"MC 145192"

MC145192 and MC145202 Evaluation Board Manual

INTRODUCTION

The MC145192EVK and MC145202EVK are two versions of one board with a few component changes. They allow users to exercise features of both devices and to build PLLs which meet individual performance requirements. The control program works with any board and can be used with other Motorola PLL devices (MC145190, MC145191, MC145200, MC145201, MC145220*). It will select frequency defaults that apply to each. All board functions are controlled through the printer port of an IBM PC. Up to three different EVKs may be controlled at the same time from one printer port. The functional block diagram is given in Figure 1.

This manual is divided into two sections. Section 1 describes the hardware and Section 2 covers the software control program.
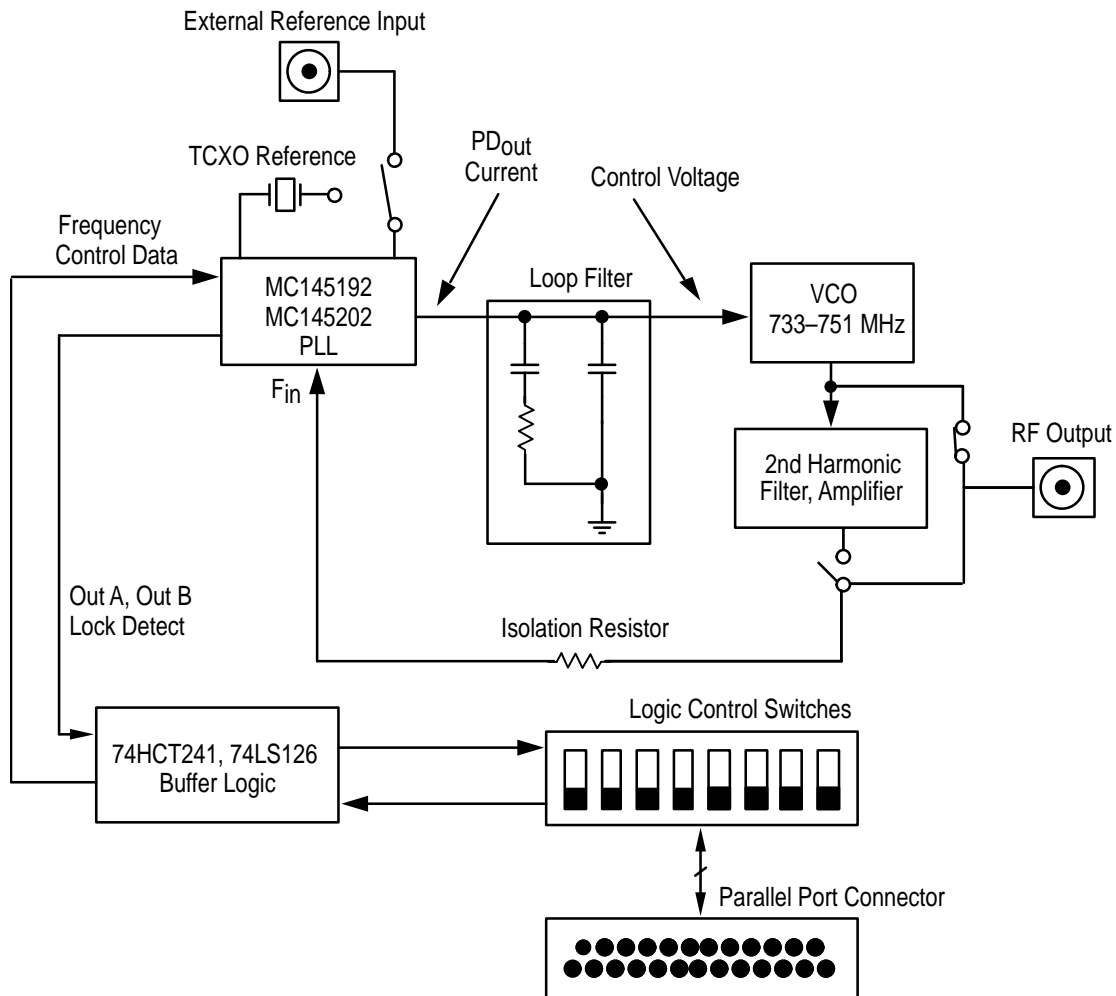

Figure 1. Evaluation Kit Block Diagram

* The MC145220 is not available with Rev. 2.5 software.
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REV 1
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MOTOROLA

SECTION 1 – HARDWARE

FEATURES

1. The EVK is a complete working synthesizer, including VCO.
2. Control program is written in Turbo Pascal.
3. Board is controlled by an IBM PC–compatible computer through the printer port.
4. Up to three boards can be operated independently through one printer port.
5. A prototype area and mounting holes are provided for VCOs, mixers, and amplifiers.
6. External reference input can be used.
7. Five element loop filter is included.
8. Frequency range of operation, step size and reference frequency can be changed in the control program.
9. Lock Detect, Out A, and Out B on any single board are accessible through the printer port.

CONTENTS OF EVALUATION KIT

1. Assembled evaluation board.
2. Nine–foot flat cable with four DB–25 male connectors.
3. MC145192/202 EVK manual.
4. 3.5″ PC–compatible disk containing compiled program.
5. PLL device data sheets.

GETTING STARTED

To perform basic functions, do the following:

1. Plug in 12 volts at J6, observing the polarity marked on the board.
2. Short circuit section 1 of the DIP switch (S1) and open circuit all other sections.
3. Connect the supplied flat cable between the computer printer port and the DB–25 connector on the board (J5).
4. Type PLL at the DOS prompt. Then press enter.
5. Type the number that corresponds with the type of board given in the on–screen menu. Then press Q.

You should now see the main menu displayed. There should be a signal present at J8 on the current output frequency given in the main menu. If the signal is not on the correct frequency, check to see if your printer card address is $278 (hexadecimal 278). If not, then select the P menu item and enter the correct address. After returning to the main menu, select the I menu item to send data to the board. You should now be on frequency.

MODIFICATIONS

The user may modify the hardware, such as utilizing a different VCO, by using the prototyping area of the board. After such modifications are made, the default values in the software may need to be changed. This is facilitated from screen #2 'Select from the available options' screen.

Note that the on–board voltage regulators allow for maximum control voltage range of 0.5 to 4.5 V.

TYPICAL PERFORMANCE

Common to both "MC145192" kits, unless noted. Typical performance applies only to the configuration as shipped. The MC145192EVK is shipped with V_{CC} = 3 V and V_{PD} = 5 V. The MC145202EVK is shipped with V_{CC} = 5 V and V_{PD} = 5 V.

Supply Voltage (J6)	11.5 – 12.5 V
Supply Current (J6) (Note 1)	120 mA
Available Current (Note 2)	60 mA
Frequency Range ('192) (Note 3)	733 – 743 MHz
Frequency Range ('202) (Note 3)	1466 – 1486 MHz
Reference Frequency	14.4 MHz
Temperature Stability (– 30°C to + 85°C)	< ± 2 ppm
TCXO Aging	< ± 1 ppm / year
Step Size ('192)	100 kHz
Step Size ('202)	200 kHz
Power Output	4.5 – 7.5 dBm
2nd Harmonic Level ('192)	< – 18 dB
Fundamental Level ('202)	< – 23 dB
3rd Harmonic Level	< – 18 dB
Frequency Accuracy ('192)	± 1.5 kHz
Frequency Accuracy ('202)	± 3.0 kHz
Reference Sidebands	– 70 dB
Phase Noise (100 Hz, '192)	– 70 dBc/Hz
Phase Noise (100 Hz, '202)	– 69 dBc/Hz
Phase Noise (10 kHz, '192) (Note 4)	– 86 dBc/Hz
Phase Noise (10 kHz, '202) (Note 4)	– 90 dBc/Hz
Switching Time (Note 5)	2.6 ms

NOTES:
1. Supply current is current the board requires without user modifications.
2. Available current is the sum of currents available to the user (in the prototype area) from the 5 V and 8.5 V supply. The 12 V supply is not regulated. Current at 12 V is limited by the external power supply. If the on–board VCO and amplifier are disconnected from the power bus, more current can be drawn in the prototype area. The current flowing into U3 (the 8.5 V regulator) should not exceed 180 mA. This will limit temperature rise in U3.
3. Frequency ranges require use of the 5 V default charge pump supply voltage.
4. 10 kHz phase noise is limited by the PLL device noise. For low noise designs, the loop bandwidth is made more narrow and the VCO is relied upon to provide the 10 kHz phase noise. This can be seen on the EVKs since the VCO has much lower noise.
5. 10 MHz step, within ± 1 kHz of final frequency ('192).
    20 MHz step, within ± 2 kHz of final frequency ('202).

SUPPORT MATERIAL

To provide further information, the following documents are included:

1. Schematic diagram of '192/202EVK.
2. Separate Bill of Materials for each board.
3. Parts layout diagram.
4. Mechanical drawing of board.
5. MC145192 and MC145202 data sheets.
6. Printer port diagram.
7. Typical signal plots for each type of EVK.

PRODUCTION TEST

After assembly is complete, the following alignment and test is performed on '192EVK (or '202EVK):

1. The control program is started in single board '190EVK ('200EVK) mode.
2. L menu item is selected.
3. Power is applied to the board. DIP switch section 1 is closed circuit with all others being open circuit.
4. After attaching computer cable, menu item I is selected.
5. Trim resistor VR1 is adjusted to obtain an output frequency at J8 of 740.999 – 741.001 MHz (1481.998 – 1482.002 MHz).
6. Voltage at the control voltage test point is measured. It must be 2.5 – 3.1 V.
7. When testing more than 1 board, steps 3 – 6 are repeated.

If in step 5 it isn't possible to obtain a signal on frequency, menu item P should be selected and the correct printer port address entered. Menu item I would then be selected to reload the data.

BOARD OPERATION

A computer is connected to the DB–25 connector J5. Data is output from the printer port. The printer card is in slot 0 using the default address in the control program. Data is sent to the PLL device (U1) through the DIP switch (S1), and 74HCT241 buffer (U5). D2, D3, D4, R19, R20, and R21 are in the data path between the 74HCT241 and PLL devices. This limits the high level output voltage of the buffer. Voltage on the PLL device inputs must not be greater than 0.5 V above V_{CC}. A '192/202 PLL has three output lines which are routed through a 74LS126 line driver (U2) to the computer.

U5, the 74HCT241, provides isolation, logic translation and a turn–on delay for PLL input lines. Logic translation is needed from the TTL levels on the printer port to the CMOS levels on the '192/202 inputs. Turn–on delay is used to ensure the power–on reset functions properly. The enable line to the PLL must be held low during power–up.

A 12 V power supply should be used to power the board at J6 (Augat 2SV–02 connector). The 2SV–02 will accept 18–24 AWG bare copper power leads. No tools are needed for connection. If power is properly connected, LED D2 will be lit.

Power passes from J6 to U3 (LM317 regulator) configured as an 8.5 V regulator. Both boards use 8.5 V to power the VCO and RF amplifier. Regulators U4 and U7 use the 8.5 V supply to produce 3 V and 5 V. The '192 always uses 3 V to power logic and 5 V to power the charge pump, while the '202 can have either power both the logic and charge pump. J3 and J4 are jumpers which select voltages for the logic and charge pump supplies. U4 and U7 are cascaded with U3 to equalize their individual voltage drops.

The PLL loop is composed of the PLL device (U1), 733 – 743 MHz VCO (M1), passive loop filter (R11, R12, C4, C5, C6) and second harmonic filter amplifier (U6). A passive loop filter was used to keep the

design simple, reduce noise, and reduce the quantity of traces susceptible to stray pickup. About 56 dB rejection of fundamental and 23 dB gain is provided by the harmonic filter amplifier. This allows the '202 to lock at 1466 — 1486 MHz.

A single VCO model is used for both boards. It is an internal Motorola part which is not sold for other applications. The '192 operates at half the output frequency and step size of the '202. This allows the same loop filter components to be used. RF is fed to the PLL chip F_{in} input through voltage dividers R14 and R10. These two resistors terminate the PLL chip RF input with 50 ohms and provide isolation.

Both boards use a phase detector current of 2 mA. J1 and J2 are removable jumpers and cut traces. They are used as connection points for a current measurement of V_{PD} or V_{CC}. A potentiometer VR1 is used to set M2 (14.4 MHz TCXO) on frequency.

COMPONENTS UNIQUE TO EACH EVK

Components that are not the same on all EVKs are given in the following table:

	'192EVK	'202EVK
U1	MC145192	MC145202
R2	18 kΩ	3.9 kΩ
R8	0 Ω	Not Used
C22	Not Used	1.0 pF
J3	3 V	5 V

EXTERNAL REFERENCE INPUT

As shipped, all boards are configured for a 14.4 MHz TCXO (supplied). To use an external reference, disconnect J13 and connect J9. Use a reference signal at J10 which complies with data sheet requirements. Then modify the reference frequency in the program main menu to reflect the changes made ([F] menu item).

DATA TRANSFER FROM COMPUTER TO EVK

To control the serial input EVK with the parallel printer port, a conversion is done. Printer cards are designed to output eight bits through eight lines. A bit mask is used to obtain the bit combination for the three required output lines (Data, Clock, Load). As bytes are sent to the printer card in sequence, it appears to be a serial transfer. The printer port is used because data transfer using the serial port is much slower. A standard IBM PC can support a parallel port data rate of 4.77 MHz.

IBM PCs and compatibles can accept up to three printer port cards. These ports are called LPT1, LPT2, and LPT3. Each printer card has jumpers or DIP switches on it to set a unique address. Two sets of addresses are in common use. One set applies to IBM PC XT, AT, and clones. The other is for the PS 2 line. To load data into the EVK, the correct address must be selected. The program default is $278, which is LPT1 in a clone. If $278 is not the address in use, it must be modified by entering the O menu item in the main menu. All allowed addresses given in hexadecimal are as follows:

Label	IBM PC and Clones	PS 2
LPT1	278	3BC
LPT2	378	378
LPT3	3BC	278

Up to three EVK boards can operate independently from one printer port. All lines on the printer port are connected to every EVK. Even with three boards operating, only three output lines (Clock, Data and Load) from the printer card are used. If two boards are controlled together, data for the second board is received from the Output A of the first. Output A is a configurable output on '192/202 devices, which in this case is used to shift data through chip 1 into chip 2. Output A and Data are connected using a printer port input line. This was done to avoid connecting extra wires. Fortunately not all port input lines are needed for computer input. Load and Clock are common to both boards.

A three–board cascade is handled similarly to a two–board cascade. Out A on the first board is fed to Data on the second. Out A on the second connects to Data on the third. Instructing the program on the quantity of boards connected together allows it to modify the number of bits sent.

All boards have a DIP switch S1 which gives each a unique address. The configuration menu is used to tell the program what type of board is connected at a board address. Switch positions for all possible addresses are given in Figure 2.
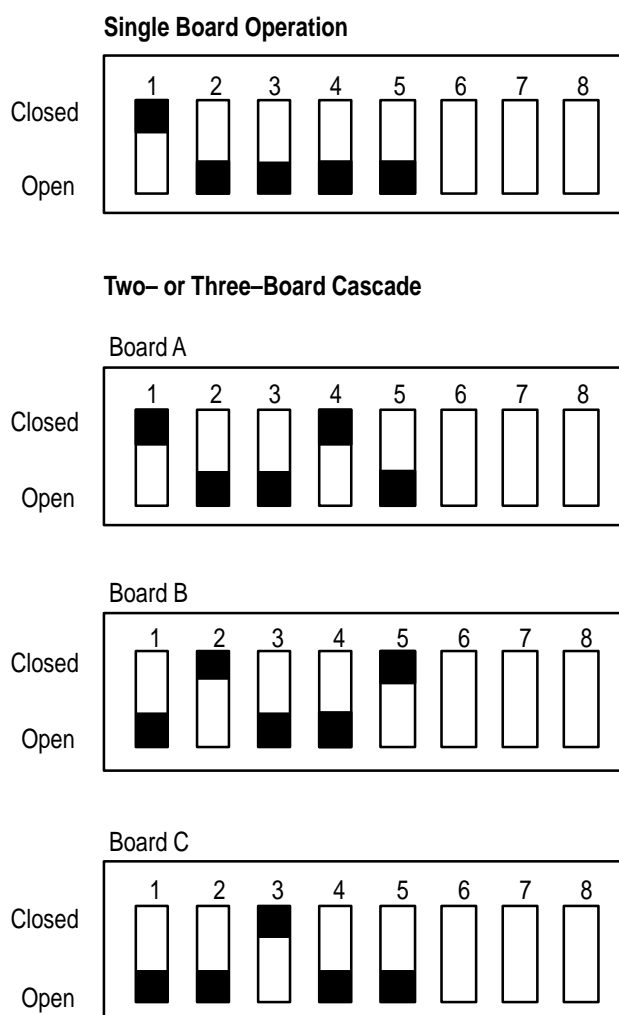
Single Board Operation

Two– or Three–Board Cascade

Board A

Board B

Board C

Figure 2. Switch Positions

In Figure 2, DIP switch sections 6, 7, and 8 allow the computer to read Out A, Out B or Lock Detect from the PLL device. Each of the inputs can only be read on one board at a time, but each item could be read on a different board. In a three−board cascade, Out A could be read from the first board, Out B from the second, and Lock Detect from the third. There is no way to determine in software the board address of a particular input. The control program does not make use of these inputs. Pin assignment on the printer port connector is:

Label	Pin Number
Out A	12
Out B	13
Lock Detect	15

PRINTER PORT CONFIGURATION

Printer port outputs on an IBM PC or clone use TTL−LS logic levels. Inputs are one TTL−LS load. Signal lines can be used for any purpose. The standard names, direction of data flow, true and inverted data are shown in Figure 3.
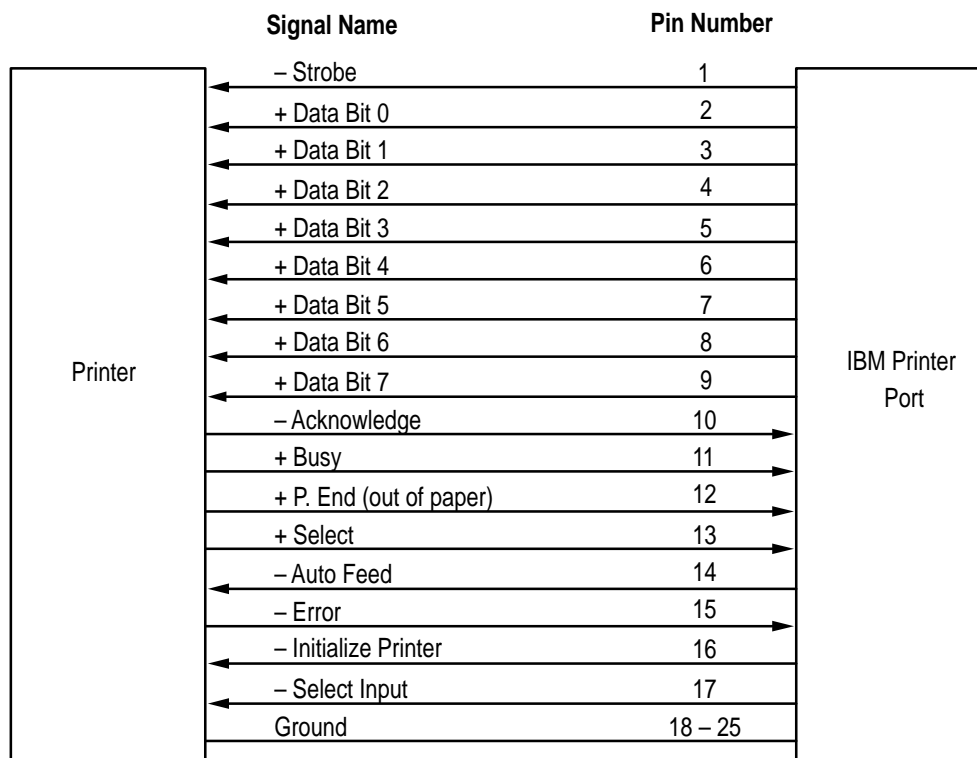
Signal Name	Pin Number
− Strobe	1
+ Data Bit 0	2
+ Data Bit 1	3
+ Data Bit 2	4
+ Data Bit 3	5
+ Data Bit 4	6
+ Data Bit 5	7
+ Data Bit 6	8
+ Data Bit 7	9
− Acknowledge	10
+ Busy	11
+ P. End (out of paper)	12
+ Select	13
− Auto Feed	14
− Error	15
− Initialize Printer	16
− Select Input	17
Ground	18 − 25

Printer — IBM Printer Port

Figure 3. Printer Port Data Lines

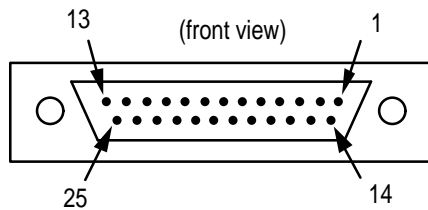Pin numbers for the port connector are shown in Figure 4.

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Figure 4. DB–25 Male Connector

SECTION 2 – SOFTWARE

"MC145192"

INTRODUCTION

The MC145xxx PLL software is provided to demonstrate the capabilities of the MC145xxx family of PLLs. The family includes the following devices:

Table 1.

Board Type	Board Description
MC145190	
MC145191	
MC145192	Low voltage version of the '191
MC145200	
MC145201	
MC145202	Low voltage version of the '201
MC145220 in Single Loop Mode*	
MC145220 in Dual Loop Mode*	

* The '220 is not available in Rev. 2.5 software.

Most of these ICs are provided on an evaluation circuit board to allow the easy demonstration of the PLL capabilities.

PURPOSE

The user guide for the MC145xxx PLL software familiarizes the user with the use and capabilities of the program referred from here on as PLL Version 3.0. The guide covers the user interface and a summary of the commands that are available.

The user should read the data sheet of the PLL frequency synthesizer of interest before using the software.

DESCRIPTION

The PLL software:
- is a Pascal program developed with Borland Turbo Pascal v7.0.
- runs under MS–DOS.
- is a character–based, menu–driven program.

USER COMMENTS

Comments on this program may be faxed to MDAD Development Tools Group at (512) 933–8570.

USER INTERFACE

The user interface consists of numerous character–based, menu–driven screens which are displayed below. Each screen is shown, along with a description of its purpose.

CONVENTIONS

Some of the PLL screens are necessarily "busy". Because of this, the program follows several conventions to help the user quickly absorb the screen information. These conventions are briefly described on a help screen that is available throughout the program. Type the help command, [?], at any time to view the help screen.

The conventions are as follows:

1. Command keys are surrounded by [ ]s. Type the letter between the [ ]s to execute the command. [ ]s are followed by a description of the command.

2. [–] indicates a command not available to the user. Commands become available when they are applicable to the currently targeted board.

3. [ ]s followed by an ! indicate the command will execute immediately. Otherwise a submenu is displayed from which further choices may be made.

4. If no changes are desired to an input field, leave the field blank. The previous value will then be used for that field. Type the TAB key to move to the next input field, or shift–TAB to move to the prior input field. Type RETURN to store the new input values while remaining on the same screen. Type Q to store the new values and return to the prior screen.

5. All numbers are entered as decimal values unless otherwise noted. A $ followed by a value indi–cates the value is in hexadecimal format. The output port address is in hexadecimal format.

6. The second line from the top of screen (screen title) states the purpose of the screen.

7. Screen information that can be changed by the user is displayed in bold or reverse video.

8. Commands are case independent. X is the same as x.

9. Frequencies are entered as two numbers, and displayed as one. The two input numbers repre–sent the desired frequency in MHz, and in kHz. These input values are added together to obtain the final frequency. Leave either input field blank to retain the prior value for that portion of fre–quency.

SCREENS

Screen #1 'Define boards to program'

The first screen the user sees when the program begins has a screen title of 'Define boards to program'. This screen is used to define which boards are connected to the LPT1 printer port of the computer. Refer to the hardware setup section to determine how to cascade the evaluation boards.

This screen is also available from the main menu (screen #2). The user may return to this screen to change the boards that are connected to the computer.

The screen is divided into two sections. The upper section shows the current board type settings while the lower section allows the user to define a board's type and position in the cascade connection.

Notice the section labeled 'Available Boards:' shows three labels, one for each board that may be cascaded. When the program first starts up it shows 'N/A' (not applicable) after each label. The user must enter the boards contiguously. Initially the program requests for the user to enter board A's type. This is signified by *A* (in the screen below) being set to A. The user can the select the board type for board A by typing the corresponding command.

Once board A's type is selected, *A* automatically increments to B and the process may be repeated. Once all boards have been correctly defined, the user may select [Q] which sends default data to the boards and continues to the next screen. NOTE: Before selecting [Q], the user should insure that the DIP switch settings shown in Figure 2 are correct.

If a board is incorrectly identified, select the board that is not correctly defined by typing the corresponding board letter ([A], [B], or [C]). The user may then reselect the board's type. Once the board has been identified, the user may select the letter ([A], [B], or [C]) of the board followed by [S] to change hardware–dependent variables for that board. See screen #1b.

[X] can be selected to exit the program completely. [?] can be selected to view the help screen.

```
              Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                          Define boards to program

    Available Boards:
     Brd [A]!: N/A              Brd [B]!: N/A              Brd [C]!: N/A
    ---------------------------------------------------------------------------

    Board A is:

     [-]! no board             [4]! MC145200

     [1]! MC145190             [5]! MC145201

     [2]! MC145191             [6]! MC145202

     [3]! MC145192

    [-] Boards defined, Continue




            [X]! Terminate demonstration program. [?]! View help screen.
```

MC145192EVK • MC145202EVK

Screen #1a Help Screen

Screen #1a is the help screen for the program. This screen is available from any point throughout the program. A short list of the interface conventions are presented on this screen.

[X] can be selected to exit the program completely. [Q] can be selected to exit the help screen.

```
                Welcome to MC145xxx EVK Demonstration Program, rev 2.5

  1) Command keys are surrounded by []'s. Type the letter between the []'s to execute
  the command. []'s are followed by a description of the command.

  2) [-] indicates a command not available to the user.

  3) []'s followed by an ! indicate the command will execute immediately. Otherwise a
  sub menu will be displayed.

  4) If no changes are desired to an input field, type the TAB key to move to the next
  input field. The previous value will be used for that field.

  5) All numbers are entered as decimal values unless otherwise noted. A $ followed by a
  value indicates the value is in hexadecimal format.

  6) The second line from the top of screen (screen title) states the purpose of the
  screen.

  7) Screen information that can be changed by the user is displayed in bold or reverse
  video.

  8) Commands are case independent. X is the same as x.

              [X]! Terminate demonstration program. [Q]! Quit help screen.
```

Screen #2 'Select from the available options'

Screen #2 is the main screen of the program. This is where the user enters commands to demonstrate the capabilities of the various boards connected to the computer. The title of the screen is 'Select from the available options'.

This screen is broken down into three sections:

Section #1, 'Available Boards'

This section displays the board types that are connected to the computer. It also designates which board is the currently selected 'target' board. This is the board that will receive the commands from section #2. This section also provides the ability to change the targeted board. Type the target board command ([A], [B], or [C]) to target that particular board.

Section #2, 'MC145xxx Commands'

This section is further divided into three subsections. Each subsection contains commands that can be sent to the 'target' board to demonstrate its capabilities. Each of these commands is described in full in the Command Summary.

The first subsection, 'MC145xxx Frequency Commands', contains commands that are used to modify the PLL frequency in some way. These commands are available for all possible target board types.

In the top line of this section, 'Current Output Frequency is *746 MHz'* designates what the frequency is for the currently targeted board. This value is dynamic.

On the lines below this, *741 MHz* is the current setting for the default low frequency. *746 MHz* is the current setting for the default medium frequency. *751 MHz is* the current setting for the default high frequency.

The second subsection, 'MC145xxx Additional Commands', contains commands that are used to further modify the currently targeted board. These commands also work with all of the MC145xxx board types.

The third subsection, 'MC145220 EVK – Single Specific Commands', are only displayed when the MC145220EVK in single loop mode is the currently targeted board. This section shows commands that are specific to this board. This is required since this board contains the equivalent of two PLLs.

The command letter for 'Set target PLL on board' is [T]!. In single loop mode, the user may toggle between PLL and PLL' on the MC145220EVK by using this command. Feedback is given to the user as to whether PLL or PLL' will be accessed. See near the top of the screen on the line titled "Available Boards - Current target board is: ..."

Section #3, 'Initialization/System Setup Commands'

This section contains commands that are used to initialize all boards connected to the computer or to set up the computer.

Screen #2 'Select from the available options' (continued)

"MC145192"

```
                  Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                          Select from the available options

     Available Boards – Current target board is: A, MC145190
      Brd [A]!: MC145190        Brd [–]!: N/A           Brd [–]!: N/A
      --------------------------------------------------------------------------------
     MC145xxx Frequency Commands – Current Output Frequency is 746 MHz
      [L]! Set to low freq      741 MHz     [W] Change default low freq.
      [M]! Set to med. freq     746 MHz     [Y] Change default med. freq.
      [H]! Set to high freq.    751 MHz     [Z] Change default high freq.
      [U]! Step frequency up by step size     [O] Set PLL output frequency
      [D]! Step frequency down by step size   [F] Set REFin freq. & channel spacing
     MC145xxx Additional Commands
      [E]   Set function of output A          [N] Change C Register
      [R]   Set crystal/reference mode – Current mode is Ref. mode, REFout low


      --------------------------------------------------------------------------------
     Initialization/System Setup Commands:
      [P]   Set output port address – Current address is $278
      [G]   Change board definitions
      [I]   Initialize board(s), Write all registers

                   [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #3 After [O] Command Selected

This is the resulting screen that is displayed after the user selects the '[O] Set PLL output frequency' command. The user is prompted to enter the new frequency.

The current output frequency is automatically retained if the user hits return or [Q] without entering a value.

```
                 Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                               Set PLL output frequency

Available Boards – Current target board is: A, MC145190
 Brd [A]!: MC145190        Brd [–]!: N/A          Brd [–]!: N/A
 ------------------------------------------------------------------------

Input new frequency in integer values of MHz and kHz.

Original program default PLL output frequency is 746 MHz
Current PLL output frequency is 746 MHz

Current frequency range is 741 MHz to 751 MHz
Frequencies outside this range will be accepted.

New PLL frequency: 746 MHz + 000 kHz

[TAB] to move to next field
[Q]   to return to main menu



                 [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #4 After [F] Command Selected

This is the resulting screen that is displayed after the user selects the '[F] Set REF$_{in}$ freq. and channel spacing' command. The user is prompted to enter the new REF$_{in}$ frequency and channel spacing values, or leave the fields blank to retain the prior settings.

```
                Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                       Set REFin frequency and channel spacing

   Available Boards – Current target board is: A, MC145190
    Brd [A]!: MC145190        Brd [–]!: N/A              Brd [–]!: N/A
   ----------------------------------------------------------------------------

   Input new REFin frequency in integer values of MHz and kHz.
   Original program default REFin frequency is 14.4 MHz
   Current REFin frequency is 14.4 MHz

   New REFin frequency: 14 MHz + 400 kHz

   Input new channel spacing in integer values of MHz, kHz, and Hz.
   Original program default channel spacing is 100 kHz
   Current channel spacing is 100 kHz

   New channel spacing: 0 MHz + 100 kHz + 000 Hz

   [TAB] to move to next field
   [Q]   to return to main menu


            [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #5 After [W, Y or Z] Command Selected

This is the resulting screen that is displayed after the user selects the '[W] Change default low freq.' command. The user is prompted to enter the new default low frequency value.

Entering a new value does not change the current output frequency of the target board. Changing the low frequency simply adjusts the low frequency setting available from the main menu. The '[L]! Set to low freq.' command changes the current output frequency.

The screen is similar for the Y and Z commands except that the prompts specify medium or high frequency, respectively.

```
              Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                            Set default low frequency

 Available Boards – Current target board is: A, MC145190
  Brd [A]!: MC145190        Brd [–]!: N/A            Brd [–]!: N/A
 ---------------------------------------------------------------------------

 Input new default low frequency in integer values of MHz and kHz.

 Original program default low frequency is 741 MHz
 Current low frequency is 741 MHz

 New default low frequency: 741 MHz + 000 kHz

 [TAB] to move to next field
 [Q]   to return to main menu




              [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #6 After [E] Command Selected

This is the resulting screen that is displayed after the user selects the '[E] Set function of output A' command. The user is provided a submenu to select from.

The current setting for the function of Output A is displayed as Port, Data Out, fv or fr. The user may choose from the listed commands to adjust this setting.

```
                  Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                              Set function of Output A

   Available Boards – Current target board is: A, MC145190
    Brd [A]!: MC145190        Brd [–]!: N/A             Brd [–]!: N/A
    -------------------------------------------------------------------------

   Set Output A function – Currently: Data Out
    [0]! Port
    [1]! Data Out
    [2]! fv
    [3]! fr

    [Q] to return to main menu




                    [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #7 After [N] Command Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C register and Prescale' command. The user is provided a submenu to select from. Each submenu option also shows a submenu.

If [Q] command is selected, the user is returned to the main menu. See screen #2.

If [0] command is selected, the user is presented with screen #8.

If [1] command is selected, the user is presented with screen #9.

If [2] command is selected, the user is presented with screen #10.

If [3] command is selected, the user is presented with screen #11.

If [4] command is selected, the user is presented with screen #12.

If [5] command is selected, the user is presented with screen #13.

If [6] command is selected, the user is presented with screen #14.

```
                   Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                                   Change C Register

 Available Boards – Current target board is: A, MC145190
  Brd [A]!: MC145190          Brd [–]!: N/A                Brd [–]!: N/A
 ---------------------------------------------------------------------------

 Change C register:
  [0] Output A – (Output A set to Port)
  [1] Output B – (Out B)
  [2] PDout Current – (PDout)
  [3] Phase Detector Select – (PDA/B)
  [4] Lock Detect Enable – (LDE)
  [5] Phase Detector Polarity – (POL)
  [6] Standby – (STBY)

 Prescale:
  [7] Prescale

  [Q] to return to main menu




              [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #8 After [N] & [0] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[0] Change output A' command. The user is provided a submenu to select from. This submenu contains commands to toggle the Output A settings.

The current setting for Output A is displayed as Output High or Output Low. The user may choose from the listed commands to toggle this setting.

```
            Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                         Change C Register, Output A

Available Boards – Current target board is: A, MC145190
 Brd [A]!: MC145190          Brd [–]!: N/A              Brd [–]!: N/A
 ----------------------------------------------------------------------

Change C Register, Output A state – Currently: Output High
 [0]! Set to 0 (low)
 [1]! Set to 1 (high)

 [Q] to return to previous menu




              [X]! Terminate demonstration program. [?]! View help screen.

```

Screen #9 After [N] & [1] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[1] Change output B' command. The user is provided a submenu to select from. This submenu contains commands to toggle the Output B settings.

The current setting for Output B is displayed as Output High or Output Low. The user may choose from the listed commands to toggle this setting.

```
                Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                            Change C Register, Output B

 Available Boards – Current target board is: A, MC145190
  Brd [A]!: MC145190        Brd [–]!: N/A           Brd [–]!: N/A
  ------------------------------------------------------------------------

 Change C Register, Output B State – Currently: Output High
  [0]! Set to 0 (low)
  [1]! Set to 1 (high)

  [Q] to return to previous menu






                 [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #10 After [N] & [2] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[2] Change PD$_{out}$ Current' command. The user is provided a submenu to select from. This submenu contains commands to change the PD$_{out}$ current settings.

The screen is slightly different depending on whether Output A is defined as a port or not. See command [E] from the main menu.

Output A is configured as a port.

The current PD$_{out}$ setting is displayed as '70%', '80%', '90%', or '100%'.

The user can select the [0], [1], [2], and [3] menu options to change the percent of PD$_{out}$ current.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                  Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                             Change C Register, PDout Current

Available Boards – Current target board is: A, MC145190
 Brd [A]!: MC145190          Brd [–]!: N/A             Brd [–]!: N/A
 ------------------------------------------------------------------------

When Output A is set to Port, Current range is 70 – 100%.
When Output A is NOT set to Port, Current range depends upon PDout Current Step Size.

   When PDout Current Step Size is set to 10%, current range is 70 – 100%.
   When PDout Current Step Size is set to 25%, current range is 25 – 100%.

Output A is currently defined as Port.

Change C Register, PDout Current – Currently: 100%
 [0]! 70%
 [1]! 80%
 [2]! 90%
 [3]! 100%

 [Q] to return to previous menu


               [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #10a After [N] & [2] Commands Selected

"MC145192"

Output A is NOT configured as a port.

The current PD_{out} setting is displayed as '25%', '50%', '75%', or '100%', depending on current PD_{out} setting.

The user can select the [0], [1], [2], and [3] menu options to change the percent of PD_{out} current.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                 Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                            Change C Register, PDout Current

Available Boards – Current target board is: A, MC145190
 Brd [A]!: MC145190          Brd [–]!: N/A              Brd [–]!: N/A
 -----------------------------------------------------------------------

When Output A is set to Port, Current range is 70 – 100%.
When Output A is NOT set to Port, Current range depends upon PDout Current Step Size.

  When PDout Current Step Size is set to 10%, current range is 70 – 100%.
  When PDout Current Step Size is set to 25%, current range is 25 – 100%.

Output A is currently NOT defined as Port.
PDout Current Step Size is currently 25%

Change C Register, PDout Current – Currently: 100%
 [0]! 25%
 [1]! 50%
 [2]! 75%
 [3]! 100%

 [Q] to return to previous menu

            [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #11 After [N] & [3] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[3] Change Phase Detector Select' command. The user is provided a submenu to select from. This submenu contains commands to toggle the phase detector setting.

The current phase detector setting is displayed as 'phi R & phi V' or 'PD$_{out}$', depending on the setting.

The user can select the [0] and [1] menu options to toggle the phase detector select setting.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                 Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                         Change C Register, Phase Detector Select

    Available Boards – Current target board is: A, MC145190
     Brd [A]!: MC145190          Brd [–]!: N/A              Brd [–]!: N/A
    --------------------------------------------------------------------------

    Change C Register, Phase Detector Select – Currently: PDout
     [0]! phi R & phi V
     [1]! PDout

     [Q] to return to previous menu








                 [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #12 After [N] & [4] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[4] Change Lock Detect Enable' command. The user is provided a submenu to select from. This submenu contains commands to toggle the lock detect enable setting.

The current setting for the lock detect is displayed as 'Output low' or 'Enable output', depending on the setting.

The user can select the [0] and [1] menu options to toggle the lock detect enable setting.

If [Q] command selected then the user is returned to the main menu. See screen #2.

```
                     Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                              Change C Register, Lock Detect Enable

    Available Boards – Current target board is: A, MC145190
     Brd [A]!: MC145190        Brd [–]!: N/A            Brd [–]!: N/A
     -------------------------------------------------------------------------

    Change C Register, Lock Detect Enable – Currently: Enable output
     [0]! Output low
     [1]! Enable output

     [Q] to return to previous menu




                  [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #13 After [N] & [5] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[5] Change polarity of phase detector' command. The user is provided a submenu to select from. This submenu contains commands to toggle the polarity setting.

The current setting of the polarity is displayed as 'Non–invert PD_{out}, do not interchange phi R & phi V' or 'Invert PD_{out}, interchange phi R & phi V', depending on the polarity setting.

The user can select the [0] and [1] menu options to toggle the polarity setting.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                              Change C Register, Polarity

    Available Boards – Current target board is: A, MC145190
     Brd [A]!: MC145190          Brd [–]!: N/A              Brd [–]!: N/A
     ---------------------------------------------------------------------------

    Change C Register, Polarity – Currently: Non–invert PDout
     [0]! Non–invert PDout, do not interchange phi R & phi V
     [1]! Invert PDout, interchange phi R & phi V

     [Q] to return to previous menu




                  [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #14 After [N] & [6] Commands Selected

This is the resulting screen that is displayed after the user selects the '[N] Change C Register' and then the '[6] Change standby' command. The user is provided a submenu to select from. This submenu contains commands to toggle the standby state setting.

The standby state setting is displayed as 'Normal operation' or 'Standby', depending on the current setting.

The user can select the [0] and [1] menu options to toggle the standby state setting.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                   Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                                 Change C Register, Standby

     Available Boards – Current target board is: A, MC145190
      Brd [A]!: MC145190        Brd [-]!: N/A              Brd [-]!: N/A
      ---------------------------------------------------------------------------

     Change C Register, Standby – Currently: Normal Operation
      [0]! Normal operation
      [1]! Stand by

      [Q] to return to previous menu







                    [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #14a After [N] & [7] Commands Selected

This screen displays the current prescale ratio. However, the value may not be modified.

```
                  Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                              Change C Register, Prescale

 Available Boards – Current target board is: A, MC145190
  Brd [A]!: MC145190          Brd [-]!: N/A            Brd [-]!: N/A
 ---------------------------------------------------------------------------

 Evaulation program does not allow Prescale to be changed on this board.
 Current Prescale Ratio is 64/65

  [Q] to return to previous menu







              [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #15 After [P] Command Selected

This is the resulting screen that is displayed after the user selects the '[P] Set output port address' command. The user is prompted to enter the new output port address in hexadecimal. This should be the port address of the LPT1 printer port for the user's computer.

The original program default port address and the current setting are displayed.

Enter the new output port address in hexadecimal format.

```
              Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                            Set output port address

Available Boards – Current target board is: A, MC145190
 Brd [A]!: MC145190          Brd [–]!: N/A              Brd [–]!: N/A
 ----------------------------------------------------------------------

Input new output port address in hexadecimal.

Original program default port address is $278
Current port address is $278

New output port address: $278

[Q] to return to main menu




              [X]! Terminate demonstration program. [?]! View help screen.
```

Screen #16 After [R] Command Selected

This is the resulting screen that is displayed after the user selects the '[R] Set crystal/reference mode' command. The user is provided a submenu to select from. This submenu contains commands to change the crystal/reference mode.

The current reference mode is displayed as 'Crystal mode, Shutdown'; 'Crystal mode, Active'; 'Reference mode, REF$_{in}$ enabled, REF$_{out}$ low'; 'Reference mode, REF$_{out}$ = REF$_{in}$'; 'Reference mode, REF$_{out}$ = REF$_{in}$/2'; 'Reference mode, REF$_{out}$ = REF$_{in}$/4'; 'Reference mode, REF$_{out}$ = REF$_{in}$/8'; or 'Reference mode, REF$_{out}$ = REF$_{in}$/16', depending on the current setting.

The user can select the [0] to [7] menu options to change the crystal/reference mode setting.

If the [Q] command is selected, then the user is returned to the main menu. See screen #2.

```
                  Welcome to MC145xxx EVK Demonstration Program, rev 2.5
                              Set crystal or reference mode

     Available Boards – Current target board is: A, MC145190
      Brd [A]!: MC145190          Brd [-]!: N/A              Brd [-]!: N/A
     ------------------------------------------------------------------------------

     Set crystal or reference mode – Currently: Ref. mode, REFout low
      [0]! Crystal mode, Shutdown
      [1]! Crystal mode, Active
      [2]! Reference mode, REFin enabled, REFout low
      [3]! Reference mode, REFout = REFin
      [4]! Reference mode, REFout = REFin/2
      [5]! Reference mode, REFout = REFin/4
      [6]! Reference mode, REFout = REFin/8
      [7]! Reference mode, REFout = REFin/16

      [Q] to return to previous menu




                 [X]! Terminate demonstration program. [?]! View help screen.
```

COMMAND SUMMARY

"MC145192"

NOTE: MC145220 selections are not implemented in rev. 2.5.

[A]! Set board A as target

This command sets the target board to the board shown as A. This means that the commands that follow will affect board A only. The user is informed of, and may modify, the target board in any screen of the program except the help screen.

This is strictly an internal program command and has no effect on the MC145xxx EVKs connected to the computer.

[B]! Set board B as target

This command sets the target board to the board shown as B. This means that the commands that follow will affect board B only. The user is informed of, and may modify, the target board in any screen of the program except the help screen.

This is strictly an internal program command and has no effect on the MC145xxx EVKs connected to the computer.

[C]! Set board C as target

This command sets the target board to the board shown as C. This means that the commands that follow will affect board C only. The user is informed of, and may modify, the target board in any screen of the program except the help screen.

This is strictly an internal program command and has no effect on the MC145xxx EVKs connected to the computer.

[L]! Set to low freq.

This command is used to set the frequency of the currently selected board to the currently defined low value. This value can be changed via the [W] command.

This is accomplished by correctly adjusting the A register for the targeted board.

If the current EVK is the MC145220 and the board is in DUAL mode, then the currently targeted PLL on the board is set to the specified low frequency. Otherwise, if the board is in SINGLE mode, both on–board PLLs are set to the new frequency.

[M]! Set to medium freq.

This command is used just as the [L]! command except that the defined medium frequency value is used. This default value can be changed by selecting command [N]. Reference [L]! command for further details.

[H]! Set to high freq.

This command is used just like the [L]! command except that the defined high frequency value is used. This default value can be changed by selecting command [W]. Reference [L]! command for further details.

[W] Change default low frequency

This command prompts the user (screen #5) to input a decimal value in MHz for the default low frequency. The program default low value is displayed along with the current value. The user may leave the low frequency value as is by entering return without a value. The program low default value is dependent on the targeted board type (see Table 2).

This value is not sent to the board immediately. It is the value that is sent to the board when the [L] command is executed.

Table 2.

Board Type	Program Default Low Frequency
MC145190	741 MHz
MC145191	733 MHz
MC145192	733 MHz
MC145200	1482 MHz
MC145201	1466 MHz
MC145202	1466 MHz
MC145220 in Single Loop Mode	733 MHz (PLL) 790 MHz (PLL')
MC145220 in Dual Loop Mode	45 MHz

[Y] Change default medium frequency

This command prompts the user (screen #5) to input a decimal value in MHz for the default medium frequency. The program default medium value is displayed along with the current value. The user may leave the medium frequency value as is by entering return without a value. The program medium default value is dependent on the targeted board type (see Table 3).

This value is not sent to the board at this time. It is the value that is sent to the board when the [M] command is executed.

Table 3.

Board Type	Program Default Medium Frequency
MC145190	746 MHz
MC145191	738 MHz
MC145192	738 MHz
MC145200	1492 MHz
MC145201	1476 MHz
MC145202	1476 MHz
MC145220 in Single Loop Mode	738 MHz (PLL) 805 MHz (PLL')
MC145220 in Dual Loop Mode	60 MHz

[Z] Change default high frequency

This command prompts the user (screen #5) to input a decimal value in MHz for the default high frequency. The program default high value is displayed along with the current value. The user may leave the high frequency value as is by entering return without a value. The program high default value is dependent on the targeted board type (see Table 4).

This value is not sent to the board immediately. It is the value that is sent to the board when the [L] command is executed.

Table 4.

Board Type	Program Default High Frequency
MC145190	751 MHz
MC145191	743 MHz
MC145192	743 MHz
MC145200	1502 MHz
MC145201	1486 MHz
MC145202	1486 MHz
MC145220 in Single Loop Mode	738 MHz (PLL) 820 MHz (PLL')
MC145220 in Dual Loop Mode	75 MHz

[U]! Step frequency up by step size

This command increments the NCOUNTER and ACOUNTER fields of the A register for the currently targeted board. This steps up the PLL's frequency by the current step size for the board.

If the currently selected board is an MC145220 in DUAL mode, then the currently targeted PLL on the board is "stepped". If the MC145220 is in SINGLE mode, then both PLLs on the board are "stepped".

[D]! Step frequency down by step size

This command decrements the NCOUNTER and ACOUNTER fields of the A register for the currently targeted board. This is the effect of stepping down the PLL's frequency by the current step size for the board.

If the currently selected board is an MC145220 in DUAL mode, then the currently targeted PLL on the board is "stepped". If the MC145220 is in SINGLE mode, then both PLLs on the board are "stepped".

[O] Set PLL output frequency

This command prompts the user (screen #3) to input a decimal value in MHz and kHz to set the targeted board frequency. The program default PLL output frequency is displayed along with the current value. The user may leave the output frequency value as is by entering return without entering a value. The program validates the entered frequency by checking to ensure that the value is a multiple of the board's current step size and that the entered frequency / frequency step size is ≥ 4032. The program accepts total divide values < 4032 if N $\geq$ A. (Total divide must be $\leq 262,143$ for all PLLs.)

N*P+A = total divide (p = prescale = 64 for '191).

A further check is made to ensure that the entered frequency is within the capability of the currently targeted demonstration board (see Table 5). Frequencies outside the range are allowed for users who use their own VCO.

Table 5.

Board Type	Minimum Frequency	Maximum Frequency
MC145190	741 MHz	751 MHz
MC145191	733 MHz	743 MHz
MC145192	733 MHz	738 MHz
MC145200	1482 MHz	1502 MHz
MC145201	1466 MHz	1486 MHz
MC145202	1466 MHz	1486 MHz
MC145220 in Single Loop Mode	733 MHz (PLL) 790 MHz (PLL')	743 MHz (PLL) 820 MHz (PLL')
MC145220 in Dual Loop Mode	45 MHz	75 MHz

Once validated, the NCOUNTER and ACOUNTER fields of the A register are appropriately modified to set the PLL frequency for the targeted board to the specified value.

If the currently targeted board is an MC145220 in DUAL mode, then the currently targeted PLL on the board will have its frequency set. If the MC145220 is in single mode, then both PLLs on the board will have their frequencies set.

[F] Set REF$_{in}$ frequency and channel spacing

This command prompts the user (screen #4) to input two values. First, a decimal value, in the form of XX MHz + XXX kHz, to set the reference frequency of the targeted board. The program default frequency is displayed along with the current value. The user may leave the reference frequency value as is by entering return. A second input, in the form of XX MHz + XXX kHz, sets the channel spacing (step size) of the targeted board. The program default step size is displayed along with the current value. The user may leave the step size as is by entering return.

The inputs are validated by checking that the step size remains ≤ 2 MHz (≤ 1 MHz for the '220) for all boards. The entered frequency is validated to ensure that the new reference frequency / new step size is < 8191 and is an even multiple of the new channel spacing.

Finally, the RCOUNTER of the R register is set with the value of (new reference frequency / new channel spacing) and R register is written to the targeted board. Then the ACOUNTER and NCOUNTER are re-set to the previous frequency using the new channel spacing (previous frequency / new channel spacing) and the A register is written out.

Table 6.

Board Type	Default Reference Frequency	Default Step Size
MC145190	14.4 MHz	100 kHz
MC145191	14.4 MHz	100 kHz
MC145192	14.4 MHz	100 kHz
MC145200	14.4 MHz	200 kHz
MC145201	14.4 MHz	200 kHz
MC145202	14.4 MHz	200 kHz
MC145220 in Single Loop Mode	10.01 MHz	10 kHz
MC145220 in Dual Loop Mode	10.01 MHz	10 Hz (10.01 kHz (PLL), 10 kHz (PLL'))

[E] Set function of output A

This command displays a submenu (screen #6) with the next four options displayed if the currently targeted board is the last board in the cascade. The user may only change the Output A configuration on the last board in line. The user can select one of the following options to configure the Output A:

[0]! Port

Bits A_{23} and A_{22} (A_{22}, A_{21} on '220) are set to 00 binary while the remaining bits of register A are preserved and the A register is written to the targeted board. Enable the [C][A] command.

[1]! Data Out

Bits A_{23} and A_{22} (A_{22}, A_{21} on '220) are set to 01 binary while the remaining bits of register A are preserved and the A register is written to the targeted board. Disable the [C][A] command.

[2]! fv

Bits A_{23} and A_{22} (A_{22}, A_{21} on '220) are set to 10 binary while the remaining bits of register A are preserved and the A register is written to the targeted board. Disable the [C][A] command.

[3]! fr

Bits A_{23} and A_{22} (A_{22}, A_{21} on '220) are set to 11 binary while the remaining bits of register A are preserved and the A register is written to the targeted board. Disable the [C][A] command.

[N] Change C Register

This command displays a submenu (screen #7) with the next seven options displayed. This is where the user can modify the C register settings.

[0] Change output A – (Port)

This is only available with Output A configured as a port for the currently targeted board. See [A][0]! command.

[0]! Reset output A to 0

This resets the PORT field of register C (C_1) to 0 and then writes register C to the currently targeted board.

[1]! Set output A to 1

This sets the PORT field of register C (C_1) to 1 and then writes register C to the currently targeted board.

[1] Change output B (Out B) (not available on '220)

Selects the logic state of output B.

[0]! Reset output B to 0

This resets the OUTB bit of register C (C_0) to 0 and then writes register C to the currently targeted board.

[1]! Set output B to 1

This sets the OUTB bit of register C (C_0) to 1 and then writes register C to the currently targeted board.

[2] Change PD$_{out}$ current with Output A defined as port (not available on '220)

If A_{23}, A_{22} are both 0 then the currently targeted board is set up as a port and the following sub–menu options are provided:

[0]! 70%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 00 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[1]! 80%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 01 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[2]! 90%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 10 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[3]! 100%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 11 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[2] Change PD$_{out}$ current with Output A NOT defined as port (not available on '220)

[0]! 25%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 00 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[1]! 50%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 01 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[2]! 75%

The PD$_{out}$ field of register C (bits C_3 and C_2) is set to 10 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[3]! 100%

The PD_{out} field of register C (bits C_3 and C_2) is set to 11 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[2] Change PD_out current (only available on '220)

[0]! 5%

The PD_{out} field of register C (bits C_5 and C_4) is set to 00 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[1]! 50%

The PD_{out} field of register C (bits C_5 and C_4) is set to 01 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[2]! 80%

The PD_{out} field of register C (bits C_5 and C_4) is set to 10 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[3]! 100%

The PD_{out} field of register C (bits C_5 and C_4) is set to 11 binary while the remaining bits of register C are preserved and the C register is written to the targeted board.

[3] Change phase detector select (not available on '220)

This command displays a submenu (screen #11) with the following options. It gives the user the ability to select which phase detector is selected.

[0]! phi R & phi V

Bit C_6 of register C is reset to 0 while the remaining bits are preserved and the C register is written to the targeted board.

[1]! PD_out

Bit C_6 of register C is set to 1 while the remaining bits are preserved and the C register is written to the targeted board.

[3] Change phase detector (only available on '220)

This command displays a submenu (screen #11) with the following options. It gives the user the ability to select which phase detector is selected.

[0]! phi R & phi V

Bit C_2 of register C is set to 1 while the remaining bits are preserved and the C register is written to the targeted board.

[1]! PDout

Bit C_2 of register C is reset to 0 while the remaining bits are preserved and the C register is written to the targeted board.

[4] Change lock detect enable (not available on '220)

This command displays a submenu (screen #12) with the following options. It gives the user the ability to change the lock detect setting.

[0]! Output low

Bit C_5 of the C register is reset to 0 while the remaining bits are preserved and the C register is written to the targeted board.

[1]! Enable output

Bit C_5 of the C register is set to 1 while the remaining bits are preserved and the C register is written to the targeted board.

[5] Change polarity

This command displays a submenu (screen #13) with the following options. It gives the user the ability to change the output polarity of the phase detector.

[0]! Non–invert PD$_{out}$

Bit C_7 (C_0 for '220) of the C register is reset to 0 while the remaining bits are preserved and the C register is written to the targeted board.

[1]! Invert PD$_{out}$

Bit C_7 (C_0 for '220) of the C register is set to 1 while the remaining bits are preserved and the C register is written to the targeted board.

[6] Change standby (not available on '220)

This command displays a submenu (screen #14) with the following commands available to set the STBY (standby) field of the C register:

[0]! Normal operation

The STBY field of register C (bit C_4) is reset to 0 while the remaining bits of register C are preserved and the C register is written to the targeted board.

[1]! Stand by

The STBY field of register C (bit C_4) is set to 1 while the remaining bits of register C are preserved and the C register is written to the targeted board.

[7] Change prescale (only available on '220)

This command displays a submenu (screen #14a) with the following commands available to set the prescale:

[0]! Prescale 32/33

The prescale is set to 32/33 while the remaining bits of the C register are preserved and the C register is written to the targeted board.

[1]! Prescale 64/65

The prescale is set to 64/65 while the remaining bits of the C register are preserved and the C register is written to the targeted board.

[R] Set crystal/reference mode

This command displays a submenu (screen #16) with the following commands:

[0]! Crystal mode, shutdown

Bits R_{15}, R_{14}, and R_{13} of register R are reset to 000 binary while the remaining bits are preserved and the R register is written to the targeted board.

[1]! Crystal mode, active

Bits R_{15}, R_{14}, and R_{13} of register R are set to 001 binary while the remaining bits are preserved and the R register is written to the targeted board.

[2]! Reference mode, REF_{in} enabled, REF_{out} low

Bits R_{15}, R_{14}, and R_{13} of register R are set to 010 binary while the remaining bits are preserved and the R register is written to the targeted board.

[3]! Reference mode, REF_{out} = REF_{in}

Bits R_{15}, R_{14}, and R_{13} of register R are set to 011 binary while the remaining bits are preserved and the R register is written to the targeted board.

[4]! Reference mode, REF_{out} = REF_{in}/2

Bits R_{15}, R_{14}, and R_{13} of register R are set to 100 binary while the remaining bits are preserved and the R register is written to the targeted board.

[5]! Reference mode, REF_{out} = REF_{in}/4

Bits R_{15}, R_{14}, and R_{13} of register R are set to 101 binary while the remaining bits are preserved and the R register is written to the targeted board.

[6]! Reference mode, REF_{out} = REF_{in}/8

Bits R_{15}, R_{14}, and R_{13} of register R are set to 110 binary while the remaining bits are preserved and the R register is written to the targeted board.

[7]! Reference mode, REF_{out} = REF_{in}/16

Bits R_{15}, R_{14}, and R_{13} of register R are set to 111 binary while the remaining bits are preserved and the R register is written to the targeted board.

[T]! Set target PLL on board

This command is only available when the targeted board is a MC145220EVK, and that board is in single loop mode (see [B]! command). The MC145220EVK contains two PLLs, which are designated PLL and PLL'. This command is a toggle function which directs the program to "steer" subsequent commands to either PLL or PLL' on the targeted MC145220EVK.

[P] Set output port address

This command prompts the user (screen #13) to input a hexadecimal address of the printer port on their computer. This address is where the EVK boards are connected. The entered address is displayed on screen #2 next to the [P] command prompt.

[G] Change board definitions

This command returns the user to the board definition screen. The user may then define a different cascade of boards.

[I]! Initialize board(s), write all registers

This command writes out all of the registers for all of the boards that are currently attached to the computer. The current settings are used for the registers.

This correctly writes out the C, R, and A registers for each EVK board connected to the bus. In the case of MC145220EVKs, they are set to SINGLE (RESET/DEFAULT) mode and then have both PLL and PLL' registers written.

[X]! Terminate demonstration program

This command causes the program to terminate and returns the user to DOS.

[?]! View help screen

This command displays the help screen (screen #1a).

"MC145192"

MC145192/202 EVK PLL and BUS Interface Rev. 2
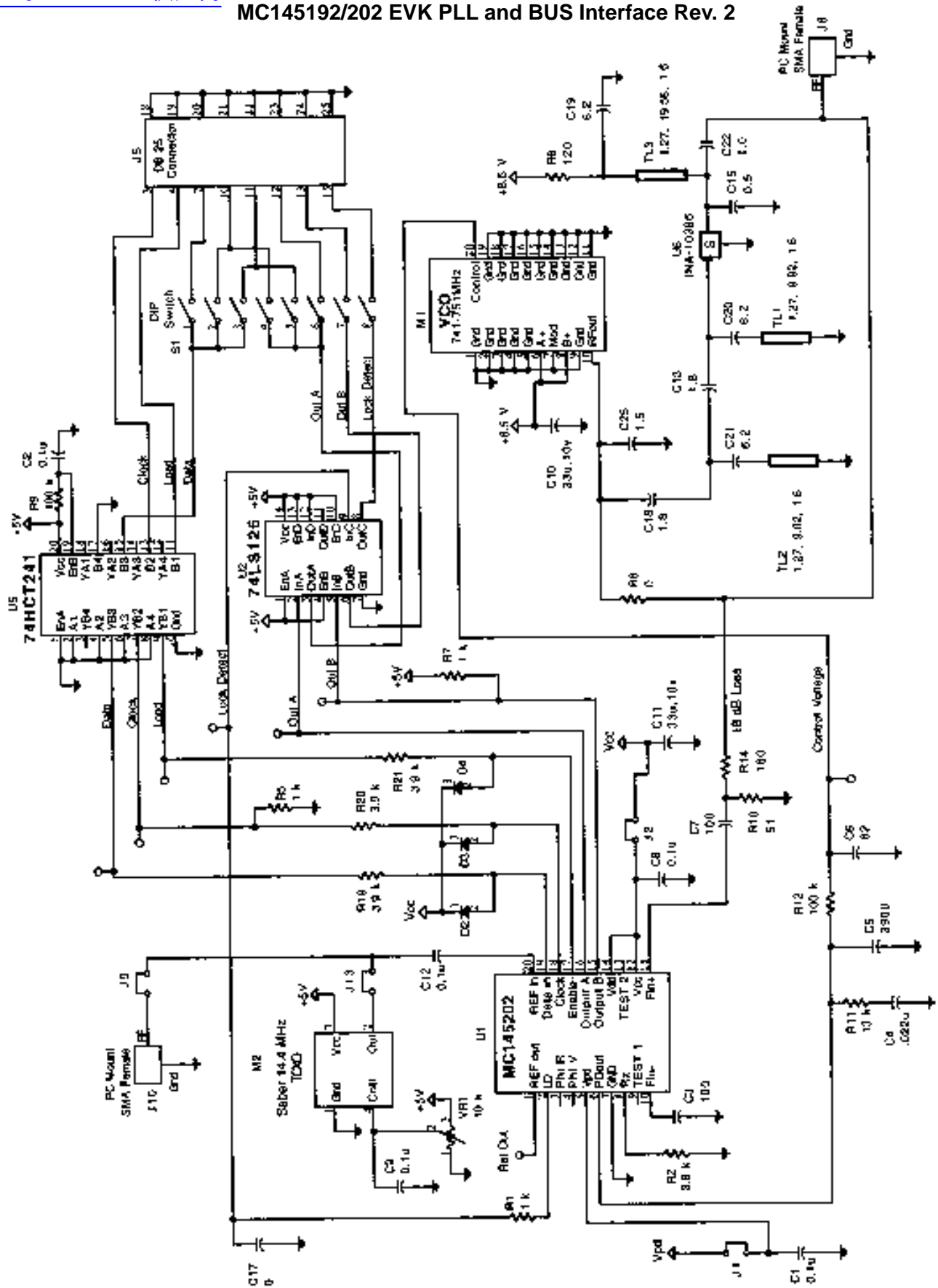
"MC145192"
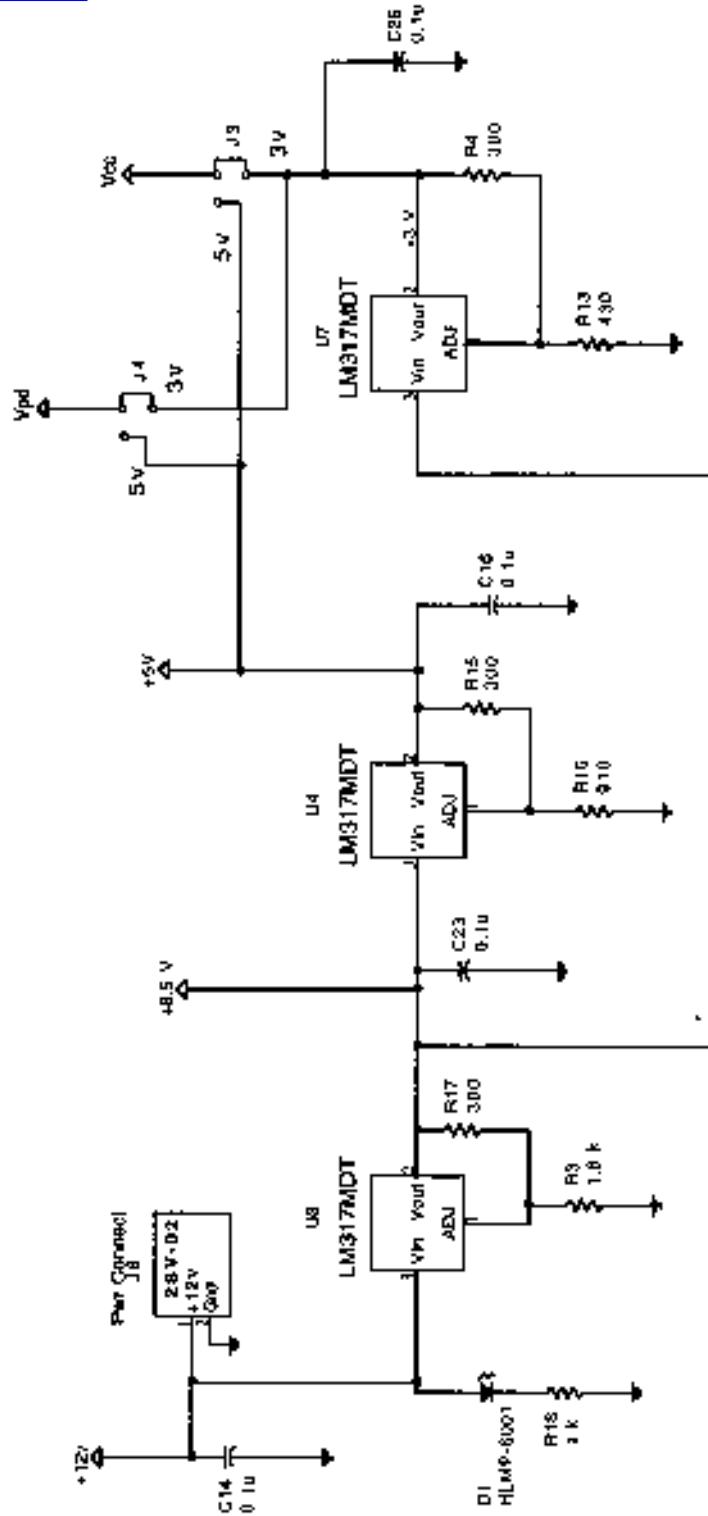
NOTES:
1. Default unit for capacitance is pF.
2. Default unit for resistance is ohms.
3. Board material is 1/16" thick G10.
4. Test points are 0.04" diameter plated through holes.
5. U1, R2, R8, C22, J3, and J4 are different on each type of EVK.
   See the manual section titled "Components Unique to Each EVK".

Drill Layer with Silkscreen (Top View)

Dimensions are in Inches

Silkscreen Layer (Top View)

"MC 145192"

MC145192/202 EVK Rev. 2
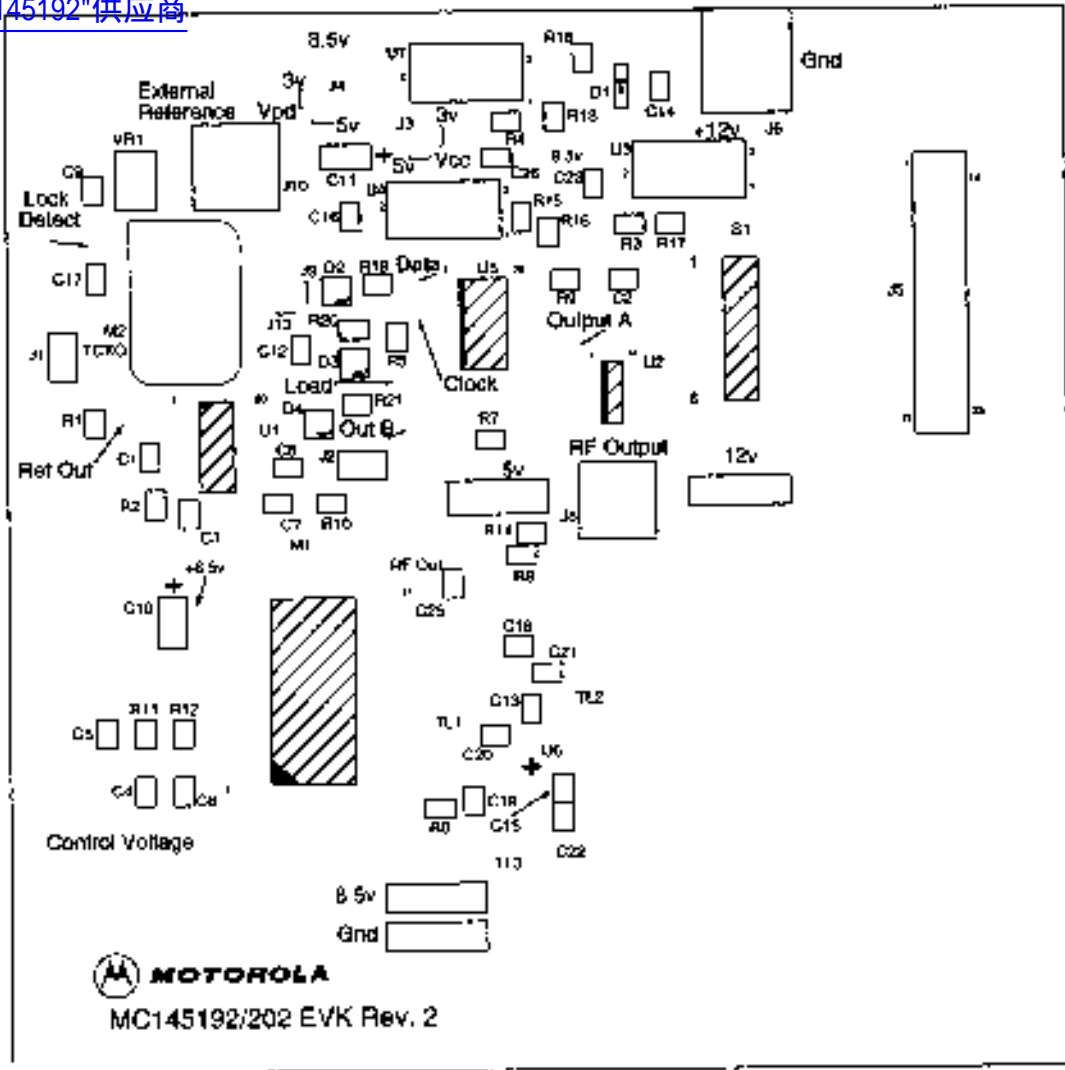
MC145192EVK Signal Plot

RL 10.0 dBm   10 dB/Div.

ΔMKR
100.4 kHz
−77.00 dB

CENTER 738 MHz   SPAN 250.0 kHz
RBW 1.0 kHz   VBW 1.0 kHz
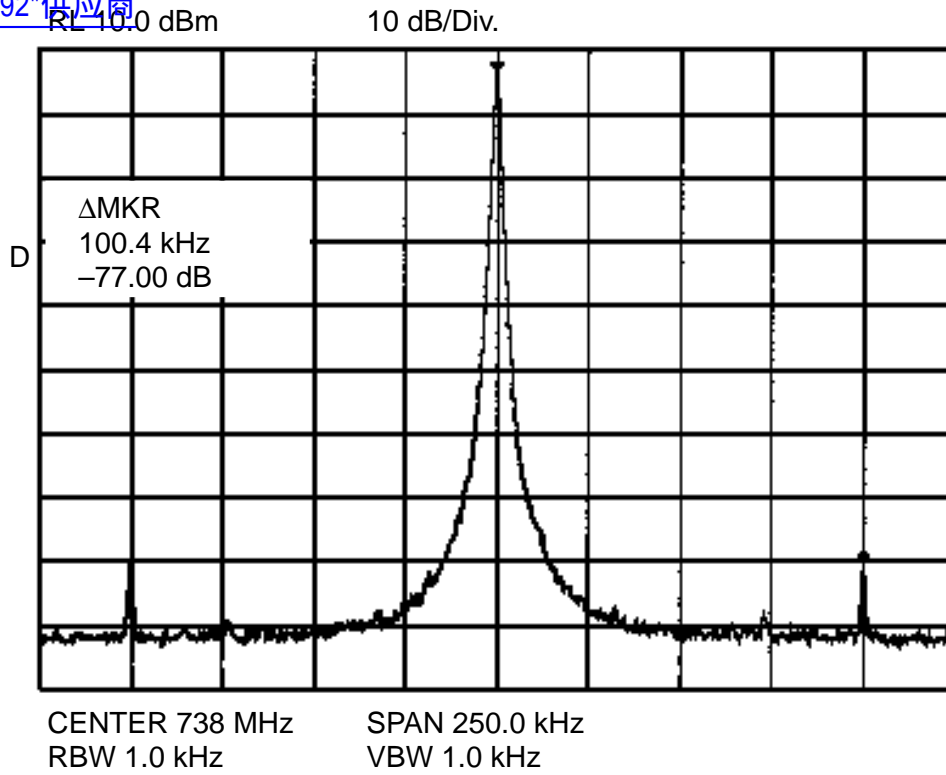
MC145202EVK Signal Plot

RL 10.0 dBm   10 dB/Div.

ΔMKR
200.0 kHz
−79.66 dB

CENTER 1.476 GHz   SPAN 500.0 kHz
RBW 3.0 kHz   VBW 3.0 kHz
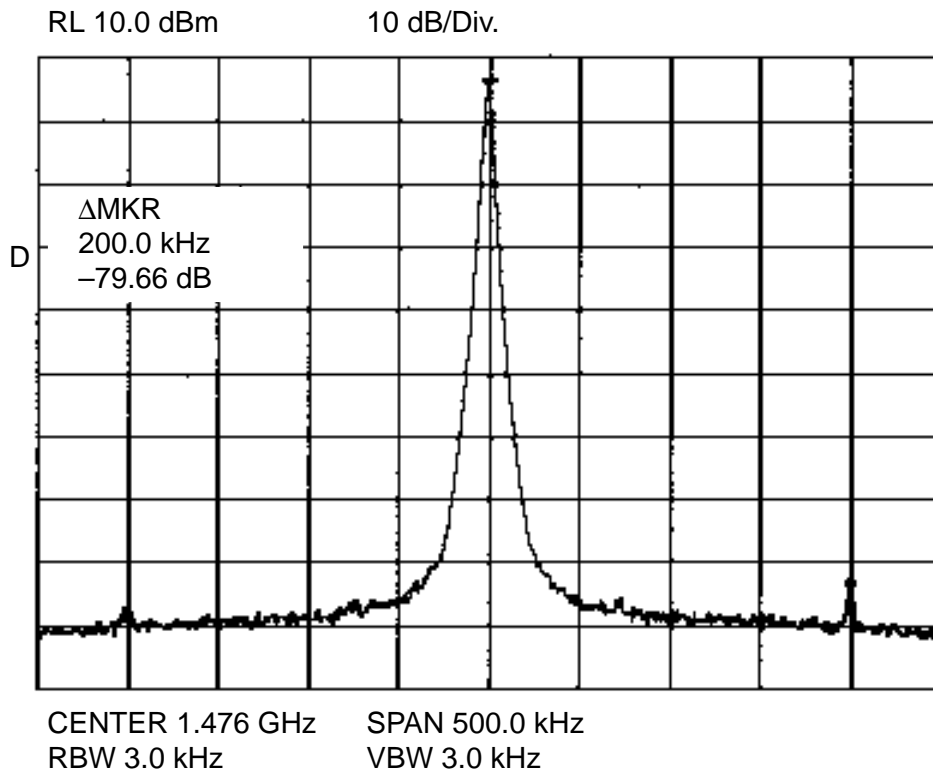
Bill of Materials — MC145192 PLL Evaluation Board Rev. 2

"MC145192"	Type	Package	Manufacturer	Value	Quantity	References
2SV–02	Pwr Connect	Special	Augat		1	J6
50–651–0000–31	SMA Female	Special	ITT Sealectro		2	J8, J10
51R05279V17	VCO, MS Spec	Special	Motorola		1	M1
76SB08S	DIP Switch	16 Pin	Grayhill		1	S1
617Y–025SAJ120	DB–25 Female	Special	Amphenol		1	J5
3266W1–103	Trim Pot.	Special	Bourns	10 k	1	VR1
Capacitor	5%, X7R	0805		0.022 μF	1	C4
Capacitor	Ceramic	0805		0.1 μF	9	C1, C2, C8, C9, C12, C14, C16, C23, C26
Capacitor	AccuF, ± .1, 50 V	0805	AVX	0.5	1	C15
Capacitor	AccuF, ± .1, 50 V	0805	AVX	1.5	1	C25
Capacitor	AccuF, ± .1, 50 V	0805	AVX	1.8	2	C13, C18
Capacitor	AccuF, ± .1, 50 V	0805	AVX	6.2	2	C19, C21
Capacitor	AccuF, ± .1, 50 V	0805	AVX	8.2	1	C20
Capacitor	5% NPO	0805		82	1	C6
Capacitor	5% NPO	0805		100	2	C3, C7
Capacitor	5% NPO	0805		3900	1	C5
HLMP–6001–011	LED	Special	HP		1	D1
HSMS–8101	Diode	SOT–23	HP		3	D2, D3, D4
INA–10386	MMIC Amp	Special	HP		1	U6
Jumper	2 x 1 Header	0.1″ Grid			2	J1, J2
KXN1142AA SP01	Saber TCXO	Special	Motorola	14.4 MHz	1	M2
LM317MDT	Regulator	Special	Motorola		3	U3, U4, U7
MC74HCT241ADW	Octal Buffer	SO–20	Motorola		1	U5
MC145192F	PLL IC	SOG	Motorola		1	U1
Resistor	5% CF	0805		0	1	R8
Resistor	5% CF	0805		1 k	4	R1, R5, R7, R18
Resistor	5% CF	0805		1.8 k	1	R3
Resistor	5% CF	0805		3.9 k	3	R19, R20, R21
Resistor	5% CF	0805		13 k	1	R11
Resistor	5% CF	0805		18 k	1	R2
Resistor	5% CF	0805	Kamaya	51	1	R10
Resistor	5% CF	0805		100 k	2	R9, R12
Resistor	5% CF	0805	Kamaya	120	1	R6
Resistor	5% CF	0805	Kamaya	180	1	R14
Resistor	5% CF	0805		300	3	R4, R15, R17
Resistor	5% CF	0805		430	1	R13
Resistor	5% CF	0805		910	1	R16
SN74LS126D	Quad Buffer	SO–14	Motorola		1	U2
TDC–336K010NSF	Tant. Cap	Special	Mallory	33 μF, 10 V	2	C10, C11
Wire Jumper	0.6″, 24 AWG				1	J13
Wire Jumper, 2–Way	0.6″, 24 AWG				2	J3, J4
SJ5027SPBL	Rubber Bumpers		3M		5	

NOTE: J3 is connected to 3 V; J4 to 5 V. The rubber bumpers must be glued on bottom side of board in the four corners and in the center.

Bill of Materials — MC145202 PLL Evaluation Board Rev. 2

"MC 145192"	Type	Package	Manufacturer	Value	Quantity	References
2SV–02	Pwr Connect	Special	Augat		1	J6
50–651–0000–31	SMA Female	Special	ITT Sealectro		2	J8, J10
51R05279V17	VCO, MS Spec	Special	Motorola		1	M1
76SB08S	DIP Switch	16 Pin	Grayhill		1	S1
617Y–025SAJ120	DB–25 Female	Special	Amphenol		1	J5
3266W1–103	Trim Pot.	Special	Bourns	10 k	1	VR1
Capacitor	5%, X7R	0805		0.022 μF	1	C4
Capacitor	Ceramic	0805		0.1 μF	9	C1, C2, C8, C9, C12, C14, C16, C23, C26
Capacitor	AccuF, ± .1, 50 V	0805	AVX	.05	1	C15
Capacitor	AccuF, ± .1, 50 V	0805	AVX	1.0	1	C22
Capacitor	AccuF, ± .1, 50 V	0805	AVX	1.5	1	C25
Capacitor	AccuF, ± .1, 50 V	0805	AVX	1.8	2	C13, C18
Capacitor	AccuF, ± .1, 50 V	0805	AVX	6.2	2	C19, C21
Capacitor	AccuF, ± .1, 50 V	0805	AVX	8.2	1	C20
Capacitor	5% NPO	0805		82	1	C6
Capacitor	5% NPO	0805		100	2	C3, C7
Capacitor	5% NPO	0805		3900	1	C5
HLMP–6001–011	LED	Special	HP		1	D1
HSMS–8108	Diode	SOT–23	HP		3	D2, D3, D4
INA–10386	MMIC Amp	Special	HP		1	U6
Jumper	2 x 1 Header	0.1″ Grid			2	J1, J2
KXN1142AA SP01	Saber TCXO	Special	Motorola	14.4 MHz	1	M2
LM317MDT	Regulator	Special	Motorola		3	U3, U4, U7
MC74HCT241ADW	Octal Buffer	SO–20	Motorola		1	U5
MC145202F	PLL IC	SOG	Motorola		1	U1
Resistor	5% CF	0805		1 k	4	R1, R5, R7, R18
Resistor	5% CF	0805		1.8 k	1	R3
Resistor	5% CF	0805		3.9 k	4	R2, R19, R20, R21
Resistor	5% CF	0805		13 k	1	R11
Resistor	5% CF	0805	Kamaya	51	1	R10
Resistor	5% CF	0805		100 k	2	R9, R12
Resistor	5% CF	0805	Kamaya	120	1	R6
Resistor	5% CF	0805	Kamaya	180	1	R14
Resistor	5% CF	0805		300	3	R4, R15, R17
Resistor	5% CF	0805		430	1	R13
Resistor	5% CF	0805		910	1	R16
SN74LS126D	Quad Buffer	SO–14	Motorola		1	U2
TDC–336K010NSF	Tant. Cap	Special	Mallory	33 μF, 10 V	2	C10, C11
Wire Jumper	0.6″, 24 AWG				1	J13
Wire Jumper, 2–Way	0.6″, 24 AWG				2	J3, J4
SJ5027SPBL	Rubber Bumpers		3M		5	

NOTE: J3 and J4 are connected to 5 V. The rubber bumpers must be glued on bottom side of board in the four corners and in the center.

MOTOROLA

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