

Interfacing the DP8422A to the 68020 (Zero Wait State Burst Mode Access)

National Semiconductor
Application Note 616
Lawson H. C. Chang
March 1989



Interfacing the DP8422A to the 68020 (Zero Wait State Burst Mode Access)

INTRODUCTION

This application note describes interfacing the DP8422A DRAM controller (also applicable to DP8420A/21A) to the 68020 with slower memories. This design is based upon burst mode access by holding $\overline{\text{RAS}}$ low and toggling $\overline{\text{CAS}}$. It is assumed that the user is familiar with the DP8422A and 68020 mode operations.

DESIGN DESCRIPTION

This design consists of the DP8422A DRAM controller, two PALs (16R4D and 16L8D), and a page detector (ALS6311). This design accommodates two banks of DRAM, each bank being 32 bits in width, giving maximum memory capacity of either 8 Mbytes (using 1M x 1 DRAMs) or 32 Mbytes (using 4M x 1 DRAMs). This design is based on 1M x 1 DRAM running at 16 MHz clock. The schematic diagram of interfacing DP8422A to the 68020 is shown in Figure 1. The

DP8422A is operated in Mode 1. An access cycle begins when the 68020 places a valid address on the address bus and asserts the Address Strobe ($\overline{\text{AS}}$) if a refresh or Port B access (DP8422A only) is not in progress. The proper $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ will be asserted respectively, depending upon programming bits C6, C5, and C4 for $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ configuration after guaranteeing the programmed value of row address hold time and the column address setup time.

The High Speed Access ($\overline{\text{HSA}}$) output signal of page detector indicates whether the current access is in the same page as previous access or not. $\overline{\text{ADS}}$ ($\overline{\text{AREQ}}$) is kept low if the current access is in the page, otherwise $\overline{\text{ADS}}$ ($\overline{\text{AREQ}}$) will be forced to go high to terminate the burst access. Internal refresh logic automatically generates refresh request every 15 μs . The timing diagrams are shown in Figure 2 and Figure 3.

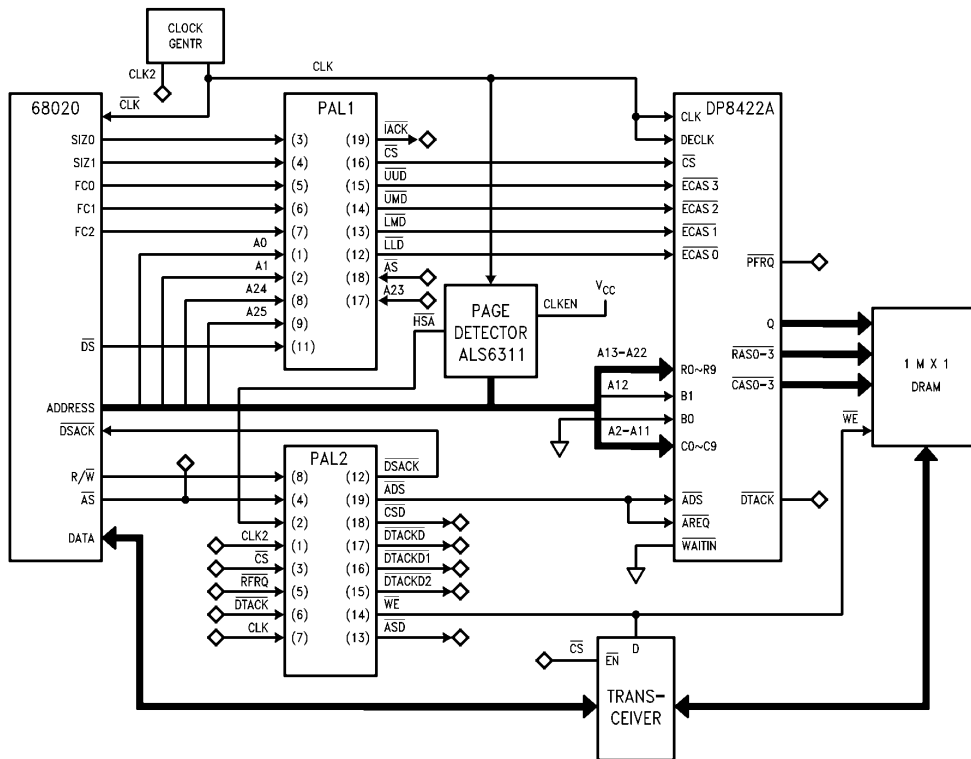


FIGURE 1. Schematic Diagram of Interfacing DP8422A/68020 Burst Access

TL/F/10440-1

DP8422A PROGRAMMING BITS

u = User Defined

Programming Bits	Description
R0, R1 = 0, 1	\overline{RAS} High and Low Times
R2, R3 = 0, 0	\overline{DTACK} Generation Mode for Nonburst Access
R4, R5 = 0, 0	\overline{DTACK} Generation Mode for Burst Access
R6 = 0	Add Wait States if \overline{WAITIN} is Low
R7 = 1	\overline{DTACK} Mode Select
R8 = 1	Noninterleave Mode
R9 = u	All \overline{RAS} 's or Staggered Refresh Select
C0, C1, C2 = 0, 1, 0	Refresh Clock Divisor Select
C3 = 0	Refresh Clock Divider Select
C4, C5, C6 = 0, 0, 1	\overline{RAS} and \overline{CAS} Configuration Mode
C7 = 1	t_{ASC} Mode Select
C8 = 1	t_{RAH} Mode Select
C9 = u	Delay \overline{CAS} during Write Access Mode Select
B0 = 1	Fall through Mode
B1 = 1	Mode 1 Access
$\overline{ECAS0}$ = 1	Extend \overline{CAS} and Refresh Request

DESIGN TIMING PARAMETERS

Timing parameters are referenced to the numbers shown in the DP8422A data sheet timing parameters. Numbered times starting with a "\$" refer to DP8422A timing parameters. Numbered times starting with a "#" refer to 68020 timing parameters.

16 MHz	$t_{CP} = 62.5$ ns
\$400:	\overline{ADS} Asserted Setup to CLK $\frac{1}{2} t_{CP} - PAL t_{CLK} \text{ Max.}$ = 31.25 ns - 8 ns = 23.25 ns
\$401:	\overline{CS} Setup to \overline{ADS} Asserted $2 t_{CP} + PAL t_{CLK} \text{ Min.} - \#6 \overline{CLK}$ to Address Valid - PAL t_p Max. = 125 ns + 5.5 ns - 30 ns - 10 ns = 90.5 ns
\$416:	\overline{AREQ} Negated to \overline{ADS} Asserted $t_{CP} - (PAL t_{CLK} \text{ Max.} - PAL t_{CLK} \text{ Min.})$ = 62.5 ns - 2.5 ns = 60 ns
#47:	\overline{DTACK} (68020) Low Setup to CLK Low $\frac{1}{2} t_{CP} - PAL t_{CLK} \text{ Max.} - PAL t_p \text{ Max.}$ = 31.25 ns - 8 ns - 10 ns = 13.5 ns

t_{RAC}	(Nonburst Access): $3 t_{CP} - PAL t_{CLK} \text{ Max.} - PAL t_p \text{ Max.} - \402 \overline{ADS} Low to \overline{RAS} Low - #27 Data Setup - F245 Transceiver t_p Max. = 187.5 ns - 8 ns - 10 ns - 29 ns - 5 ns - 6 ns = 129.5 ns (-25 Part) = 187.5 ns - 8 ns - 10 ns - 35 ns - 5 ns - 6 ns = 123.5 ns (-20 Part)
t_{CAC}	(Nonburst Access): $3 t_{CP} - PAL t_{CLK} \text{ Max.} - PAL t_p \text{ Max.} - \$403a$ \overline{ADS} Low to \overline{CAS} Low - #27 Data Setup - F245 Transceiver t_p Max. = 187.5 ns - 8 ns - 10 ns - 82 ns - 5 ns - 6 ns = 76.5 ns (-25 Part) = 187.5 ns - 8 ns - 10 ns - 94 ns - 5 ns - 6 ns = 64.5 ns (-20 Part)
t_{AA}	(Nonburst Access): $3 t_{CP} - PAL t_{CLK} \text{ Max.} - PAL t_p \text{ Max.} - \417 \overline{ADS} Low to Column Address Valid - #27 Data Setup - F245 Transceiver t_p Max. = 187.5 ns - 8 ns - 10 ns - 78 ns - 5 ns - 6 ns = 80.5 ns (-25 Part) = 187.5 ns - 8 ns - 10 ns - 92 ns - 5 ns - 6 ns = 66.5 ns (-20 Part)
t_{CAC}	(Burst Access): $2 t_{CP} - \#9 \overline{CLK}$ High to \overline{DS} Low Max. - PAL t_p Max. - \$14 \overline{ECAS} Low to \overline{CAS} Low Max. - #27 Data Setup - F245 Transceiver t_p Max. = 125 ns - 30 ns - 10 ns - 27 ns - 5 ns - 6 ns = 47 ns (-25 Part) = 125 ns - 30 ns - 10 ns - 31 ns - 5 ns - 6 ns = 43 ns (-20 Part)
t_{AA}	(Burst Access): $3.5 t_{CP} - \#6 \overline{CLK}$ Low to Address Valid Max. - \$26 Address Valid to Q Max. - #27 Data Setup - F245 Transceiver t_p Max. = 218.75 ns - 30 ns - 35 ns - 5 ns - 6 ns = 142.75 ns (-25 Part) = 218.75 ns - 30 ns - 38 ns - 5 ns - 6 ns = 139.75 ns (-20 Part)

68020PAL EQUATIONS

The Boolean entry operators are listed as

“:=” Replaced by (After Clock)

“=” Equality

“*” AND

“+” OR

“/” Complement

“~” Active low

The brief explanation of PAL output signals

CS~ This combinational output signal is Chip Select.

CSD~ This sequential output signal is Chip Select Delayed by one clock.

ADS~ This sequential output signal is Address Strobe (also used as an Access Request, /AREQ, to DP8422A).

DTACKD~ This sequential output signal is Data Transfer Delayed by one clock.

DTACKD1~ This sequential output signal is Data Transfer Delayed by two clocks.

DTACKD2~ This sequential output signal is Data Transfer Delayed by three clocks.

WE~ This sequential output signal is Write Enable to DRAM.

DSACK~ This combinational output signal is Data Transfer and Size Acknowledge.

UUD~ This combinational output signal is to select upper upper byte.

UMD~ This combinational output signal is to select upper middle byte.

LMD~ This combinational output signal is to select lower middle byte.

LLD~ This combinational output signal is to select lower lower byte.

IACK~ This combinational output signal is interrupt acknowledge.

(I) PAL1 (PAL16L8D) EQUATIONS

Inputs: A0, A1, A23, A24, A25, FC2, FC1, FC0, SIZ0, SIZ1, DS~, AS~

Outputs:

$$/IACK\sim = /FC2 + /FC1 + /FC0$$

$$/CS\sim = /A23 * /A24 * /A25 * /FC2 * /FC1 * FC0 + /A23 * /A24 * /A25 * /FC2 * FC1 * /FC0 + /A23 * /A24 * /A25 * FC2 * /FC1 * FC0 + /A23 * /A24 * /A25 * FC2 * FC1 * /FC0$$

$$/UUD\sim = /A0 * /A1 * /DS\sim * /AS\sim$$

$$/UMD\sim = /SIZ0 * /A1 * /DS\sim * /AS\sim + A0 * /A1 * /DS\sim * /AS\sim + SIZ1 * /A1 * /DS\sim * /AS\sim$$

$$/LMD\sim = /A0 * /A1 * /DS\sim * /AS\sim + /A1 * /SIZ0 * /SIZ1 * /DS\sim * /AS\sim + SIZ1 * SIZ0 * /A1 * /DS\sim * /AS\sim + /SIZ0 * /A1 * A0 * /DS\sim * /AS\sim$$

$$/LLD\sim = A0 * SIZ0 * SIZ1 * /DS\sim * /AS\sim + /SIZ0 * /SIZ1 * /DS\sim * /AS\sim + A0 * A1 * /DS\sim * /AS\sim + A1 * SIZ1 * /DS\sim * /AS\sim$$

(II) PAL2 (PAL16R6D) EQUATIONS

Inputs: CLK2, CS~, HSA~, AS~, RFRQ~, DTACK~, CLK, RW~

$$/ADS\sim = /HSA\sim * /ASD\sim$$

$$/DSACK\sim = /DTACK\sim * /DTACKD\sim$$

$$/DTACKD\sim := /DTACK\sim * /CLK + /DTACKD\sim * CLK$$

$$/DTACKD1\sim := /DTACKD\sim * /CLK + /DTACKD1\sim * CLK$$

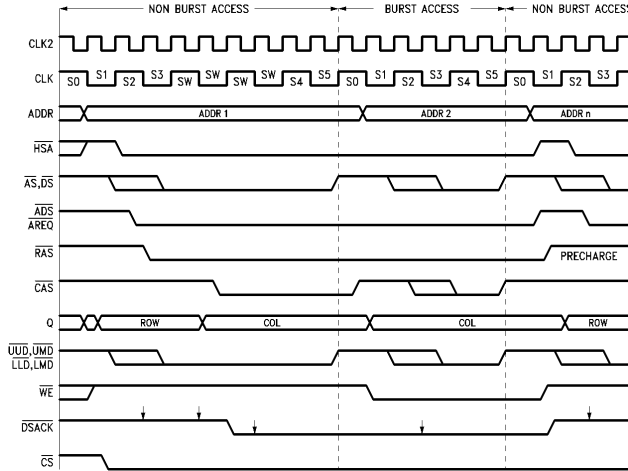
$$/DTACKD2\sim := /DTACKD1\sim * /CLK + /DTACKD2\sim * CLK$$

$$/ASD\sim := /CSD\sim * CLK /AS\sim + /CSD\sim * /HSA\sim * /AS\sim + /CSD\sim * /RFRQ\sim * /AS\sim + /RFRQ\sim * CSD\sim * /AS\sim + /RFRQ\sim * CLK * /AS\sim + /RFRQ\sim * /HSA\sim * /AS\sim + /CSD\sim * CLK * RFRQ\sim + /CSD\sim * /HSA\sim * RFRQ\sim$$

$$/WE\sim := /RW\sim * AS\sim * CLK + /WE\sim * /CLK$$

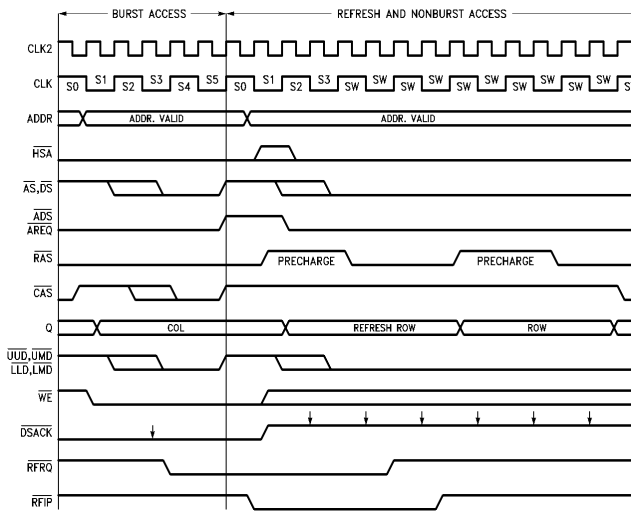
$$/CSD\sim := /CS\sim * /CLK + /CSD\sim * CLK$$

Note: PAL1 address inputs, such as A23, A24 and A25, are system memory size dependent.



TL/F/10440-2

FIGURE 2. Timing Diagram of Burst and Nonburst Access



TL/F/10440-3

FIGURE 3. Timing Diagram of Refresh, Burst and Nonburst Access.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
 2900 Semiconductor Drive
 P.O. Box 58090
 Santa Clara, CA 95052-8090
 Tel: (1800) 272-9959
 TWX: (910) 339-9240

National Semiconductor GmbH
 Livny-Gargan-Str. 10
 D-82256 Fürstenfeldbruck
 Germany
 Tel: (81-41) 35-0
 Telex: 527849
 Fax: (81-41) 35-1

National Semiconductor Japan Ltd.
 Sumitomo Chemical
 Engineering Center
 Bldg. 7F
 1-7-1, Nakase, Mihama-Ku
 Chiba-City,
 Chiba Prefecture 261
 Tel: (043) 299-2300
 Fax: (043) 299-2500

National Semiconductor Hong Kong Ltd.
 13th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semicondutores Do Brazil Ltda.
 Rue Deputado Lacorda Franco
 120-3A
 Sao Paulo-SP
 Brazil 05418-000
 Tel: (55-11) 212-5066
 Telex: 391-1131931 NSBR BR
 Fax: (55-11) 212-1181

National Semiconductor (Australia) Pty. Ltd.
 Building 16
 Business Park Drive
 Monash Business Park
 Nottingham, Melbourne
 Victoria 3168 Australia
 Tel: (3) 558-9999
 Fax: (3) 558-9998