

### Description

The  $\mu$ PD71065 and  $\mu$ PD71066 are CMOS devices that interface a floppy-disk drive (FDD) with a floppy-disk controller (FDC). The controller can be  $\mu$ PD765A/B,  $\mu$ PD7265,  $\mu$ PD72065/B,  $\mu$ PD72066,  $\mu$ PD7260, or one of the FD179X series.

The floppy-disk interface can operate at various data rates, including the 300-kb/s rate that results from using high-density 5-inch drives with media formatted at the standard 250-kb/s rate. Also, the  $\mu$ PD71065/66 generates the write clock needed by the selected controller and provides synchronous switching when changing data rates.

### Features

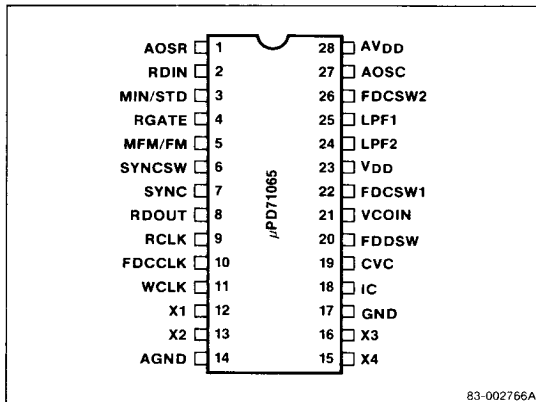
- ☐ Compatible with all industry-standard controllers
- ☐ Multiple data rates: 500/300/250/150/125 kb/s
- ☐ Internal or external sync field detection logic
- ☐ Head-loading timer for FD179X-series controllers
- ☐ No analog adjustments required
- ☐ CMOS, low power consumption
- ☐ 5-volt power supply

### Ordering Information

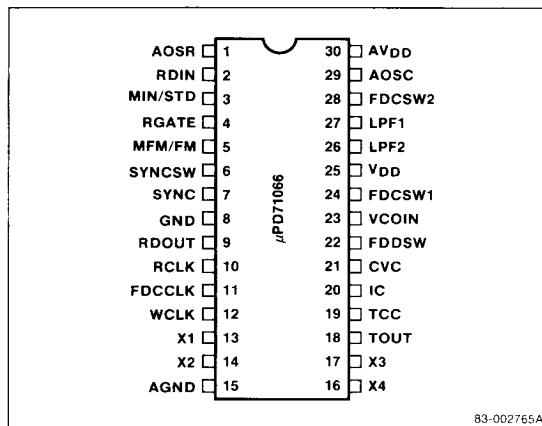
Part Number	Package	Internal Timer
$\mu$ PD71065G	28-pin plastic SO	Not included
$\mu$ PD71066CT	30-pin plastic shrink DIP	Implemented to FD179X-series controllers as head-loading timer.

### Pin Configurations

#### 28-Pin Plastic SO



#### 30-Pin Plastic Shrink DIP



### Pin Identification

Symbol	Input/Output	Function
ACOS		Capacitor connection pin for analog one-shot
AGND		Ground for analog circuits
AOSR		Resistor connection pin for analog one-shot
AV <sub>DD</sub>		Power supply for analog circuits
CVC		Capacitor connection pin for VCO
FDCCLK	Output	Clock to FDC
FDCSW1	Input*	FDC selection pin or timer trigger input
FDCSW2	Input*	FDC selection pin
FDDSW	Input*	Data transfer rate selection pin
GND		Ground
IC		Internally connected; should be left open
LPF1, LPF2	Output	Connection pins to external lowpass filter
MFM/FM	Input*	Recording density selection pin
MIN/STD	Input*	5- or 8-inch FDD selection pin
RCLK	Output	Read data sampling clock
RDOUT	Output	Read data to FDC
RGATE	Input*	Read enable/disable
RDIN	Input*	Read data from FDD
SYNC	Input*	External PLL gain selection
SYNCSW	Input*	Determines whether gain selection is internal or external
TCC		External RC time constant connection to internal timer (μPD71066)
TOUT	Output	Timer signal (μPD71066)
VCOIN	Input	External lowpass filter output to internal VCO
V <sub>DD</sub>		+5-volt power supply
WCLK	Output	Write clock to FDC
X1, X2		Connection pins for 16-MHz crystal (X1, X2) or external clock input (X1)
X3, X4		Connection pins for 19.2-MHz crystal (X3, X4) or external clock input (X3)

\*Input pin has an on-chip pull-up resistor

### Pin Functions

The following paragraphs supplement the brief descriptions of certain pins in the preceding table. Pin symbols are in alphabetical order.

**FDCSW1 and FDCSW2.** The μPD71065/66 is configured for the applicable FDC by applying logic levels L and H (or open) to these pins.

FDCSW1	FDCSW2	Floppy-Disk Controller
Open or H	Open or H	μPD765A/7265
L	Open or H	μPD7260
*	L	FD179X series

\* FDCSW1 is the trigger input to the timer circuit when FDCSW2 is low.

**FDDSW.** The logic level applied to this pin selects the data transfer rate of the FDD.

FDDSW	Data Transfer Rate
Open or H	500/250/125 kb/s
L	500/250/300/150 kb/s

**MFM/FM Pin.** The logic level applied to this pin and the FDCSW2 pin selects the modulation type. Double-density and single-density recording use MFM (modified FM) and FM modulation, respectively.

FDCSW2	MFM/FM	Modulation
H	H	MFM
H	L	FM
L	H	FM
L	L	MFM

**MIN/STD.** Logic level L on this pin selects a 5-inch FDD. An open or H selects an 8-inch FDD.

**RDIN.** This is a composite read data and clock signal input from the FDD.

**RDOUT.** The read data output from this pin is synchronized with the read clock (RCLK) derived from the RDIN composite signal.

**RGATE.** In conjunction with FDCSW2, RGATE enables or disables the read operation that is sent from the FDC.

FDCSW2	RGATE	Read Operation
H	H	Enable
H	L	Disable
L	H	Disable
L	L	Enable

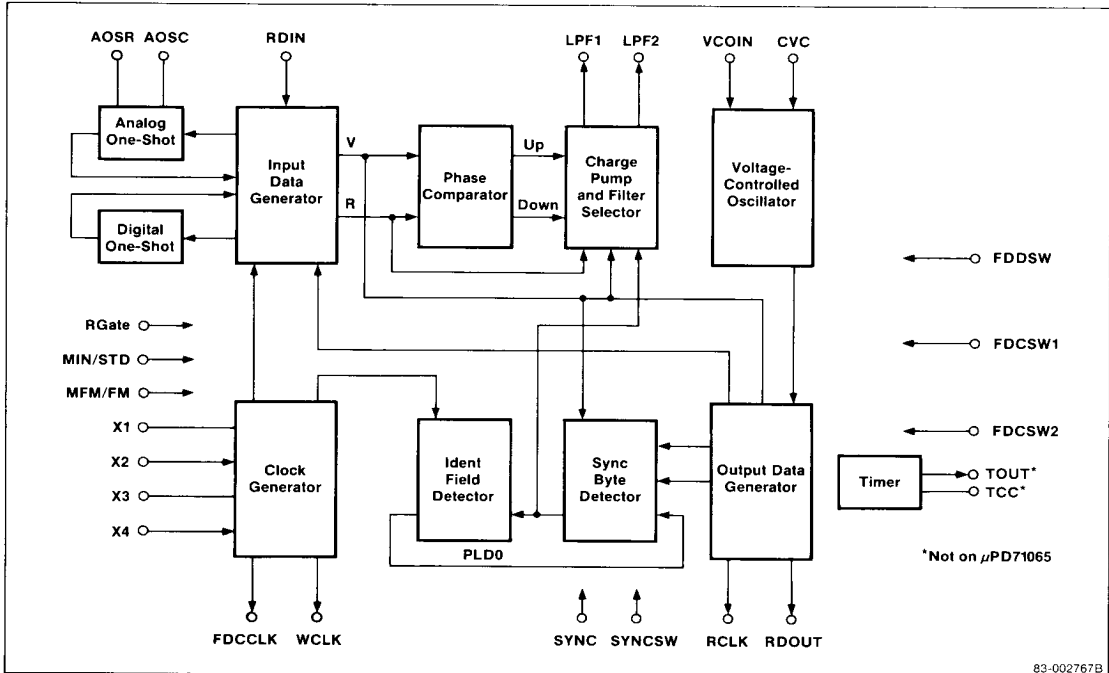
**SYNC and SYNC<sub>SW</sub>.** The PLL gain is determined by the input signal at the SYNC pin and the logic levels at the FDCSW1 and SYNC<sub>SW</sub> pins.

FDCSW1	SYNC <sub>SW</sub>	SYNC	PLL Gain
Open or H	Open or H	H (1)	Low
		L (1)	High
L	L	H (2)	Low
		L (2)	High

**Note:**

- (1) Input signal at SYNC is the PLL gain selection signal between the ID and DATA fields.
- (2) Input signal at SYNC is the SYNC field detection signal from the FDC.

## Block Diagram



Functions of the block diagram components are explained below.

**Clock Generator.** Using both 16-MHz and 19.2-MHz oscillators, outputs clock signals corresponding to the mode used to the FDCCLK and WCLK pins.

**Input Data Generator.** According to the input data, generates the R and V signals to be input to the phase comparator. In addition to this, the input data generator determines whether the analog one-shot circuit or the digital one-shot circuit is used.

**Charge Pump and Filter Selector.** According to the PLL (phase-locked loop) gain selection signal, enables or disables the LPF2 side charge pump to control the PLL gain.

**Output Data Generator.** Generates the window signal (RCLK) and read data signal (RDOUT) depending on the mode and FDC to be used.

**Sync Byte Detector.** Detects the sync field within 16 to 20 pulses regardless of FM or MFM mode.

**Ident Field Detector.** Determines whether the sync field detected by the sync byte detector is ID or DATA field and sets the PLL gain.

## Basic External Circuit

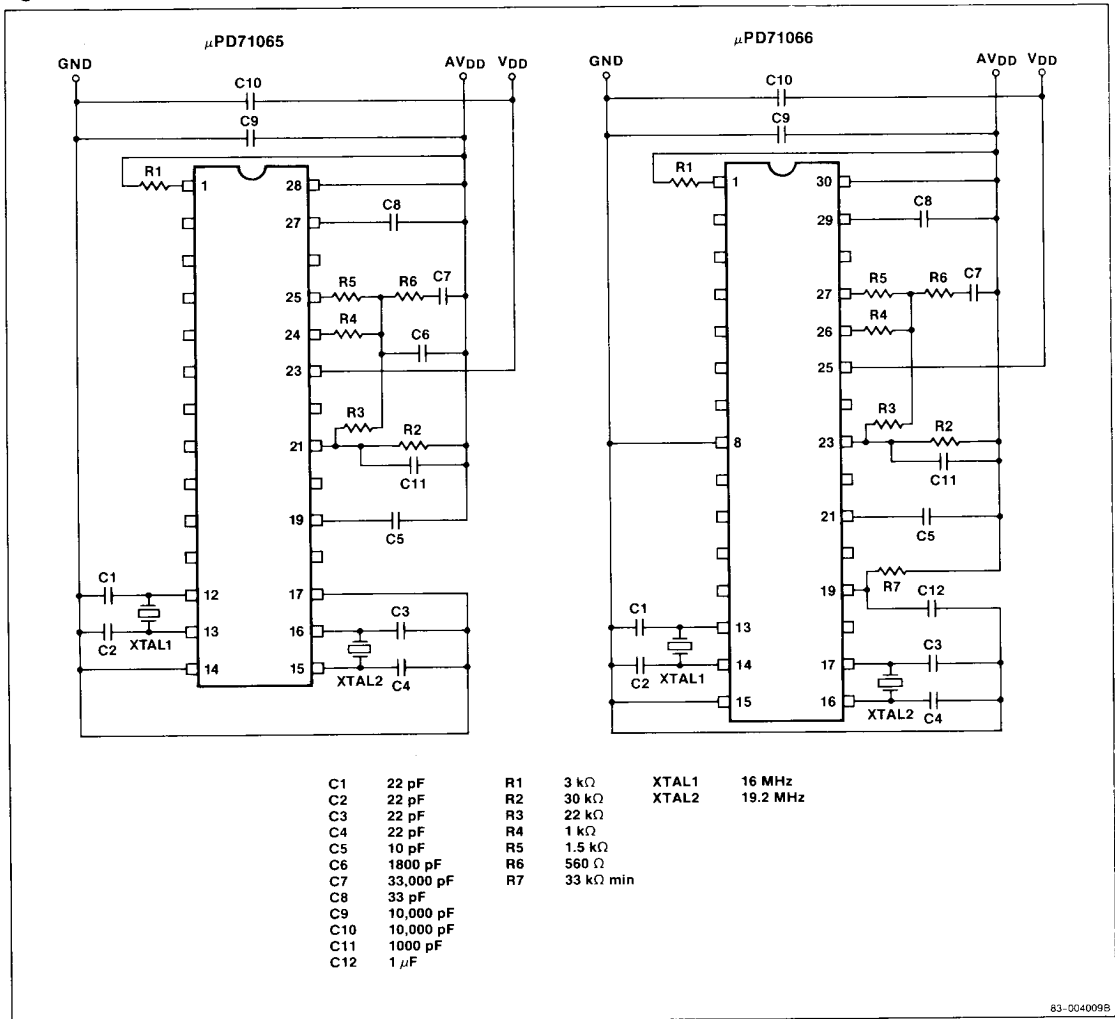
Figure 1 shows the basic external circuit including the lowpass filter and crystals. The data transfer rate is selected by strapping pins FDDSW, MIN/STD, and MFM/FM to L (low) or open (high). See table 1.

The VCO frequency and the phase delay between RDIN and RDOUT can be optimized by adjusting resistors R2 and R1, respectively.

## VCO Frequency

For this procedure, the data transfer rate is undefined. Strap RGATE to H and RDIN to L. Adjust resistor R2 to set the VCO frequency at the RCLK pin to the same numerical value as the data transfer rate; for example, 500 kHz and 500 kb/s.

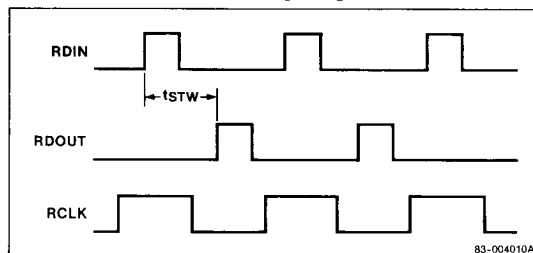
Figure 1. Basic External Circuit



## Data Read Phase Delay

For this procedure, set the data transfer rate to 500 kb/s, set the RDIN signal to a 2-μs cycle time, and strap RGATE to H. Adjust resistor R1 to set the value of  $t_{STW}$  (figure 2) to 950 ns.

**Figure 2. Read Data Timing Diagram**



**Table 1. Data Transfer Rate Selection**

Floppy-Disk Controllers	Data Transfer Rate (kb/s)	Clock Output Frequencies from μPD71065/71066			Selection Pins (Note 1)		
		FDCCLK (MHz)	RCLK (kHz)	WCLK (kHz)	FDCSW	MIN/STD	MFM/FM
μPD765A, μPD7265, μPD72065, μPD72066 (Note 2)	250	4	250	500	Open	Open	Open
	125	4	125	250	Open	Open	L
	500	8	500	1 MHz	Open	L	Open
	250	8	250	500	Open	L	L
	300	4.8	300	600	L	Open	Open
	150	4.8	150	300	L	Open	L
	500	8	500	1 MHz	L	L	Open
	250	8	250	500	L	L	L
μPD7260 (Note 3)	250	4	500	500	Open	Open	Open
	125	4	250	250	Open	Open	L
	500	8	1 MHz	1 MHz	Open	L	Open
	250	8	500	500	Open	L	L
	300	4.8	600	600	L	Open	Open
	150	4.8	300	300	L	Open	L
	500	8	1 MHz	1 MHz	L	L	Open
	250	8	500	500	L	L	L
FD179X Series (Note 4)	250	1	250	500	Open	Open	L
	125	1	125	250	Open	Open	Open
	500	2	500	1 MHz	Open	L	L
	250	2	250	500	Open	L	Open
	300	1.2	300	600	L	Open	L
	150	1.2	150	300	L	Open	Open
	500	2	500	1 MHz	L	L	L
	250	2	250	500	L	L	Open

### Note:

- (1) Selection pin states: L = low; Open = open or H (high) (4) FD179X Series:  
 (2) μPD765A/7265/72065/72066: FDCSW1 = Don't care and FDCSW2 = L.  
 FDCSW1 and FDCSW2 = Open WCLK clock is not used.  
 (3) μPD7260:  
 FDCSW1 = L and FDCSW2 = Open.  
 FDCCLK clock is not used

**Electrical Characteristics**

Figures 3 through 8 are test circuits for verifying certain parameters in the dc and ac characteristics tables.

**Absolute Maximum Ratings**

$T_A = +25^\circ\text{C}$

Power supply voltage, $V_{DD}$	-0.3 to +6 V
Input voltage, $V_I$	-0.3 to $V_{DD} + 0.3$ V
Output voltage, $V_O$	-0.3 to $V_{DD} + 0.3$ V
Operation temperature, $T_{OPT}$	-10 to +70°C
Storage temperature, $T_{STG}$	-40 to +125°C

**DC Characteristics**

$T_A = -10$  to  $+70^\circ\text{C}$ ;  $V_{DD} = +5\text{ V} \pm 10\%$

Parameter	Symbol	Limits			Unit	Test Conditions	Test Circuit
		Min	Typ	Max			
Input voltage, low	$V_{IL}$	-0.3		0.8	V		
Input voltage, high	$V_{IH}$	2.2		$V_{DD} + 0.3$	V		
Output voltage, low	$V_{OL}$			0.45	V	$I_{OL} = 2\text{ mA}$	
Output voltage, high	$V_{OH}$	$0.7 V_{DD}$		$V_{DD}$	V	$I_{OH} = -200\text{ }\mu\text{A}$	
Clock input level	$V_{Kp-p}$	1		$V_{DD}$	V		Figure 5
Input leakage current, low	$I_{LIL}$	-150		-50	$\mu\text{A}$	$V_I = 0\text{ V}$	
Input leakage current, high	$I_{LIH}$	-10		+10	$\mu\text{A}$	$V_I = V_{DD}$	
Output leakage current, low	$I_{LOL}$	-10			$\mu\text{A}$	$V_O = 0.45\text{ V}$	
Output leakage current, high	$I_{LOH}$			+10	$\mu\text{A}$	$V_O = V_{DD}$	
Power supply current	$I_{DD}$			25	mA	XTAL: 16 MHz, 19.2 MHz	Figure 3
				20	mA	XTAL: 16 MHz	Figure 4

## AC Characteristics

$T_A = -10$  to  $+70^\circ\text{C}$ ;  $V_{DD} = +5\text{ V} \pm 10\%$

Parameter	Symbol	Limits			Unit	Test Conditions	Test Circuit
		Min	Typ	Max			
Rise time	$t_R$	0		20	ns		
Fall time	$t_F$	0		20	ns		
RDOUT setup time to RCLK $\uparrow$	$t_{SRR}$	40			ns	For $\mu\text{PD7260}$	Figure 6
CLK high/low level width	$t_{KK}$	20			ns		
VCO oscillation frequency	$f_o$			8	MHz	$V_F = V_{DD}$	Figure 7
VCO free-run frequency	$f_i$	3.6	4	4.4	MHz	$FDDSW = H, V_F = \text{open}$	
		2.1	2.4	2.7	MHz	$FDDSW = L, V_F = \text{open}$	
VCO control voltage sensitivity	$K_V$	2.5	3.5	4.6	MHz/V	$ (V_{DD}/2) - V_F  \leq 0.5\text{ V}$	
$K_V$ voltage coefficient	$\Delta K_V/V_{DD}$	-1	-19	-22	%/V		
$f_i$ power supply voltage coefficient	$\Delta f_i/V_{DD}$	0		5	%/V		
$f_i$ temperature coefficient	$\Delta f_i/T_A$	0	-500	-1000	ppm/ $^\circ\text{C}$		
Phase detect sensitivity	$K_P$	0.7	0.8	0.9	V/rad		
RCLK jitter	$t_j$	0	30	50	ns	500-kb/s mode	Figure 8
RDIN $\uparrow$ to RDOUT $\uparrow$ delay time	$t_{DRR}$	900	950	1000	ns		
Capture range (Note 1)	$f_{CAP}$	537		427	kHz	500-kb/s mode	
		286		213	kHz	250-kb/s mode	
		143		107	kHz	125-kb/s mode	
		343		256	kHz	300-kb/s mode	
		172		128	kHz	150-kb/s mode	
FDCCCLK $\uparrow$ to WCLK $\uparrow$ delay time (Note 2)	$t_{DFWR}$			30	ns	$C_L = 15\text{ pF}$	Figure 1
FDCCCLK $\uparrow$ to WCLK $\downarrow$ delay time (Note 2)	$t_{DFWF}$			30	ns	$C_L = 15\text{ pF}$	

### Note:

- (1) The frequencies in the Max and Min columns are the lower and upper limits, respectively, of the capture range. For example, in the 500-kb/s mode, the capture range is from 427 kHz (or lower) to 537 kHz (or higher).
- (2) Clock outputs to FDC.

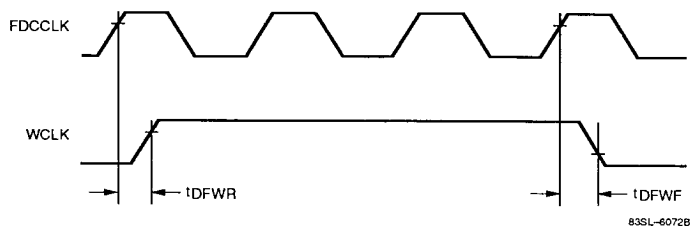


Figure 3. Test Circuit 1

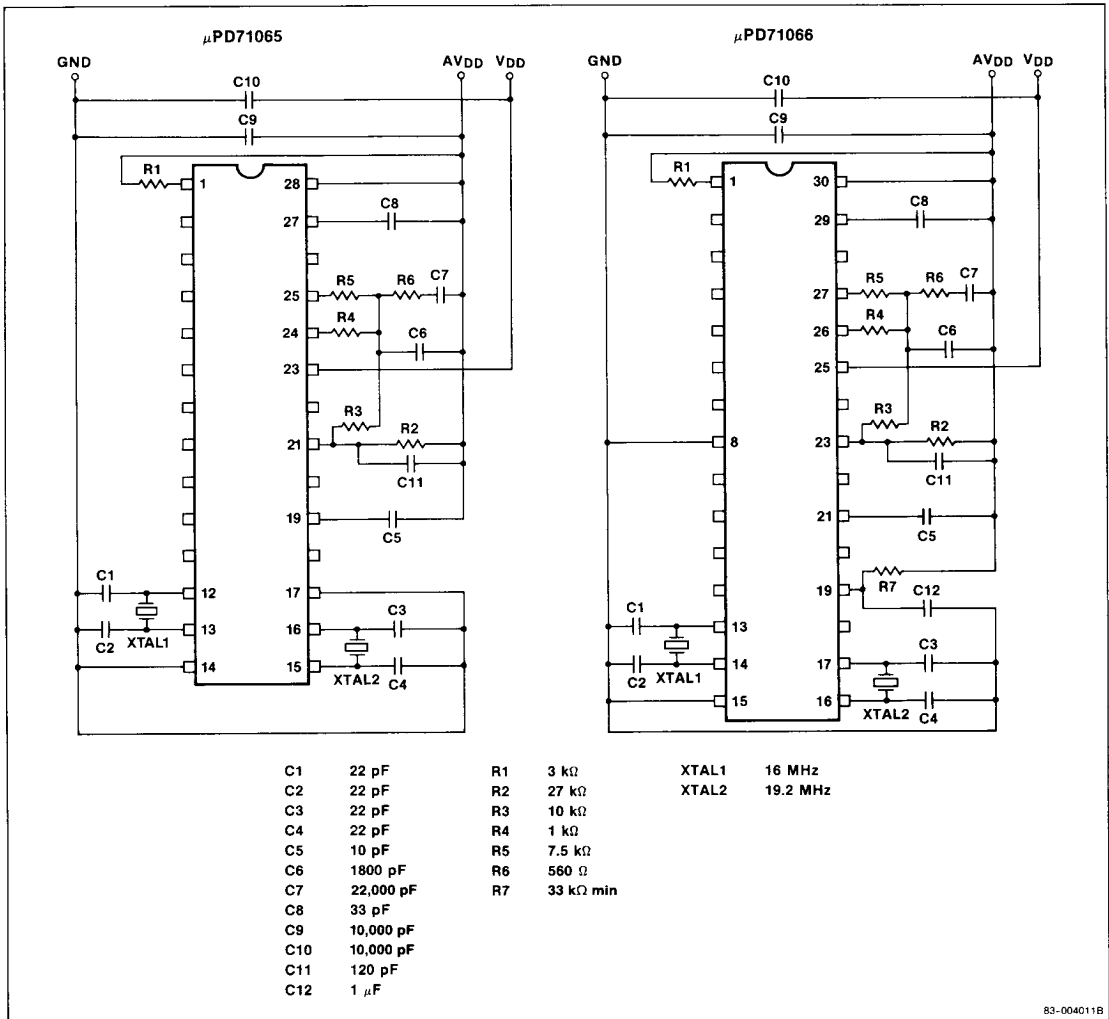
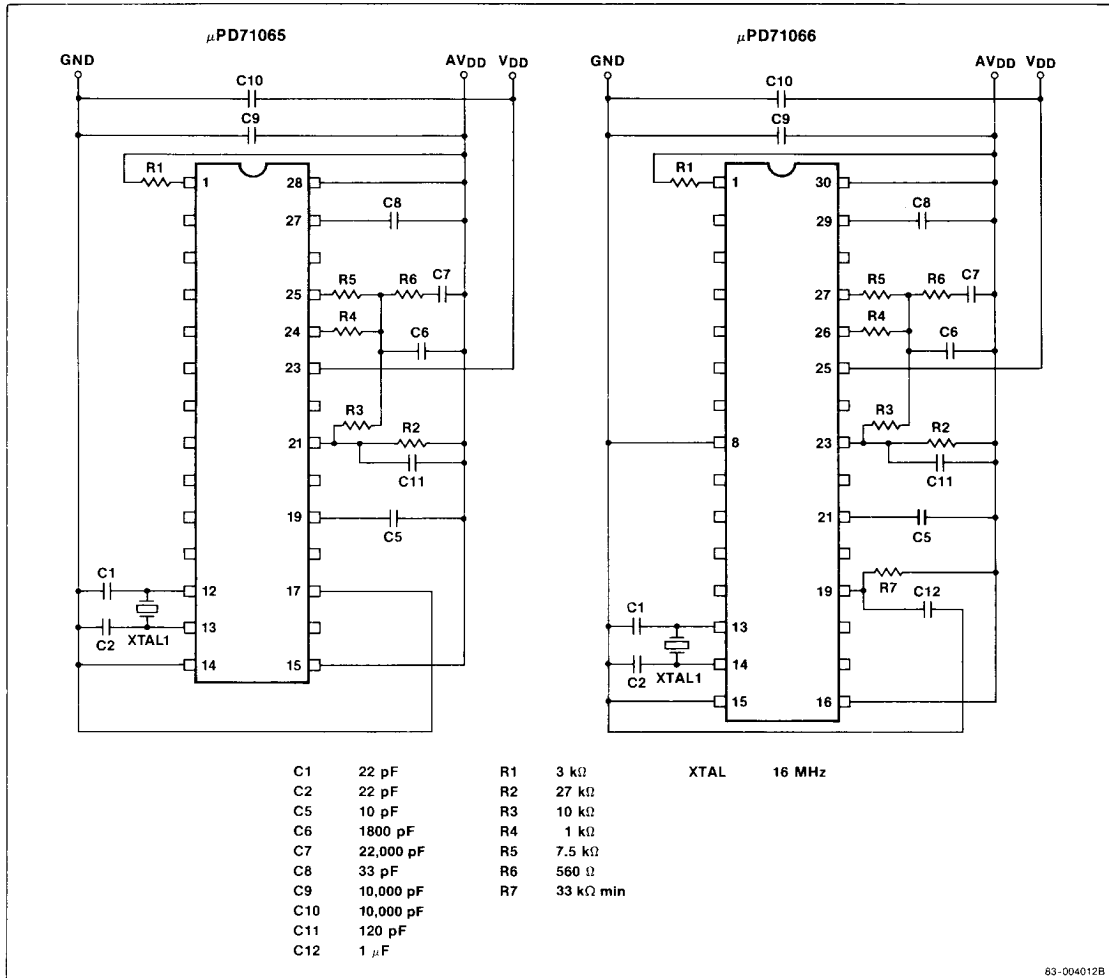
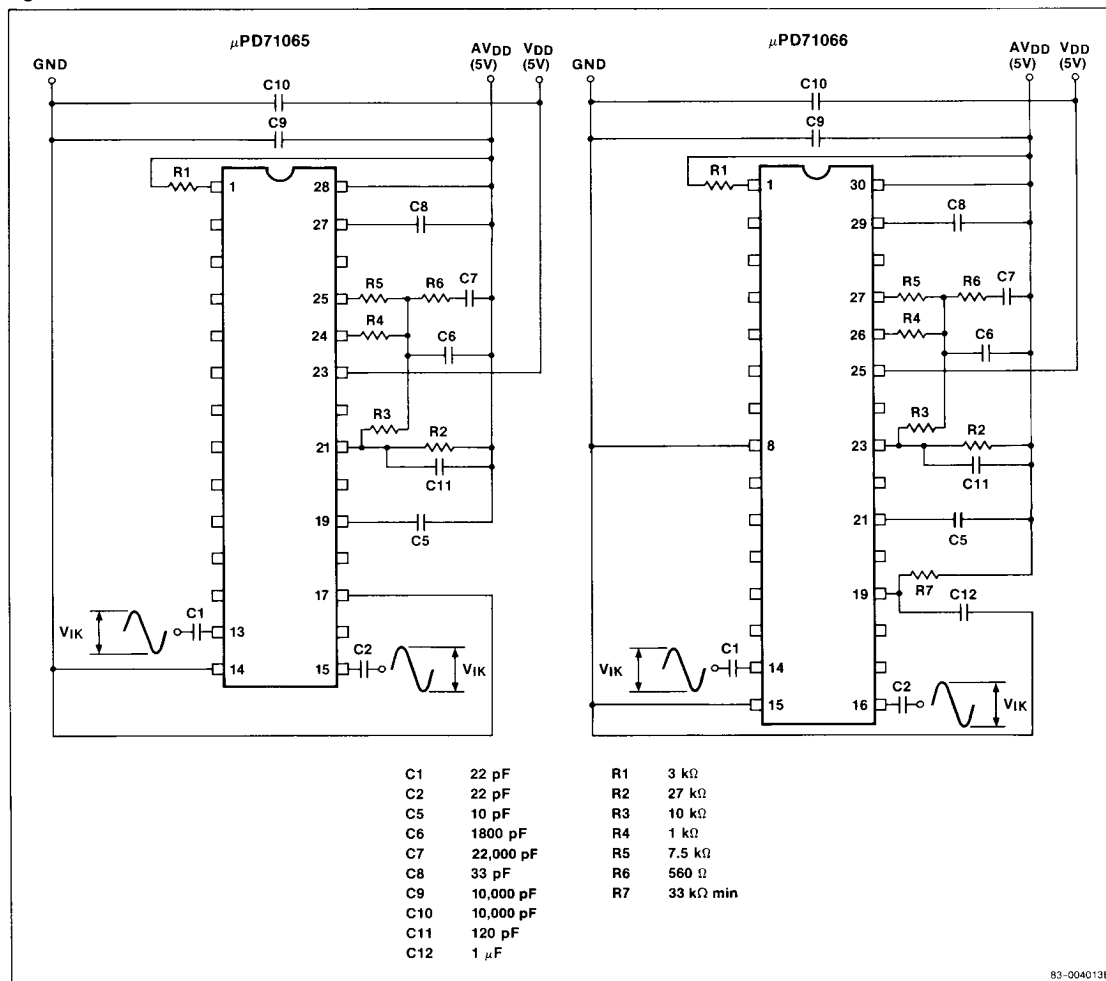




Figure 4. Test Circuit 2

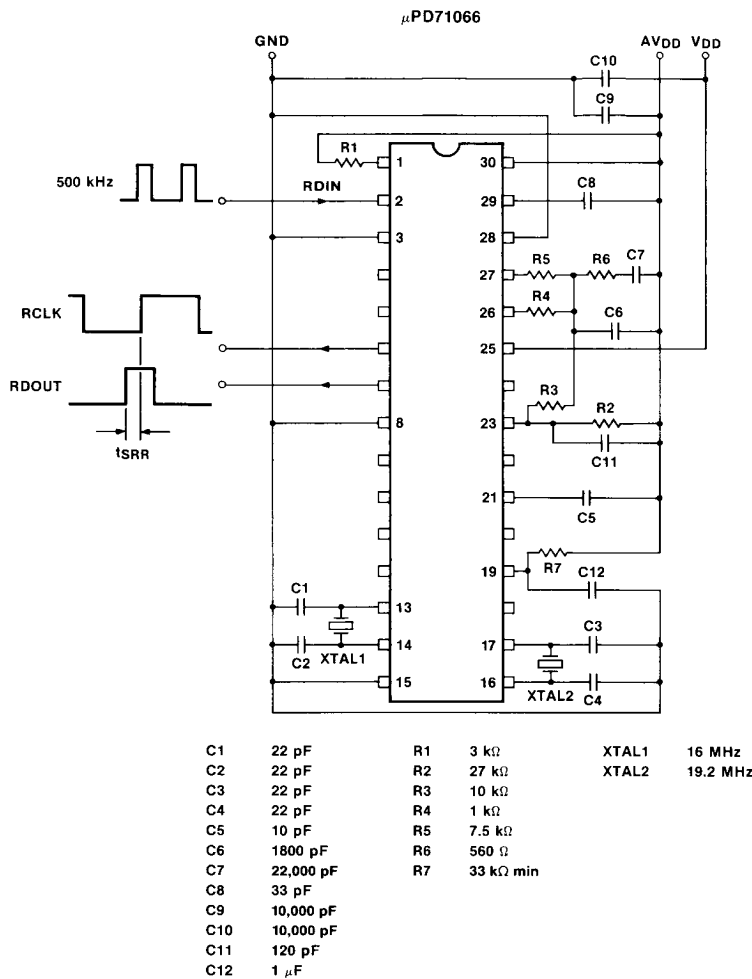


**Figure 5. Test Circuit 3**



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**Figure 6. Test Circuit 4**



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Figure 7. Test Circuit 5

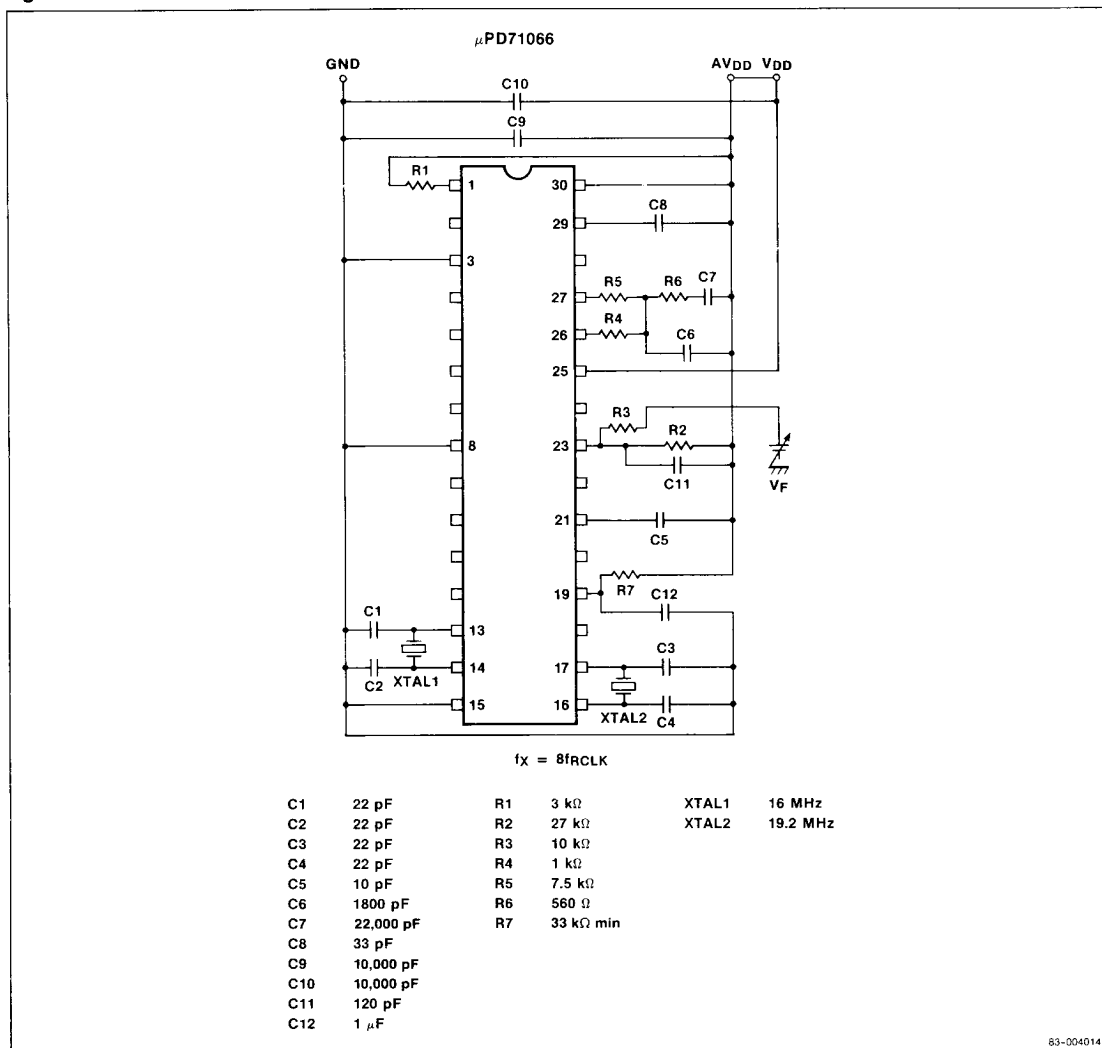
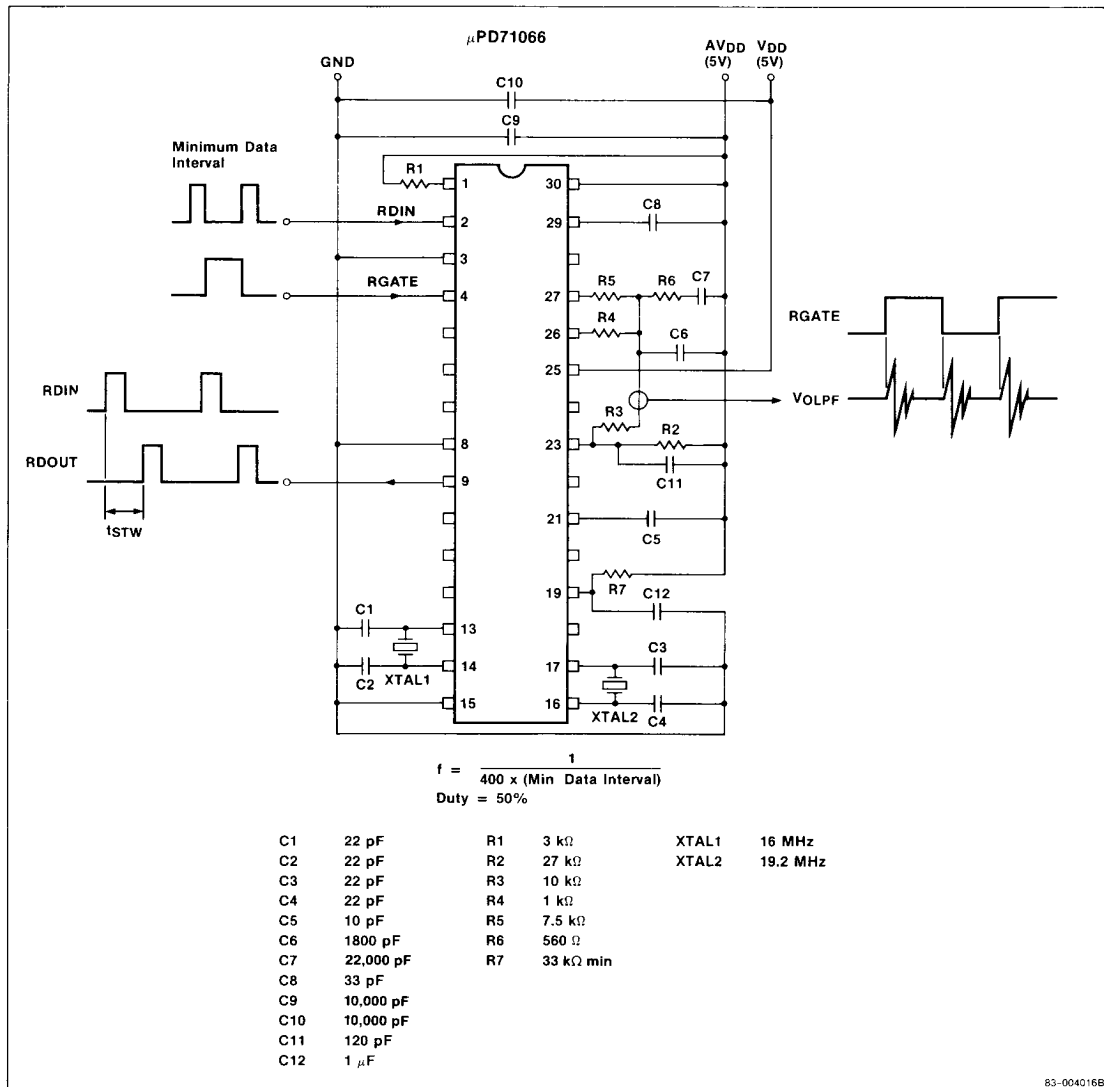


Figure 8. Test Circuit 6



## System Configurations

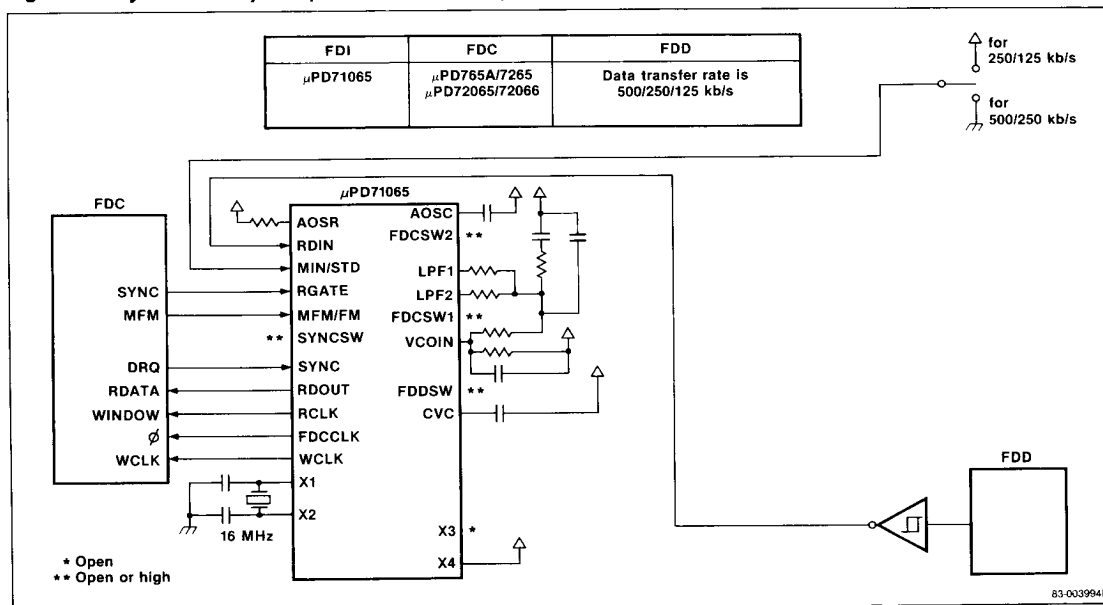
Figures 9 through 23 are system configuration examples of the μPD71065 and μPD71066 with various floppy-disk controllers and data transfer rates. See table 2.

For additional details and the values of resistors and capacitors, see figure 1.

**Table 2. System Configuration Examples**

Floppy-Disk Interface	Floppy-Disk Controllers	Data Transfer Rates (kb/s)	Figure
μPD71065	μPD765A, μPD7265, μPD72065, μPD72066	500/250/125	9
		300/150	10
		500/250/125 and 300/150	11
	μPD7260	500/250/125	12
		300/150	13
μPD71066	μPD765A, μPD7265, μPD72065, μPD72066	500/250/125 and 300/150	14
		500/250/125	15
		300/150	16
	μPD7260	500/250/125 and 300/150	17
		500/250/125	18
		300/150	19
	FD179X	500/250/125 and 300/150	20
		500/250/125	21
		300/150	22
		500/250/125 and 300/150	23

**Figure 9. System Example 1: μPD71065 FDI and μPD765A FDC**



FDI	FDC	FDD
$\mu$ PD71065	$\mu$ PD765A/7265 $\mu$ PD72065/72066	Data transfer rate is 300/150 kb/s

Block diagram illustrating the FDI/FDC/FDD interface. The FDI (FDI) block is connected to the FDC (FDC) block, which is connected to the FDD (FDD) block. The FDI block includes pins for AOSR, RDIN, MIN/STD, RGATE, MFM/FM, SYNC, RDOUT, RCLK, FDCCLK, WCLK, X1, X2, X3, and X4. The FDC block includes pins for AOSC, FDCSW2, LPF1, LPF2, FDCSW1, VCOIN, FDDSW, and CVC. The FDD block is connected to the FDC block via a buffer. A 19.2 MHz crystal is connected to X3 and X4.

Legend:

- \* Open
- \*\* Open or high

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FDI	FDC	FDD
μPD71065	μPD765A/7265 μPD72065/72066	Data transfer rates are both 500/250/125 kb/s & 300/150 kb/s

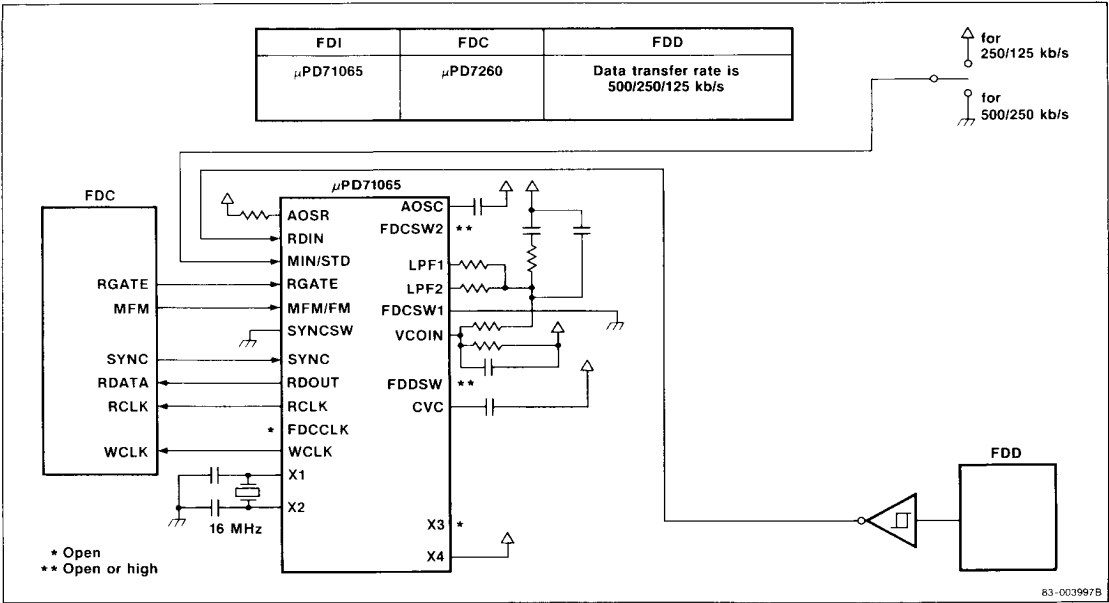
for 300/150/250/125 kb/s  
 for 500/250 kb/s  
 for 500/250/125 kb/s  
 for 500/250/300/150 kb/s

FDC: SYNC, MFM, DRQ, RDATA, WINDOW,  $\phi$ , WCLK  
 FDD: AOSC, FDCSW2, LPF1, LPF2, FDCSW1, VCOIN, FDDSW, CVC  
 Mux: Multiplexer  
 16 MHz, 19.2 MHz

\* Open  
 \*\* Open or high

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**Figure 12. System Example 4: μPD71065 FDI and μPD7260 FDC**



**Figure 13. System Example 5: μPD71065 FDI and μPD7260 FDC**

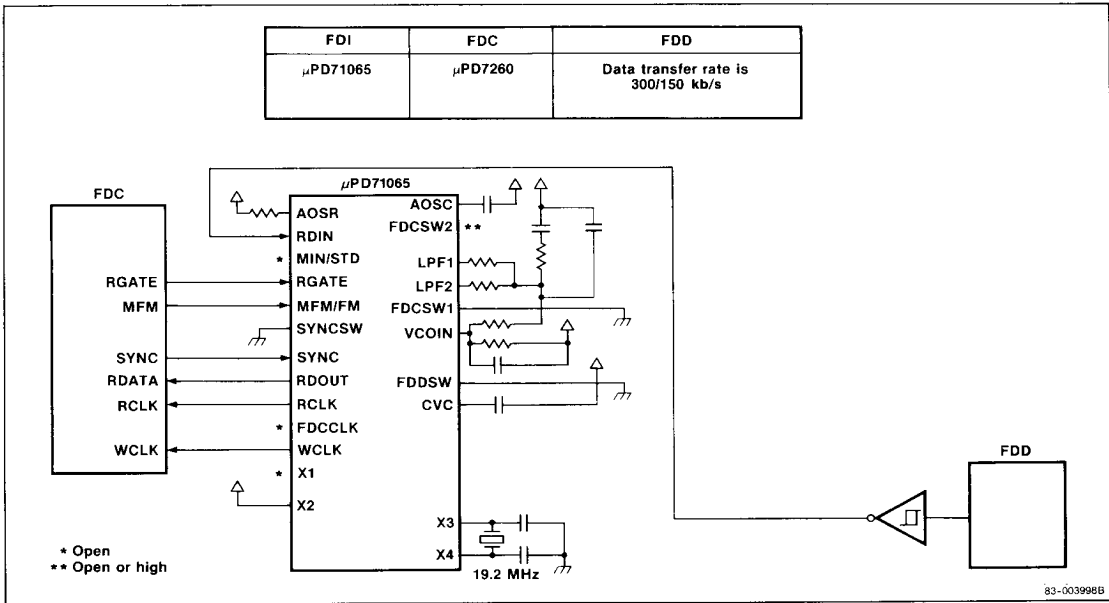




Figure 14. System Example 6: μPD71065 FDI and μPD7260 FDC

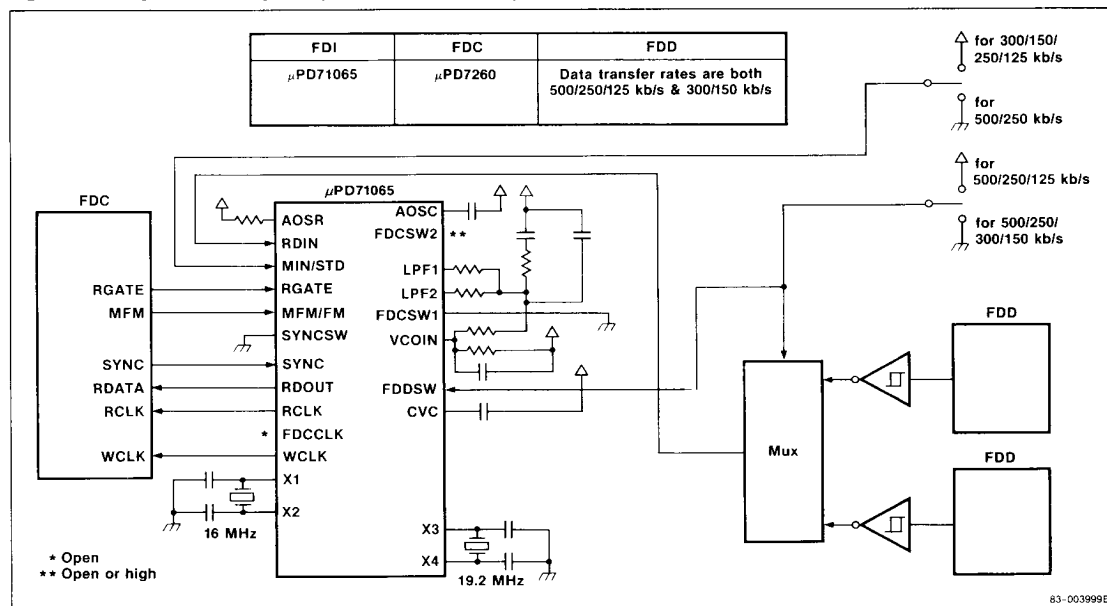
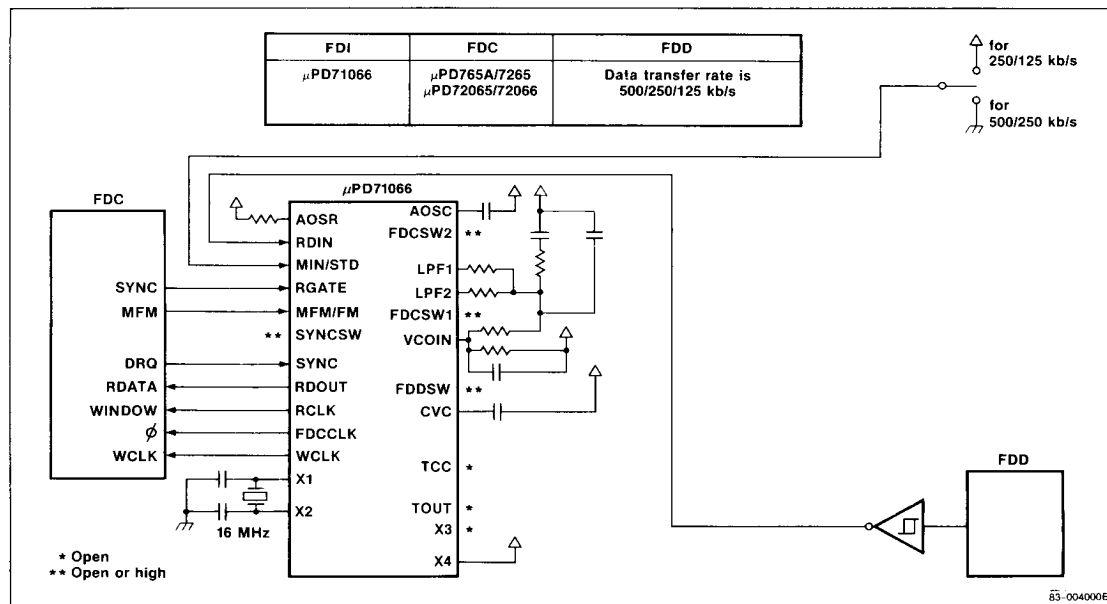


Figure 15. System Example 7: μPD71066 FDI and μPD765A FDC



FDI	FDC	FDD
$\mu$ PD71066	$\mu$ PD765A/7265 $\mu$ PD72065/72066	Data transfer rate is 300/150 kb/s

\* Open  
\*\* Open or high

83-004001B

FDI	FDC	FDD
μPD71066	μPD765A/7265 μPD72065/72066	Data transfer rates are both 500/250/125 kb/s & 300/150 kb/s

\* Open  
 \*\* Open or high

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Figure 18. System Example 10: μPD71066 FDI and μPD7260 FDC

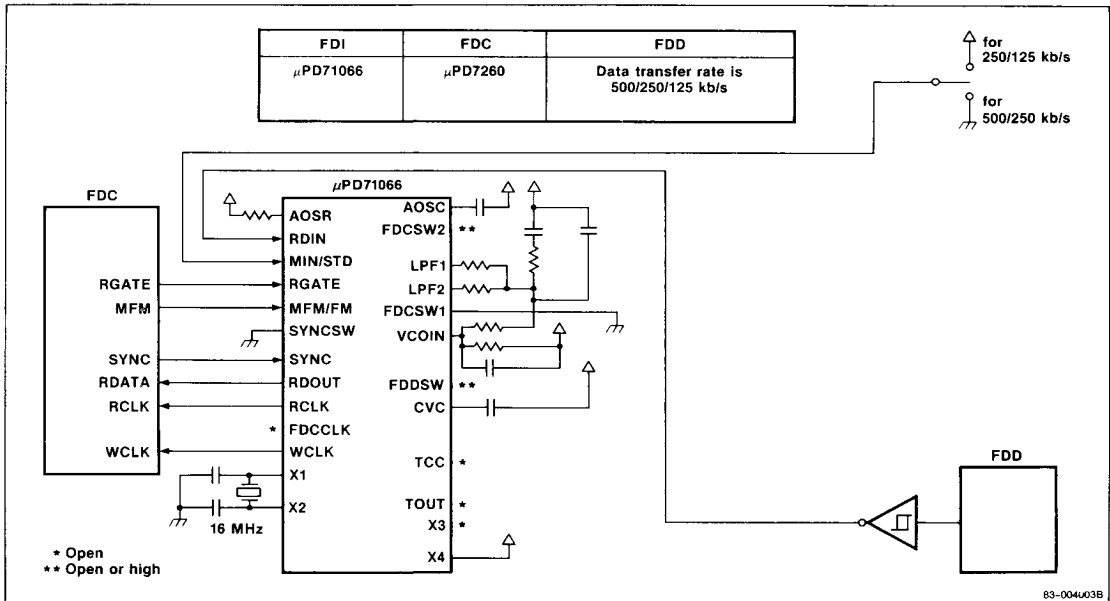
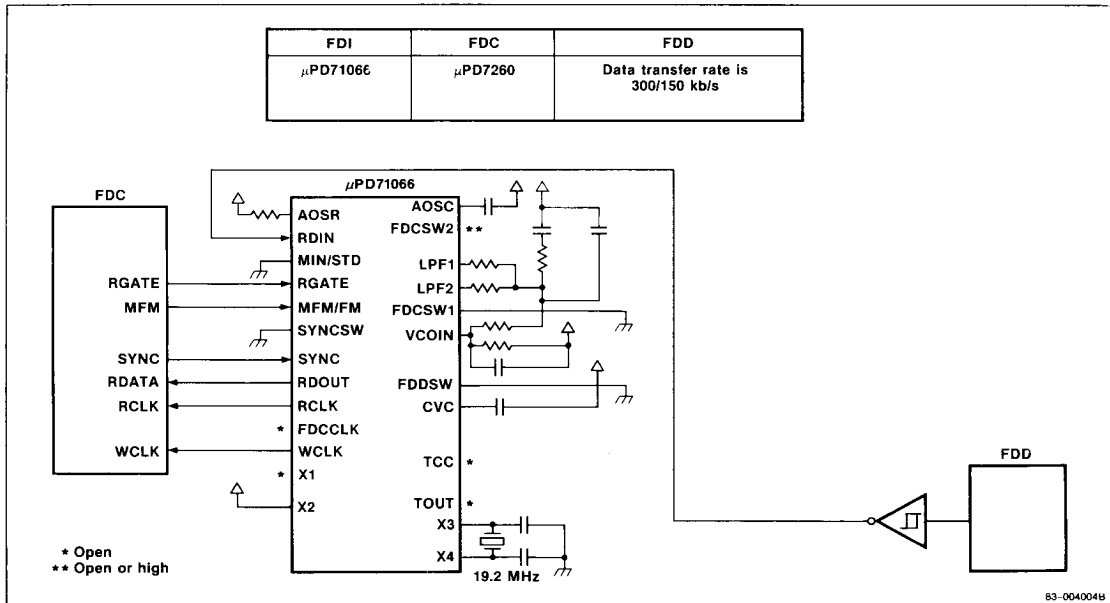
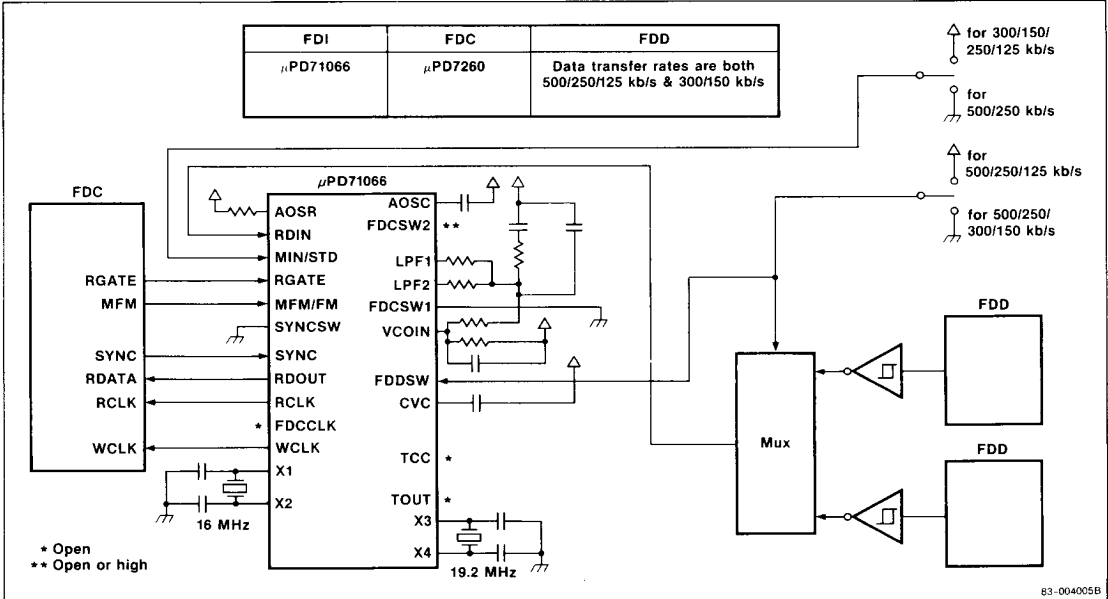


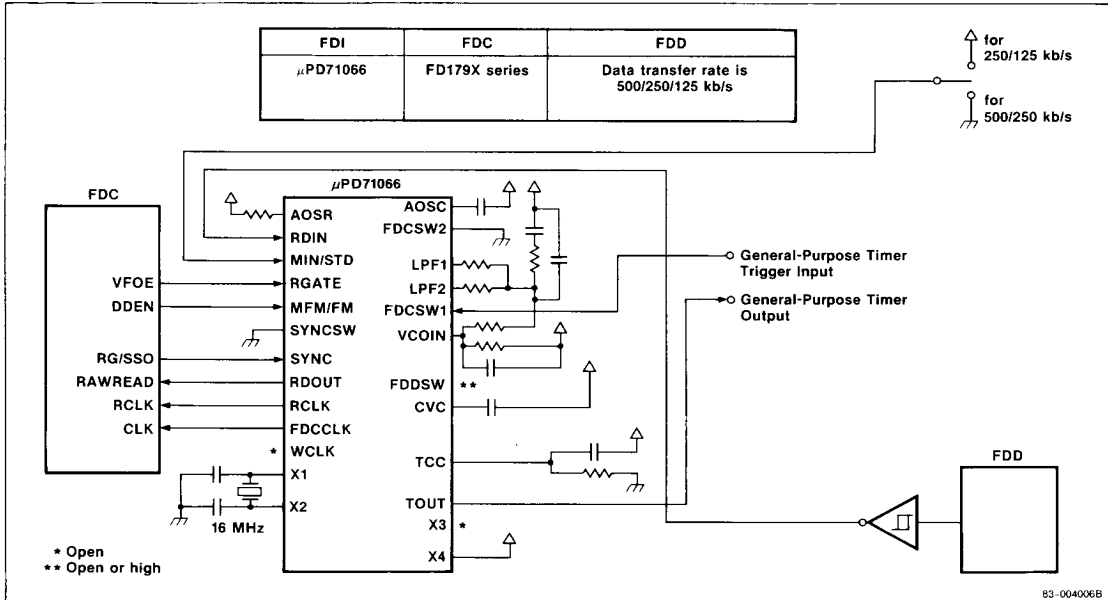
Figure 19. System Example 11: μPD71066 FDI and μPD7260 FDC



**Figure 20. System Example 12: μPD71066 FDI and μPD7260 FDC**



**Figure 21. System Example 13: μPD71066 FDI and FD179X FDC**



FDI	FDC	FDD
$\mu$ PD71066	FD179X series	Data transfer rate is 300/150 kb/s

\* Open

83-004007B

FDI	FDC	FDD
$\mu$ PD71066	FD179X series	Data transfer rates are both 500/250/125 kb/s & 300/150 kb/s

The diagram illustrates the internal components and connections of the FD179X series interface. It features three main functional blocks: FDI (Input), FDC (Control), and FDD (Data). The  $\mu$ PD71066 is the central microprocessor unit.

**FDI (Input) Connections:**

- AOSR:** Analog Output Signal Register, connected to a pull-up resistor.
- RDIN:** Read Data Input, connected to a pull-up resistor.
- MIN/STD:** Minimum/Standard mode select, connected to a pull-up resistor.
- RGATE:** Read Gate, connected to a pull-up resistor.
- FM/FM:** Full Mode/Full Mode select, connected to a pull-up resistor.
- SYNCSW:** Synchronization Switch, connected to a pull-up resistor.
- SYNC:** Synchronization signal, connected to a pull-up resistor.
- RDOUT:** Read Data Output, connected to a pull-up resistor.
- RCLK:** Read Clock, connected to a pull-up resistor.
- CLK:** Clock signal, connected to a pull-up resistor.

**FDC (Control) Connections:**

- VFOE:** VFOE signal, connected to a pull-up resistor.
- DDEN:** Data Drive Enable, connected to a pull-up resistor.
- RG/SSO:** Read Gate/Serial Shift Output, connected to a pull-up resistor.
- RAWREAD:** Read Address Word, connected to a pull-up resistor.
- RCLK:** Read Clock, connected to a pull-up resistor.
- CLK:** Clock signal, connected to a pull-up resistor.

**FDD (Data) Connections:**

- General-Purpose Timer Input:** Connected to the FDD input.
- General-Purpose Timer Output:** Connected to the FDD output.
- Mux:** Multiplexer, connected to the FDD input and output.
- FDD:** Data Drive, connected to the FDD input and output.

**Internal Components and Connections:**

- AOSC:** Analog Output Signal Register, connected to a pull-up resistor.
- FDCSW2:** Full Data Control Switch 2, connected to a pull-up resistor.
- LPF1:** Low Pass Filter 1, connected to a pull-up resistor.
- LPF2:** Low Pass Filter 2, connected to a pull-up resistor.
- FDCSW1:** Full Data Control Switch 1, connected to a pull-up resistor.
- VCOIN:** Variable Control Input, connected to a pull-up resistor.
- FDDSW:** Full Data Drive Switch, connected to a pull-up resistor.
- CVC:** Control Voltage Control, connected to a pull-up resistor.
- TCC:** Transfer Control Control, connected to a pull-up resistor.
- TOUT:** Transfer Output, connected to a pull-up resistor.
- X3:** External component, connected to a pull-up resistor.
- X4:** External component, connected to a pull-up resistor.

**Timing and Frequency:**

- X1:** 16 MHz crystal.
- X2:** 16 MHz crystal.
- X3:** 19.2 MHz crystal.
- X4:** 19.2 MHz crystal.

**Legend:**

- \* Open