shown with the initials SF (Setup feature). They can be selected via Setup mode (described in Chapter 4) and cannot be changed by the host. Each mode can be set or reset individually, or in strings using 'Set Mode' or 'Reset Mode' control sequences.

Note: Pn is a variable, ASCII coded, numeric parameter.

Set Mode

CSI Ps ; .... ; Ps h — This sequence sets the ANSI modes individually or in strings. The Ps parameters listed in the next table are valid.

Reset Mode

CSI Ps ; .... ; Ps 1 — This sequence resets the ANSI modes individually or in strings. The following Ps parameters are valid.

ANSI Set/Reset Mode Parameters

0 Error (ignored)
12 Send/Receive
20 Line feed/New Line

Selectable Modes

	Name	Set Mode	Reset Mode
SF	Send/Receive	Off CSI 12 h	On CSI 12 l
SF	Line Feed/New Line	New Line CSI 20 h	Line Feed CSI 20 l
SF	Cursor Key	Application CSI ? 1 h	Cursor CSI ? 1 l
SF	ANSI/VT52	N/A	VT52 CSI ? 2 l
	Origin	Origin CSI ? 6 h	Absolute CSI ? 6 l

Selectable modes (cont.)

	Name	Set Mode	Reset Mode
SF	Auto Wrap	On CSI ? 7 h	Off CSI ? 7 l
	Auto Repeat	On CSI ? 8 h	Off CSI ? 8 l
SF	Text Cursor Enable	On CSI ? 25 h	Off CSI ? 25 l
	Keypad	Application ESC =	Numeric ESC >

NB: The last character of a sequence specified as l is lowercase L.

SF = Setup Function

Send/Receive

Set	CSI 12 h	Disables local echo. When the terminal transmits characters to the host, the host must echo characters back to the terminal display.
Reset	CSI 12 l	Enables local echo. When the terminal transmits characters, the characters are automatically sent to the terminal display.

Line Feed/New Line

Set	CSI 20 h	Causes a received LF, FF, or VT code to move the cursor to the first position of the next line. CR transmits both a carriage return and a line feed code.
Reset	CSI 20 l	Causes a received LF, FF, or VT code to move the cursor to the next line in the current column. CR transmits a carriage return code only.

Text Cursor Enable

Set	CSI ? 25 h	Causes the cursor to be visible.
Reset	CSI ? 25 l	Causes the cursor to be invisible.

Cursor Key

Set	CSI ? 1 h	Causes the cursor keys to generate "application" control functions.
Reset	CSI ? 1 l	Causes the cursor keys to generate ANSI cursor control sequences.

ANSI/VT52

Set		Not applicable.
Reset	CSI ? 2 l	Sets the terminal to VT52 mode.

Origin

Set	CSI ? 6 h	Causes cursor addressing to be relative to the top left corner of the scrolling region.
Reset	CSI ? 6 l	Causes cursor addressing to be relative to the top left corner of the screen.

Auto Wrap

Set	CSI ? 7 h	Causes graphic display characters entered past the right side of the screen to appear at the start of the next line. The display scrolls up if the cursor is at the end of the scrolling region.
Reset	CSI ? 7 l	Causes graphic display characters entered past the right side of the screen to replace the last character on the line.

Auto Repeat

Set	CSI ? 8 h	Causes a key to automatically repeat if it is pressed for longer than 0.5 second.
Reset	CSI ? 8 l	Turns off auto repeat.

Keypad

A mode ESC = When in A (Application) mode, causes the keys to generate the following codes:

Key	ANSI Mode	VT52 Mode
0	ESC O p	ESC ? p
1	ESC O q	ESC ? q
2	ESC O r	ESC ? r
3	ESC O s	ESC ? s
4	ESC O t	ESC ? t
5	ESC O u	ESC ? u
6	ESC O v	ESC ? v
7	ESC O w	ESC ? w
8	ESC O x	ESC ? x
9	ESC O y	ESC ? y
-	ESC O m	ESC ? m
,	ESC O l	ESC ? l
.	ESC O n	ESC ? n
ENTER	ESC O M	ESC ? M
PF1	ESC O P	ESC P
PF2	ESC O Q	ESC Q
PF3	ESC O R	ESC R
PF4	ESC O S	RSC S

N mode ESC > When in N (Numeric or Normal) mode, causes the auxiliary keypad keys to generate the following codes:

Key	ANSI Mode	VT52 Mode
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
-	-	-
,	,	,
.	.	.
ENTER	CR	CR
PF1	ESC O P	ESC P
PF2	ESC O Q	ESC Q
PF3	ESC O R	ESC R
PF4	ESC O S	ESC S

7.4 Cursor Positioning

Cursor Up	CSI Pn A	Moves the cursor up Pn lines in the same column. If the cursor is at the top of the scrolling region or at the top of the screen, no action takes place.
Cursor Down	CSI Pn B	Moves the cursor down Pn lines in the same column. If the cursor is at the bottom of the scrolling region or at the bottom of the screen, no action takes place.
Cursor Right	CSI Pn C	Moves the cursor to the right Pn columns. If the cursor is at the right side of the screen, no action takes place.
Cursor Left	CSI Pn D	Moves the cursor to the left Pn columns. If the cursor is at the left side of the screen, no action takes place.
Cursor Addressing		
	CSI Pl ; Pc H	Moves the cursor to line Pl, column Pc. The numbering of the lines and columns depends on the state (set/reset) of Origin Mode.
Cursor Addressing (Horizontal and Vertical)		
	CSI Pl ; Pc f	Moves the cursor to line Pl, column Pc. The numbering of the lines and columns depends on the state (set/reset) of Origin Mode.
Index	ESC D	Moves the cursor down 1 line. If the cursor is at the bottom of the scrolling region, a scroll up is performed.
Reverse Index	ESC M	Moves the cursor up 1 line. If the cursor is at the top of the scrolling region a scroll down is performed.
Next Line	ESC E	Moves the cursor down 1 line, and to column 1. If the cursor is at the bottom margin, the screen performs a scroll-up.

Save Cursor	ESC 7	Saves the following in terminal memory: Cursor position Graphic rendition Character set shift state State of wrap flag State of origin mode
Restore Cursor	ESC 8	Restores the states described above. If none of these characters was saved: the cursor moves to the home position, origin mode is reset, no character attributes are assigned, and the default character set mapping is established.

7.5 Tab Stops

Tab Set	ESC H	Sets a tab stop at the current column.
Tab Clear	CSI g	Clears tab stop at cursor position.
	CSI 0 g	Clears tab stop at cursor position.
	CSI 3 g	Clears all tab stops.

7.6 Character Rendition

Character Graphic rendition

CSI Ps ; Ps ... m

One or more character renditions may be selected at a time using this format. The delimiter (;) is not required for a single parameter. The following sequences and Ps parameter values are valid:

CSI 0 m	All attributes off
CSI 7 m	Display reverse video
CSI 22 m	Display normal intensity
CSI 24 m	Display not underlined
CSI 25 m	Display not blinking
CSI 27 m	Display positive image

7.7 Erasing

Erase in Line

Causes all erased characters within the line to be replaced with blanks. The cursor position is included in the following sequences.

CSI K	Erases from cursor to end of line.
CSI 0 K	Erases from cursor to end of line.
CSI 1 K	Erases from start of line to cursor.
CSI 2 K	Erases the entire line containing the cursor.

Erase in Display

Causes all erased characters within the screen display to be replaced with blanks. The cursor position is included in the following sequences.

CSI J	Erases from cursor to end of screen.
CSI 0 J	Erases from cursor to end of screen.
CSI 1 J	Erases from start of screen to cursor.
CSI 2 J	Erases entire screen display.

7.8 Scrolling Margins

Set Top and Bottom Margins

CSI Pt ; Pb r Causes all scrolling operations to be bounded by an upper and a lower limit. The minimum size of the scrolling region allowed is 2 lines, which means that the top margin must be at least 1 less than the number of the bottom margin.

7.9 Reports

Attributes Request

CSI c
:Asks the terminal to send a report to the host describing the terminal's class code and attributes.

CSI 0 c
:Same as above.

Response from the terminal:

CSI ? 1; 2 c
:The terminal is described as VT100 + AVO.

Terminal Status Request

CSI 5 n
:Asks the terminal to send a report to the host describing whether or not the terminal has detected any malfunctions.

Response from the **Terminal**:

CSI 0 n (If terminal functioning)

CSI 3 n(If terminal malfunctioning)

Request for Cursor Position

CSI 6 n
:Asks the terminal to send a report to the host, describing the current position of the cursor.

Response from the Terminal:

CSI l ; c R
:Where l is the current line number and c is the current column.

Identification Request

ESC Z
:Asks the terminal to send a report to the host describing the type of terminal and the options installed. (It is recommended that Status report sequence CSI 5 n is used instead of this sequence.)

Response from the **Terminal**:

ESC [? 1 ; 11 c (If in ANSI mode)

ESC / Z (If in VT52 mode)

7.10 Terminal Reset

Hard Terminal Reset ESC c

This function can be invoked at any time using the Restore function in Setup. It can also be invoked anytime by this escape sequence which causes an NVR restore. All Setup parameters are replaced by their NVR values, or power-up default values if NVR values do not exist. Parity and baud rates are restored from NVR. In addition this sequence performs the following:

Clears the screen.

Returns the cursor to the upperleft corner of the screen.

Sets the graphic rendition state to normal.

Sets the selective erase attribute write state to "non-selective erasable".

Sets all character sets to the default.

7.11 Terminal Adjustments

Adjustments ESC # 8

This sequence fills the screen with upper case E's. This pattern is used for alignment purposes.

7.12 VT52 Mode Escape Sequences

The VT52 mode allows the terminal to operate software written for VT52 terminals. In VT52 mode, while all C0 control characters are allowed, some are ignored. No C1 control characters or ANSI mode control functions are allowed. The following defines the VT52 mode escape sequences:

ESC A	Cursor Up
ESC B	Cursor Down
ESC C	Cursor Right
ESC D	Cursor Left
ESC F	Select Graphic Set
ESC G	Select ASCII Set
ESC H	Cursor to Home
ESC I	Reverse Line Feed
ESC J	Erase to End of Screen
ESC K	Erase to End of Line
ESC Y l c	Cursor Addressing *
ESC Z	Identify/What are you
ESC =	Enter Keypad Application Mode
ESC >	Enter Keypad Normal Mode
ESC <	Enter ANSI/Extended ANSI Mode

* Line Column manipulation : moves the cursor to line l, column c. l and c are single numbers with a code of the desired number + 31. This causes all codes to be "printable characters". Eg., to move the cursor to line 5, column 11:

```
l =  5 + 31 = 36 (decimal)
c = 11 + 31 = 42 (decimal)
```

36 = $ and 42 = * so the entire escape sequence would be:

```
ESC Y $ *
```

7.13 Graphics Programming

In addition to the ANSI escape/control sequences already described in this chapter, the PVK11G responds to extra control codes and escape sequences which drive the various graphic modes. There are five graphic modes available, called alphagraphic, vector, point plot, incremental point plot, and graphic input.

Alphagraphic Mode:

In alphagraphic mode, printable characters are shown on the screen in one of four sizes. A blinking underline cursor appears at the position of the next character. Certain control codes can be used to position the cursor and for various other functions as described below.

Vector Mode:

In vector mode, all printable characters are interpreted in a special way and define the endpoints for straight lines which will be drawn on the screen. Various line styles can be selected via special escape sequences. Refer paragraph 7.13.1.

Point Plot Mode:

Printable characters are interpreted in a similar way to vector mode, except that instead of drawing a line, a single point is plotted at the endpoint specified. Refer paragraph 7.13.1.

Incremental Point Plot Mode:

In this mode, certain printable characters translate into single pixel displacements in various directions. A single point is plotted for each character received. Refer paragraph 7.13.2.

Graphic Input Mode:

Graphic input mode is used to send coordinate pairs back to the host computer. A half intensity crosshair appears on the screen and it's position can be controlled via the arrow keys and the auxiliary keypad keys. When a main keyboard key is pressed, the current coordinates of the crosshair are sent to the host, and the terminal enters alphagraphic mode. Refer paragraph 7.13.3.

Control Codes Applicable to Graphics Modes

BS Moves the alphagraphic cursor one character position to the left.

HT Moves the alphagraphic cursor one character position to the right.

LF Moves the alphagraphic cursor down one line.

VT Moves the alphagraphic cursor up one line.

CR Enters alphagraphic mode from any other graphic mode. In alphagraphic mode, it moves the alphagraphic cursor to the currently defined left margin.

CAN Exits all graphic modes and resumes ANSI or VT52 mode operation.

FS Enters point plot mode.

GS Enters vector mode, and marks the next vector to be drawn as a move. This is used to position the starting point of a vector without drawing anything.

RS Enter incremental point plot mode.

US Enter alphagraphics mode.

EM Moves alphagraphic cursor to the top left corner of the screen, and resets the current margin flag.

Escape Sequences Used in Graphics Modes

ESC FF Enters alphagraphics mode, homes the alphagraphic cursor, resets character size, linestyle and current margin, and clears the graphics screen.

ESC 0 Selects normal size characters.

ESC 1 Selects double size characters.

ESC 2 Selects triple size characters.

ESC 3 Selects quadruple size characters.

ESC SUB Enters graphic input mode.

ESC ENQ Reports crosshair position to host computer.

ESC ` Selects solid lines.

ESC a Selects dotted lines.

ESC b Selects dot dash lines.

ESC c Selects short dash lines.

ESC d Selects long dash lines.

ESC x Selects user defined pattern 1.

ESC y Selects user defined pattern 2.

ESC z Selects user defined pattern 3.

ESC / 0 d Sets drawing mode to dots on.

ESC / 1 d Sets drawing mode to dots off.

ESC / 2 d Sets drawing mode to complement.

ESC / 3 d Sets drawing mode to replace by pattern.

In the three user defined line style escape sequences which follow, n is a decimal integer in the range 0 <= n <= 65535 :

ESC / n a Sets user defined pattern 1 to n.

ESC / n b Sets user defined pattern 2 to n.

ESC / n c Sets user defined pattern 3 to n.

Specific Keyboard Controls Used in Graphics Modes

CTRL-K Moves the alphagraphic cursor up one line.

CTRL-X Exits all graphics modes and resumes ANSI or VT52 mode operation.

CTRL-\ Enters point plot mode

CTRL-] Enters vector mode, and marks the next vector to be drawn as a move. this is used to position the starting point of a vector without drawing anything.

CTRL-^ Enters incremental point plot mode.

CTRL-6 As above.

CTRL-_ Enters alphagraphic mode.

CTRL-Y Moves alphagraphic cursor to the top left corner of the screen, and resets the current margin flag.

7.13.1 Vector Mode and Point Plot Mode Encoding

In these modes, a point is encoded into 4 characters. Only the 7 low order bits of the character are significant to the encoding. Each point consists of an x coordinate and a y coordinate. Each coordinate consists of a low byte and a high byte, with 5 bits of the actual coordinate encoded into each byte. The two high order bits represent a tag which differentiates between the different bytes. The bytes are encoded as follows:

Character Bits							Function
6	5	4	3	2	1	0	
0	1	y9	y8	y7	y6	y5	High 5 bits of y coordinate.
1	1	y4	y3	y2	y1	y0	Low 5 bits of y coordinate.
0	1	x9	x8	x7	x6	x5	High 5 bits of x coordinate.
1	0	x4	x3	x2	x1	x0	Low 5 bits of x coordinate.

After entering vector mode with the GS control code, and sending the coordinates of the first point, it is only necessary to send those bytes which have changed for subsequent points. However, the low x byte must always be sent as it initiates the drawing of the vector, and if the high x byte has changed then the low y byte must also be sent in order for the terminal to be able to differentiate between the high x and high y bytes, which have the same tag bits.

In vector mode, sending the coordinates of a point causes one of two possible actions. First, if the previous character was a GS then no vector is drawn, and the coordinate is simply stored internally as the "from" coordinate. Otherwise, a vector is drawn from the previously stored "from" coordinate to the newly received coordinate, and the new coordinate is stored into the "from" coordinate.

In point plot mode, a point is plotted for every coordinate pair received.

7.13.2 Incremental Point Plot Mode Characters

Character	Function
Space	Pen up. Subsequent points are move only.
P	Pen down. Subsequent points are drawn.
D	Plots a point to the North of the current point.
H	Plots a point to the South of the current point.
A	Plots a point to the East of the current point.
B	Plots a point to the West of the current point.
E	Plots a point to the Northeast of the current point.
I	Plots a point to the Southeast of the current point.
F	Plots a point to the Northwest of the current point.
J	Plots a point to the Southwest of the current point.

7.13.3 Graphic Input Mode

In graphic input mode, a crosshair appears on the screen, and can be used by the operator to indicate a certain part of the picture to the host computer. The crosshair can be moved up, down, left, and right by the arrow keys. It can also be moved by the auxiliary keypad keys according to the following table.

Key	Direction
1	down left
2	down
3	down right
4	left
6	right
7	up left
8	up
9	up right

If the numeric keypad keys or the arrow keys are pressed once, the crosshair moves by one pixel. If the keys are held down and allowed to auto repeat, then the crosshair moves in increments of ten pixels. This allows rapid positioning of the crosshair to anywhere on the screen.

The numeric keypad 5 key also has a special function in graphic input mode. When it is pressed, any text displayed in ANSI or VT52 mode will be blanked. This allows a clear view of the graphic image when text and graphics overlay the same area. Pressing the 5 key again will restore the text.

Format of Graphic Input Mode Reports

There are two reports generated for reporting the position of the crosshair. One is generated by the operator when in GIN (Graphic Input) mode and the other is generated on request from the host computer. The two reports differ only in that if the report is generated by the operator in GIN mode, the key struck by the operator is sent first, and then the crosshair coordinate report is sent in the normal manner.

Character Bits							Function
6	5	4	3	2	1	0	
?	?	?	?	?	?	?	If present, this byte is the code of the key struck by the operator.
0	1	x9	x8	x7	x6	x5	High 5 bits of the x coordinate.
0	1	x4	x3	x2	x1	x0	Low 5 bits of the x coordinate.
0	1	y9	y8	y7	y6	y5	High 5 bits of the y coordinate.
0	1	y4	y3	y2	y1	y0	Low 5 bits of the y coordinate.
0	0	0	1	1	0	1	CR (ASCII Carriage Return code)
0	0	0	0	1	0	0	EOT (ASCII End Of Text code)

Screen Geometry

The PVK11-G screen is an array of 600 lines each containing 800 pixels (dots). Each pixel is defined by a coordinate pair x,y where x is the number of pixels from the left edge of the screen and y is the number of pixels up from the bottom of the screen. In setup mode, it is also possible to invoke auto scaling. This causes the incoming coordinates to be divided by 1.28 before vectors or points are drawn. When auto scaling is invoked, the screen appears to have 768 lines each containing 1024 pixels. The reported coordinates of the crosshair are also modified accordingly.

CHAPTER 8
PVK11-G Functional description

This section describes the general operation of each principal logic function of the PVK11-G.

8.1 Microprocessor

The microprocessor used is the Motorola 68B09, a high performance 8-Bit NMOS microprocessor. The on-chip crystal oscillator is used with a 7.3278 MHz crystal. This frequency was chosen as it can conveniently be used to generate baud rates for communications.

On power-up, RESET/ is generated by R5 which is an ICL8211 voltage detector. This chip pulls RESET/ low until the +5V supply reaches approximately 4.7V. An 820K ohm positive feedback resistor provides hysteresis to prevent oscillation as the +5V rises and falls.

When RESET/ goes high, indicating that there is now enough voltage, the 6809 reads a 16 bit word from memory locations $FFFE,$FFFF which are the last two locations in the 64K byte address space. Address bit A15 inverted, selects the program ROM C4 for any address in the top 32K of memory. This causes the 16 bit word to be read from the last two locations in the ROM. The 6809 loads this 16 bit value into its program counter and then begins executing code at that address. Whenever RESET/ is low, the 6809 outputs address $FFFE, which selects the ROM, and reads back the high 8 bits of the reset address.

As stated above, address bit A15 selects the program ROM when high. When it is low, it selects the address decoder E3, which is a 74LS139. This decoder receives A14 and A13 to divide the bottom 32K of memory into 4 x 8K banks.

Bank 0, addresses $0000-$1FFF, is the C-RAM. Bank 1, addresses $2000-$3FFF is the DUART. Bank 2, addresses $4000-$5FFF is the NOVRAM. Bank 3, addresses $6000-$7FFF, is further divided into 4 x 2048 byte pages.

Page 0, addresses $6000-$67FF, selects the 9007 CRT controller. Page 1, addresses $6800-$6FFF, selects the 7220 graphic display controller. Page 2, addresses $7000-$77FF, generates the NVR store command (see below) and Page 3, addresses $7800-$7FFF, selects the auxiliary control latch.

These address assignments are summarised in Table 8-1.

Table 8-1
Address Assignments

Address Hex	Signal	Function/Device
0000-1FFF		C-RAM
2000-3FFF	DUART/	DUART
4000-5FFF	NOVRAM/	NOVRAM
6000-67FF		9007 CRT Controller
6800-6FFF	GDC/	7220 Graphic Display Controller
7000-77FF	STORE/	NOVRAM Store Command
7800-7FFF		Auxiliary Control Latch

8.2 DMA Operation

The 9007 initiates the DMA operation by asserting DMAR (DMA request) which is inverted by M2, driving the 6809 HALT/ input low. This halts the 6809 at the completion of the current instruction. When the 6809 has halted and placed the bus in high impedance mode, it asserts BA (Bus available) which drives the ACK (DMA acknowledge) input to the 9007, which allows the 9007 to commence transferring data. BA also connects, through inverter F3, to OR gate E2. This forces the RAM to be enabled during DMA. BA also drives one of the chip select inputs of the ROM, inhibiting the ROM during DMA.

As the 6809 bus assumes the high impedance state, address bit A15 is pulled high by a pullup resistor. This disables address decoder E3, preventing any spurious accesses to any of the devices it selects. As the R/W (Read/Write) output from the 6809 also floats during DMA, another pullup resistor is used to force this signal into the READ (high) state during DMA.

Gate E2 converts R/W and E from the 6809 into RD/ and WR/ for those devices which require these 8080 style signals.

8.3 Peripherals

DUART

The 2681 is an LSI device containing the equivalent of two UARTs (Universal Asynchronous Receiver Transmitter), two programmable baud rate generators, and one counter timer circuit. One of the UART channels communicates with the keyboard at 300 baud, and the other communicates with the host computer at various rates.

The 2681 contains 16 programmable registers. The clock to the 2681 is the exclusive-or of the 6809 E & Q outputs. These are square waves, 90 degrees apart in phase, at 1/4 of the 6809 crystal frequency. Thus the 2681 clock is 1/2 of the 6809 crystal frequency or 3.6864 MHz. The interrupt request from the 2681 connects directly to the 6809 FIRQ (Fast interrupt request) input. The keyboard receive and transmit signals KBRX and KBTX connect directly to the keyboard with no drivers or receivers. The main port receive signal MPRX comes from an integrated line receiver U5 which is a 9637. U5 converts incoming RS232 levels into TTL levels for the 2681. The main port transmit data signal MPTX drives one side of S5, an LM393 comparator used as a line driver. This device has a reference voltage, generated by a diode and resistor, connected to its Pin 3. As MPTX crosses this threshold, the LM393 output, TXD, swings between +12V and approximately -8 volts. Note that this driver is not intended to drive long lines, and it is not short circuit proof. The negative voltage is generated by V2 an ICL7660 integrated charge pump circuit. As the 7660 cannot withstand the full 12 Volt input, the 12 Volt supply is dropped to 9.5 Volts by an LM336 reference diode.

NOVRAM

The NOVRAM is a XICOR type X2212P non-volatile memory. This device is of the shadow RAM type in which a normal static RAM is coupled to a non-volatile RAM of the same size. The RECALL operation copies the contents of the non-volatile RAM into the static RAM all at once. The STORE operation copies the static RAM into the non-volatile RAM. The non-volatile RAM retains its memory even when power is removed. The 2212 needs to be protected during power outages, otherwise spurious stores might occur. This protection is accomplished by the 8211 voltage detector and transistor array U6, a type 3086. When the supply voltage begins to fall, the 8211 instantly clamps RESET/ to ground. This causes the 3086 to clamp the AR/ (Array recall) to ground. The 2212 cannot initiate a store while AR/ is low. Once the supply voltage is below 3V, the 2212 protects itself.

CRT Controller

The CRT controller is an SMC type CRT9007. It generates timing signals for keeping the CRT refreshed, and generates Horizontal and Vertical sync for the monitor. The 9007 has 32 on-board registers for containing the various display parameters. The basic job of the 9007 is to read the screen data from the RAM, and load the characters into the ROW buffer. Other signals from the 9007 control the cursor and CRT blanking. The 9007 generates an interrupt once every vertical period (60 Hz). This interrupt is used for various timing functions. As the interrupt is the wrong level for the 6809, and is not open drain, it goes through an open collector inverter, V4, to the 6809 FIRQ/ input. During DMA the 9007 drives the address bus. At other times, the address bus bits A0 - A5 are inputs to select the registers within the 9007.

8.4 7220 Graphic Display Controller

The 7220 is used to maintain the data in the graphic memory. As far as the 6809 is concerned, it consists of two readable registers and two writeable registers. As the 7220 has no chip select input, its chip select must externally be combined with the RD/ and WR/ signals. This is done in gate J3. The 7220 does no DMA to the 6809 bus and generates no interrupts.

8.5 Character Video Generation

The PVK11-G generates a character display of 24 rows of 80 characters each. Each character is 10 pixels wide and 24 pixels high. As there are 600 lines in the raster, and only 576 used, there is room for one extra row of characters. This row is not used.

The pixel clock is the master clock of 19.734 MHz. This is divided by state machine S3/R3 by a factor of 10. This gives CSRLD/ (character shift register load) and CCLK (character clock).

CCLK reads characters out of the row buffer, K4, through the character generator M5, a 2732A EPROM, and they are directly latched by the character shift register, R6.

The pixel clock shifts the characters out of the shift register R6, through the dot stretcher R4/J3, and into latch R4. From R4, the pixels go through video mixing ROM S6, are latched again by R4, and finally drive the monitor through V4. The function of S6 is to take all the various video signals and combine them into a single output. The input signals are character video, graphic video, cursor, character blanking, and character attribute. S6 produces a video output on two output pins. These two signals are mixed with resistors to provide an analog video signal for driving the monitor.

8.6 Graphic Video Generation

The PVK11-G generates a graphic display of 800 x 600 pixels. To do this it generates an interlaced display at 60 Hz. (Total picture repeated at 30 Hz rate.) All the monitor timing signals are derived from the character CRT controller, the 9007. The graphic display controller is slaved to the 9007, and generates its own raster in exact synchronism.

The 7220 generates all the timing signals needed to interface the raster memory, which is constructed from 64K DRAMs. Latches A1 and C2 latch the 16 bit address put out by the 7220 on its address/data bus. These latches are enabled onto the DRAM address bus 8 bits at a time in conjunction with RAS/ and CAS/. When the 7220 wants to write to the RAM, it asserts DBIN/. All data going into the RAM is routed through or generated by the 7220. Latch M3 delays the 7220 DBIN/ signal and feeds it to the state machine U2/U3 which uses it to generate GW/, the write strobe for the DRAMs. The DRAMs have separate input and output buses because they are used in read modify write mode.

During a read, 16 bits of data from the DRAMs are gated through tri-state buffers N2 and F2 back onto the 7220 A/D bus. They are also parallel loaded into the two graphic shift registers S2/J2. The 16 bits of graphic data are shifted out of the shift registers by dot clock. They are combined with the graphic blanking signal before being sent to the video mixing PROM, S6. S6 decides whether to display a graphic pixel or a character pixel at any location. RAS/ is generated directly by the 7220. CAS/ is generated from RAS/ by S4. RAS/ delayed is used as the row/column address multiplexing signal. VSYNC from the 9007 is fed into the 7220 VSYNC pin. During initialisation, the 7220 monitors this pin and synchronises its internal circuits to it. Thereafter the two controllers remain synchronised.

8.7 Qbus Logic

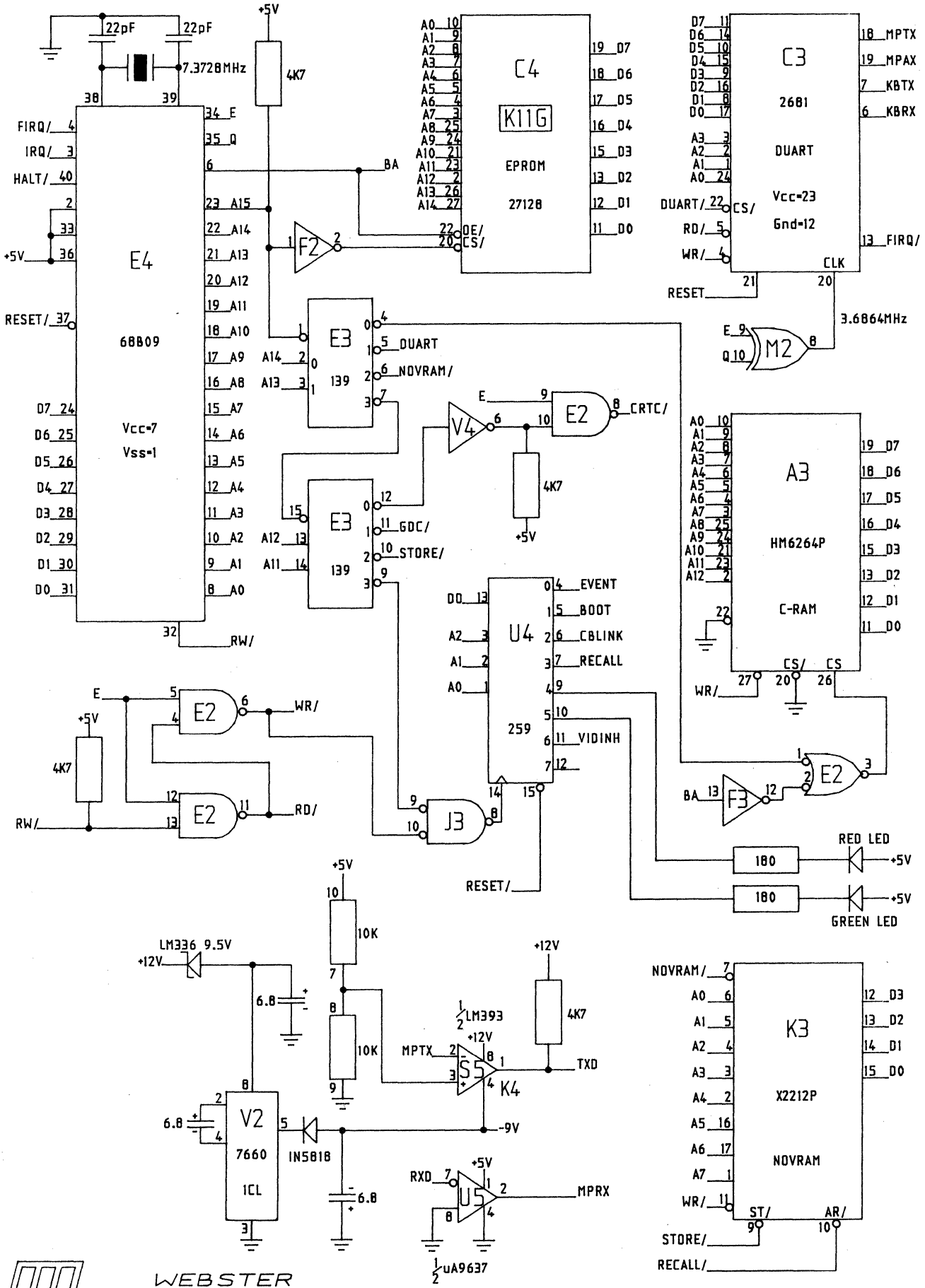
Three Qbus signals ar connected to the PVK11-G. There are two outputs, B EVENT L and B DCOK H, and one input S RUN L.

The two outputs are driven by transistors from array V6, a type 30B6. B EVENT L is derived from the vertical sync interrupt and always runs at 60Hz. It can be logically disconnected via a setup option. This signal is used for various time keeping purposes in Qbus systems.

B DCOK H is the Qbus bootstrap initiating signal. When pulsed low, the Qbus CPU begins its bootstrap procedure. B DCOK H is pulsed low at power up, and can be caused to pulse via the setup display.

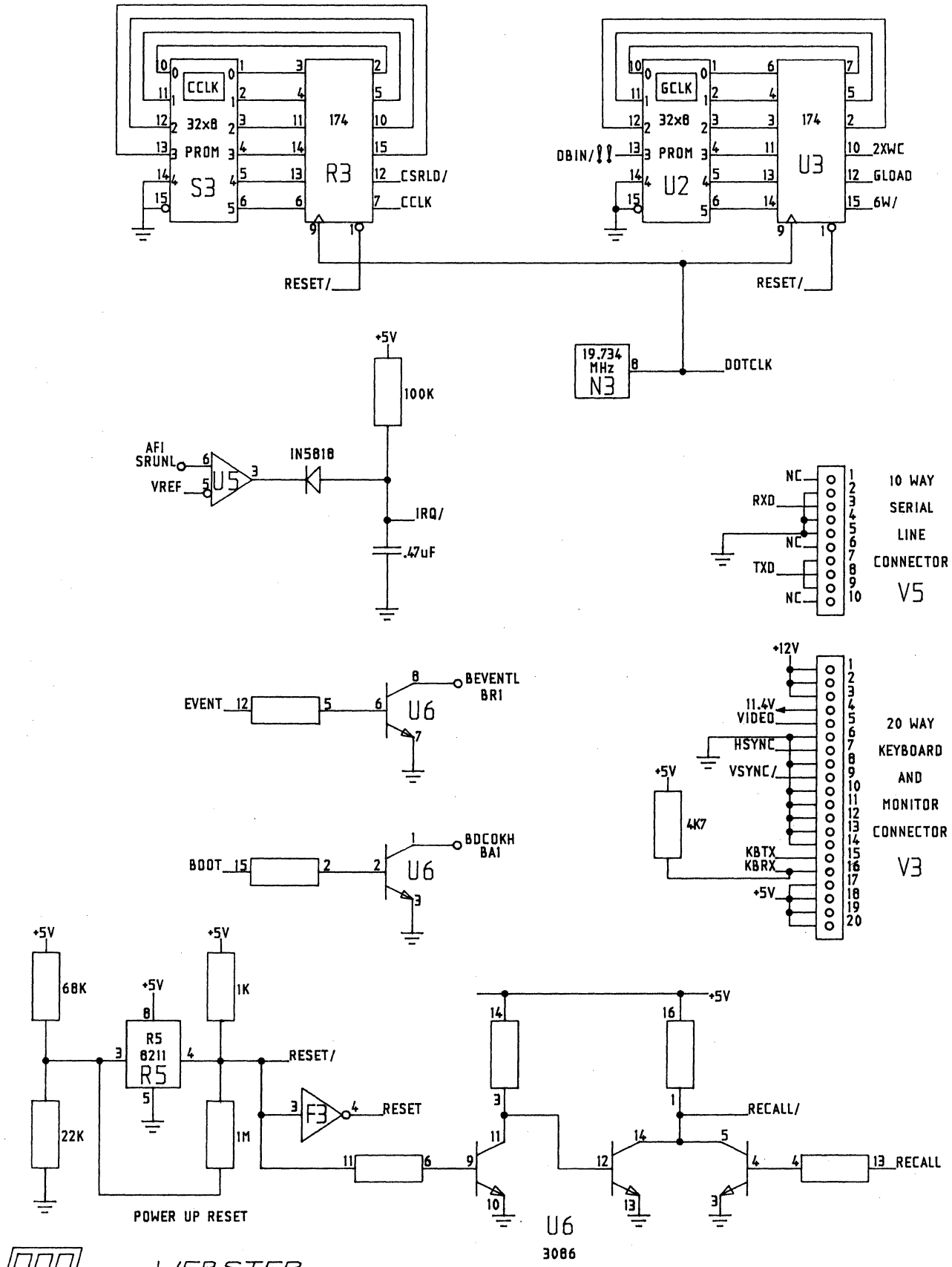
S RUN L is received by U5, an integrated line receiver. The output of the receiver drives an integrator which is kept reset whenever the Qbus CPU is running. When the S RUN L pulses stop, the integrator capacitor charges up to +5V. The capacitor is connected to the 6809 IRQ input. The 6809 tests to see if IRQs are being generated. It uses this information to illuminate a lamp on the keyboard to indicate that the Qbus CPU is alive.

CHAPTER 9
PVK11-G Circuit Diagrams



WEBSTER COMPUTER CORPORATION

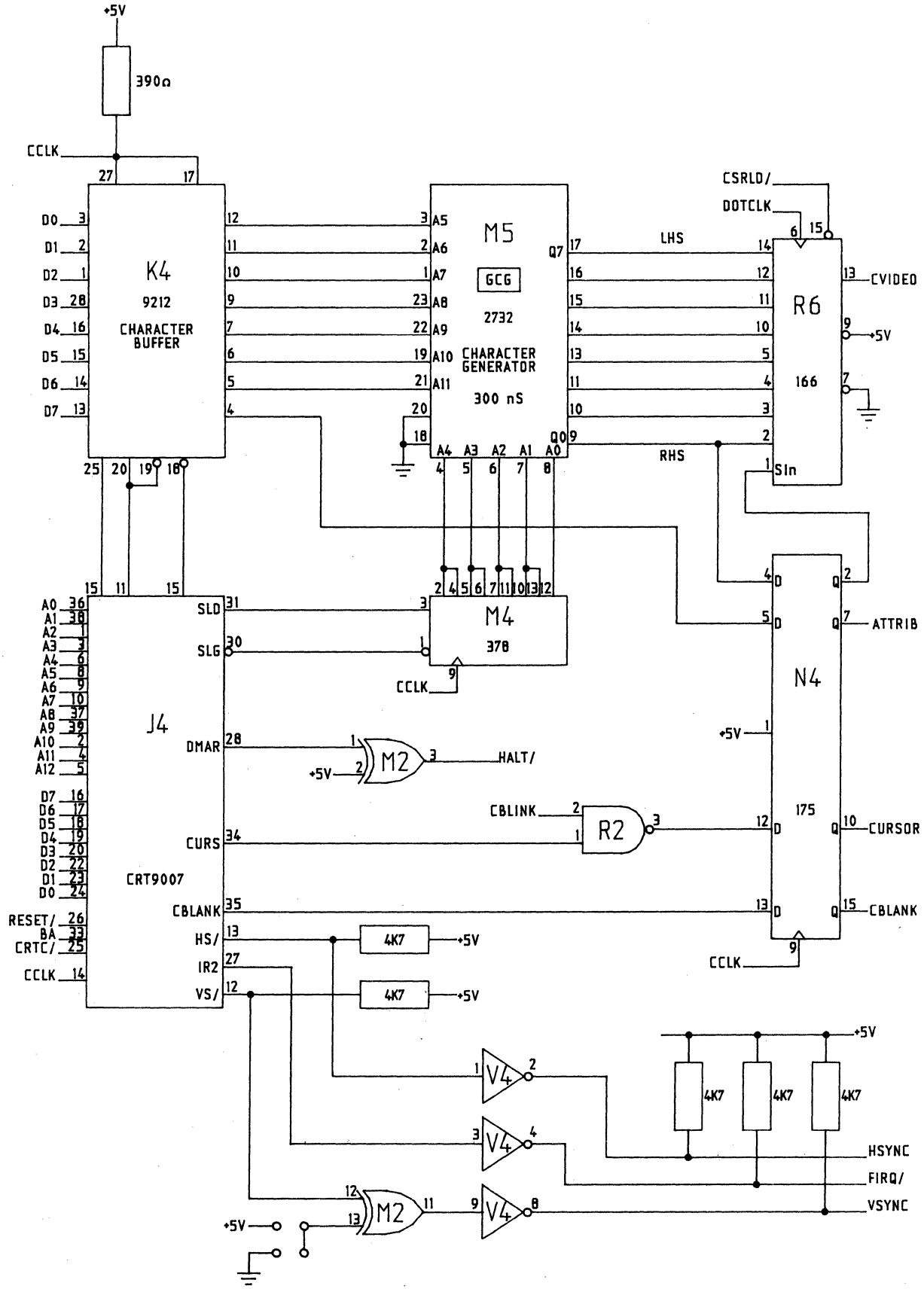
PVK11-G
CPU AND MEMORY



WEBSTER COMPUTER CORPORATION

PVK11-G
CLOCK GENERATORS

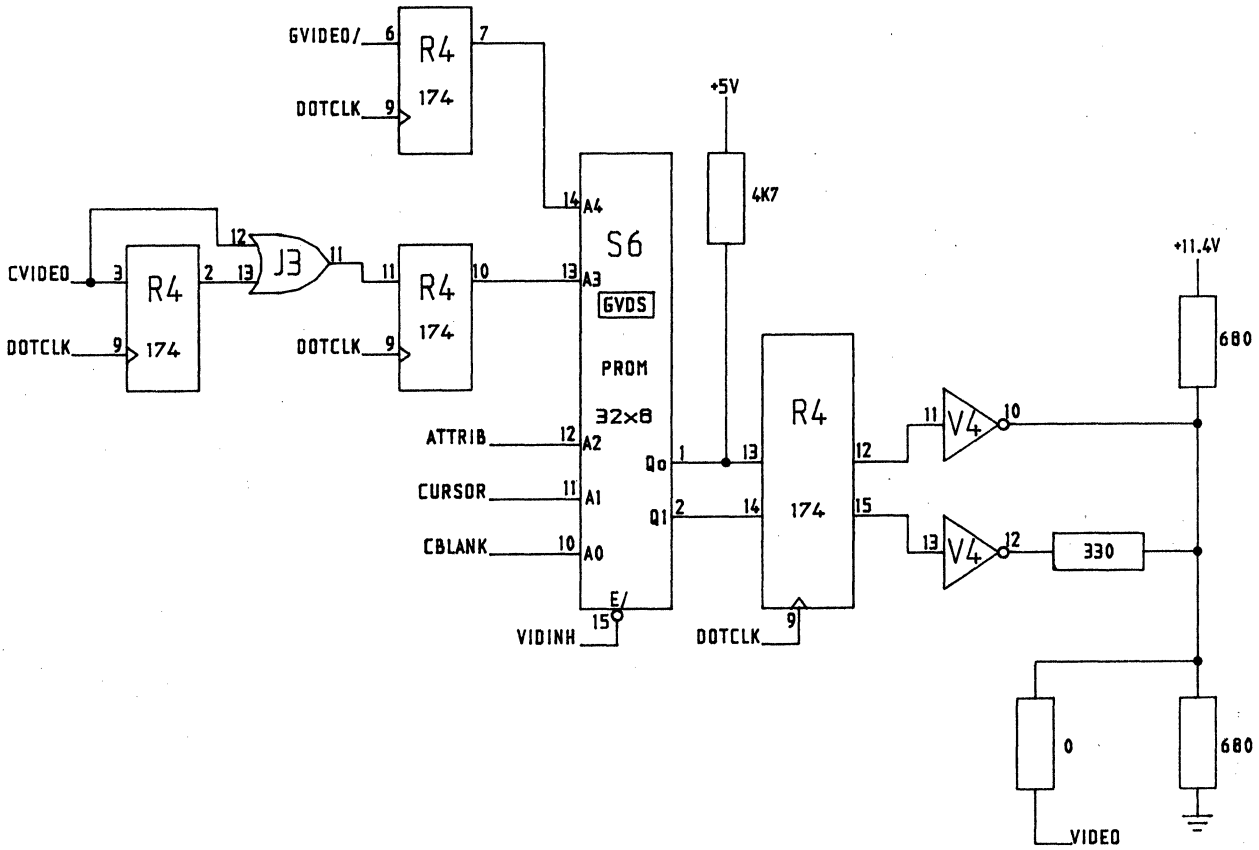
SHEET 2 OF 6

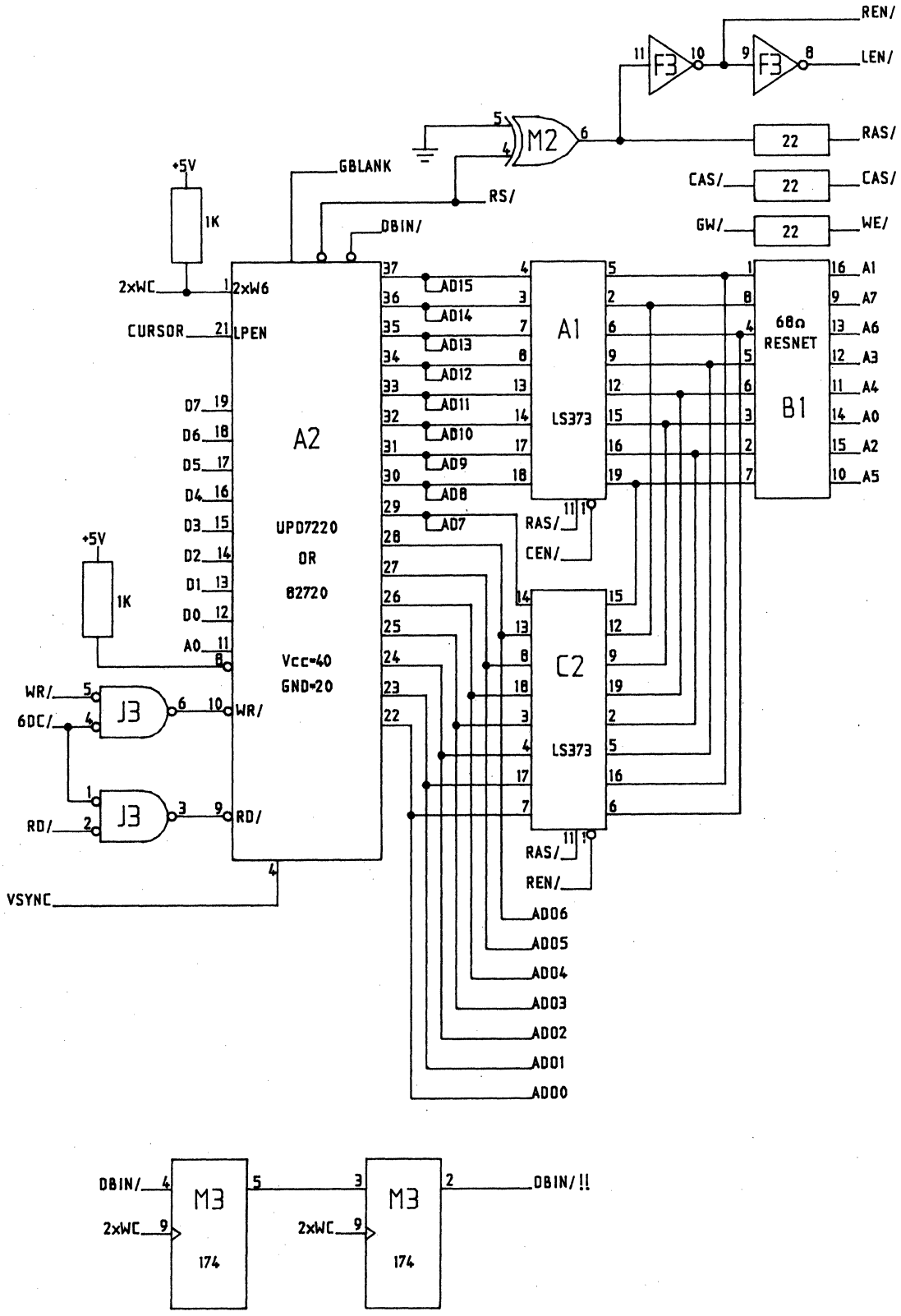


WEBSTER COMPUTER CORPORATION

PVK11-G
CHARACTER CONTROLLER

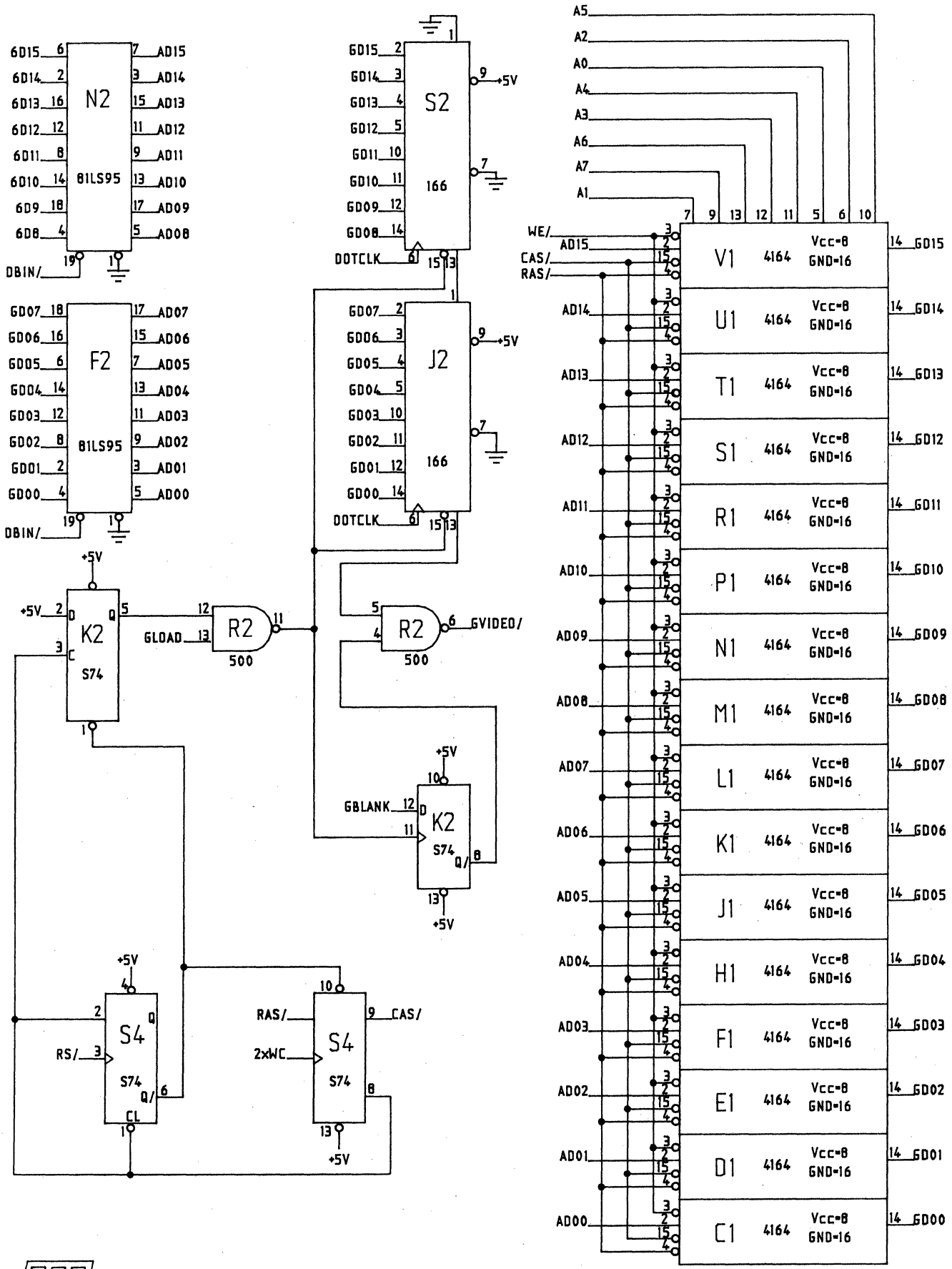
SHEET 3 OF 6


GVIDEO/
DOTCLK
R4
174
+5V
4K7
S6
GVDS
PROM
32x8
A4
A3
A2
A1
A0
Qo
Q1
E/
CVIDEO
J3
ATTRIB
CURSOR
CBLANK
VIDINH
+11.4V
680
V4
330
0
VIDEO



WEBSTER COMPUTER CORPORATION

PVK11-G
GRAPHIC CONTROLLER



WEBSTER COMPUTER CORPORATION

PVK11-G
SCREEN BUFFER

SHEET 6 OF 6

CHAPTER 10
PVK11-G Installation

10.1 PVK11-G Installation Procedures

The PVK11-G can be installed in any Qbus slot. It passes all interrupt and DMA requests straight through, so it has no effect on device priority within the backplane. To install the module, the following steps are necessary.

1. Remove power from the backplane. Do not install or remove Qbus modules while power is applied.

2. It is physically possible to install the module the wrong way around. However, most backplanes have a mechanical ridge which prevents a reversed module from being fully inserted. Ascertain which way to insert the module.

3. Decide which backplane slot you will plug the module into. Take care with the routing of cables from the PVK11-G and any other modules with cables. Select an arrangement which simplifies the cabling.

4. Insert the PVK11-G into the selected backplane slot. Using the handles on the module, press until the module edge connectors are firmly seated in the backplane. The module should plug in completely, and be flush with the other modules in the backplane. If the module protrudes, it has not been seated correctly. Correct it before proceeding.

5. Install the serial line connector into J0 at the handle end of the PVK11-G. This connector is wired so that a standard 10-way IDC type flat cable can be used to connect it to a DEC DL type serial line controller, such as a DLV11-J.

6. Install the monitor/keyboard cable into J1 at the handle end of the module. Refer paragraph 10.2 below for a detailed explanation of the wiring and interfacing of monitors and keyboards.

7. Check all connections before proceeding. If you have used non-polarised IDC connectors, check that the connections to the monitor and keyboard are correct. Failure to do so may result in damage to monitor, keyboard, cables, PVK11-G, or the backplane.

8. Apply power to the backplane. If you are using the recommended keyboard, you should see at least one LED illuminate. If not, the module has been incorrectly connected. In addition, when

power is applied, you should see a red and a green lamp illuminate at one corner of the module. If neither light comes on, the module has been installed incorrectly. Correct the problem now.

9. After approximately 1 minute you should be able to get a display on your screen. The module always powers up with its cursor enabled so at least a cursor should be visible in the top left corner of the screen.

10.2 Monitor and Keyboard Interfacing

The PVK11-G module is intended to interface to a video monitor which has a separate sync, and an industry standard 10-way edge connector. The signals from the PVK11-G to the monitor are via a 10-way flat cable. An option, the PRC1 is available.

The PRC1 consists of a connector to mate with the 10-way monitor edge connector, a connector to mate with the 10-way flat cable, a voltage regulator/filter circuit, and a brightness control. The PRC1, PVK11-G, and monitor are connected according to the scheme shown on the next page (Figure 10-1).

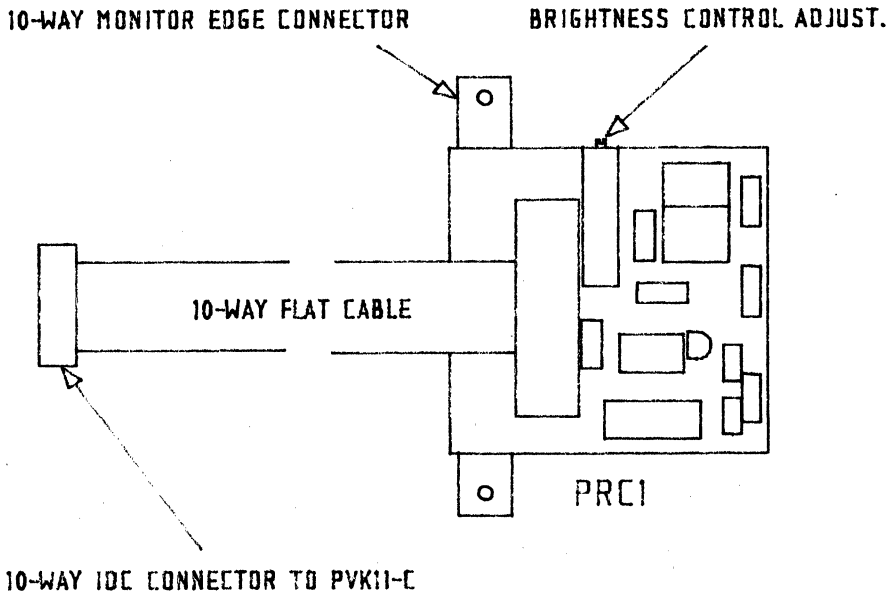
Serial Line Connector : 10-way IDC

1	NC	6	NC
2	Ground	7	Connected to 9
3	Received data	8	Transmitted data
4	Ground	9	Connected to 7
5	Ground	10	NC

Keyboard/Video Connector : 20-way IDC

1	+12V	11	Ground
2	+12V power to	12	Ground
3	+12V monitor	13	Ground
4	+VIN (connect to +12V externally	14	Ground
5	Video out	15	Data transmitted to keyboard
6	Ground	16	Data received from keyboard
7	Horizontal sync	17	+5V power to keyboard
8	Ground	18	+5V power to keyboard
9	Vertical sync	19	+5V power to keyboard
10	Ground	20	+5V power to keyboard

FIGURE 10-1



Notes:

1. The PRC1 feeds regulated voltage to the monitor and the PVK11-G video driver. This is to reduce display disturbances caused by electrical noise or the Qbus +12V supply.

2. If a monitor with its own AC power supply is used, eg., many 110 degree types, use caution. Many of these monitors feed DC voltage out of Pin 7 of the monitor edge connector. This voltage is usually about +70V DC. Do not connect such a monitor to the PRC1 or PVK11-G without first cutting the connection to Pin 7 of the monitor edge connector.

CHAPTER 11
PVK11-G Troubleshooting Guide

If you are experiencing problems, and you suspect that the PVK11-G is faulty, check the symptoms in the following list.

Symptom	Check
No display, no keyboard lights	1. Is power correctly applied? 2. Are cables installed in PVK11-G?
No display, keyboard OK	1. Is brightness level on monitor adjusted correctly? 2. If you have an AC monitor, does it have power applied? 3. Are cables from PVK11-G to PRC1, and from PRC1 to monitor, OK and connected properly?
Display OK, no keyboard lights	1. Check cable from PVK11-G to keyboard.
No communication	1. Check baud rate, stop bits, parity, Online/Local. 2. Check cable from PVK11-G to serial line controller
Display rolling	1. Check monitor vertical and horizontal hold controls

APPENDIX A
ASCII Chart

Hex	Decimal	Octal	Symbol	Description
00	0	000	NUL	Null
01	1	001	SOH	Start of Heading
02	2	002	STX	Start of Text
03	3	003	ETX	End of Text
04	4	004	EOT	End of Transmission
05	5	005	ENQ	Enquiry
06	6	006	ACK	Acknowledge
07	7	007	BEL	Bell
08	8	010	BS	Backspace
09	9	011	HT	Horizontal Tabulation
0A	10	012	LF	Line Feed
0B	11	013	VT	Vertical Tabulation
0C	12	014	FF	Form Feed
0D	13	015	CR	Carriage Return
0E	14	016	SO	Shift Out
0F	15	017	SI	Shift In
10	16	020	DLE	Data Link Escape
11	17	021	DC1	Device Control 1
12	18	022	DC2	Device Control 2
13	19	023	DC3	Device Control 3
14	20	024	DC4	Device Control 4
15	21	025	NAK	Negative Acknowledge
16	22	026	SYN	Synchronous Idle
17	23	027	ETB	End of Transmission Block
18	24	030	CAN	Cancel
19	25	031	EM	End of Medium
1A	26	032	SUB	Substitute
1B	27	033	ESC	Escape
1C	28	034	FS	File Separator
1D	29	035	GS	Group Separator
1E	30	036	RS	Record Separator
1F	31	037	US	Unit Separator

ASCII Chart (Continued)

Hex	Decimal	Octal	Symbol	Description
20	32	040	SP	Space Bar
21	33	041	!	Exclamation Point
22	34	042	"	Quotation Marks
23	35	043	#	Number Sign
24	36	044	$	Dollar Sign
25	37	045	%	Percent Sign
26	38	046	&	Ampersand
27	39	047	'	Closing Quotation Mark/Apostrophe
28	40	050	(	Opening Parenthesis
29	41	051	)	Closing Parenthesis
2A	42	052	*	Asterisk
2B	43	053	+	Plus
2C	44	054	,	Comma
2D	45	055	-	Hyphen/Minus
2E	46	056	.	Period/Decimal Point
2F	47	057	/	Slant
30	48	060	0	Zero
31	49	061	1	
32	50	062	2	
33	51	063	3	
34	52	064	4	
35	53	065	5	
36	54	066	6	
37	55	067	7	
38	56	070	8	
39	57	071	9	
3A	58	072	:	Colon
3B	59	073	;	Semicolon
3C	60	074	<	Less Than
3D	61	075	=	Equals
3E	62	076	>	Greater Than
3F	63	077	?	Question Mark

ASCII Chart (Continued)

Hex	Decimal	Octal	Symbol	Description
40	64	100	@	Commercial At
41	65	101	A	
42	66	102	B	
43	67	103	C	
44	68	104	D	
45	69	105	E	
46	70	106	F	
47	71	107	G	
48	72	110	H	
49	73	111	I	
4A	74	112	J	
4B	75	113	K	
4C	76	114	L	
4D	77	115	M	
4E	78	116	N	
4F	79	117	O	
50	80	120	P	
51	81	121	Q	
52	82	122	R	
53	83	123	S	
54	84	124	T	
55	85	125	U	
56	86	126	V	
57	87	127	W	
58	88	130	X	
59	89	131	Y	
5A	90	132	Z	
5B	91	133	[	Opening Bracket
5C	92	134	\	Reverse Slant
5D	93	135	]	Closing Bracket
5E	94	136	^	Circumflex
5F	95	137	_	Underline

ASCII Chart (Continued)

Hex	Decimal	Octal	Symbol	Description
60	96	140	`	Opening Quotation Mark/Grave
61	97	141	a	
62	98	142	b	
63	99	143	c	
64	100	144	d	
65	101	145	e	
66	102	146	f	
67	103	147	g	
68	104	150	h	
69	105	151	i	
6A	106	152	j	
6B	107	153	k	
6C	108	154	l	
6D	109	155	m	
6E	110	156	n	
6F	111	157	o	
70	112	160	p	
71	113	161	q	
72	114	162	r	
73	115	163	s	
74	116	164	t	
75	117	165	u	
76	118	166	v	
77	119	167	w	
78	120	170	x	
79	121	171	y	
7A	122	172	z	
7B	123	173	{	Opening Brace
7C	124	174	|	Vertical Line
7D	125	175	}	Closing Brace
7E	126	176	~	Tilde
7F	127	177	DEL	Delete

APPENDIX B
PVK11-G Programming Summary

The CSI control sequences and the Escape sequences described in Chapter 7 are summarised here for your convenience. These sequences appear in the same order as when originally documented.

ANSI/Extended ANSI Mode Sequences:

	Sequence	Page Reference
Character Sets:		38
G0 is U.K. set	ESC (A	
G1 is U.K. set	ESC) A	
G0 is ASCII set	ESC (B	
G1 is ASCII set	ESC) B	
G0 is Special Graphics set	ESC (0	
G1 is Special Graphics set	ESC) 0	
Character Sets (Lock Shift):		38
G0 into GL	SI	
G1 into GL	SO	

	Sequence		Page Reference
Terminal Modes:			
Set Mode	CSI Ps ; .... ; Ps h		40
Reset Mode	CSI Ps ; .... ; Ps l		40
	Set	Reset	
Send/Receive	CSI 12 h	CSI 12 l	40,41
Line Feed/New Line	CSI 20 h	CSI 20 l	40,41
Text Cursor Enable	CSI ? 25 h	CSI ? 25 l	41,42
Cursor Key	CSI ? 1 h	CSI ? 1 l	40,42
ANSI/VT52	N/A	CSI ? 2 l	40,42
Origin	CSI ? 6 h	CSI ? 6 l	42
Auto Wrap	CSI ? 7 h	CSI ? 7 l	42
Auto Repeat	CSI ? 8 h	CSI ? 8 l	42
Keypad Application	ESC =		43
Keypad Normal	ESC >		43

	Sequence	Page Reference
Cursor Movement:		
Cursor up	CSI Pn A	44
Cursor down	CSI Pn B	"
Cursor right	CSI Pn C	"
Cursor left	CSI Pn D	"
Cursor addressing	CSI Pl ; Pc H	"
Cursor addressing	CSI Pl ; Pc f	"
Index	ESC D	"
Reverse index	ESC M	"
Next line	ESC E	"
Save cursor	ESC 7	45
Restore cursor	ESC 8	"
Tab Stops:		45
Set tab	ESC H	
Clear tab	CSI g	
Clear all tabs	CSI 3 g	
Character Rendition:		45
Attribute off	CSI m	
Reverse video	CSI 7 m	
Normal intensity	CSI 22 m	
Not underlined	CSI 24 m	
Not blinking	CSI 25 m	
Positive image	CSI 27 m	
Erasing:		46
At cursor position	CSI Pn X	
Cursor to end of line	CSI K	
Start of line to cursor	CSI 1 K	
Entire cursor line	CSI 2 K	
Cursor to end of screen	CSI J	
From start of screen to cursor	CSI 1 J	
Entire screen	CSI 2 J	
Scrolling Region:		
Set top and bottom margins	CSI Pt ; Pb r	46
Reports:		47
Status report	CSI 5 n	
Cursor Position report	CSI 6 n	
Identify/What are you	ESC Z	

	Sequence	Page Reference
Terminal Reset:		
Hard terminal reset	ESC c	48
Adjustments:		
Screen alignment display	ESC # 8	48
VT52 Mode Escape Sequences:		49
Cursor up	ESC A	
Cursor down	ESC B	
Cursor right	ESC C	
Cursor left	ESC D	
Select graphic set	ESC F	
Select ASCII set	ESC G	
Home cursor	ESC H	
Reverse line feed	ESC I	
Erase to end of screen	ESC J	
Erase to end of line	ESC K	
Cursor addressing	ESC y l c	
Identify/What are you	ESC Z	
Keypad application	ESC =	
Keypad normal	ESC >	
ANSI/Extended ANSI mode	ESC <	
Graphics Modes Escape Sequences:		
Enter alphagraphics mode, home the alphagraphic cursor reset character size, linestyle, current margin, and clear the graphics screen	ESC FF	51
Select normal size characters	ESC 0	51
Select double size characters	ESC 1	"
Select triple size characters	ESC 2	"
Select quadruple size characters	ESC 3	"
Enter graphic input mode	ESC SUB	"
Report crosshair position to host computer	ESC ENQ	"
Select solid lines	ESC `	"
Select dotted lines	ESC a	52
Select dot dash lines	ESC b	"
Select short dash lines	ESC c	"
Select long dash lines	ESC d	"
Select user defined pattern 1	ESC x	"
Select user defined pattern 2	ESC y	"
Select user defined pattern 3	ESC z	"
Set drawing mode to dots on	ESC / 0 d	"

Graphics Mode Escape Sequences (cont.)

	Sequence	Page Reference
Set drawing mode to dots off	ESC / 1 d	52
Set drawing mode to complement	ESC / 2 d	"
Set drawing mode to replace by pattern	ESC / 3 d	"
Set user defined pattern 1 to n	ESC / n a	"
Set user defined pattern 2 to n	ESC / n b	"
Set user defined pattern 3 to n	ESC / n c	"

(n is a decimal integer in the range 0 <= n <= 65535)

APPENDIX C
Baud Rate Selection Table

The PVK11-G allows baud rates to be transmitted and received at the following speeds:

Transmit	Receive	
50	50	
75	75	
75	600	
75	1200	
75	2400	
110	110	
134.5	134.5	
150	150	
200	200	
300	300	
600	600	
1050	1050	
1200	2000	
1800	1800	
2000	2000	
2400	2400	
4800	4800	
7200	7200	
9600	9600	(Default)
19200	19200	
38400	38400	

INDEX