

## **GENERAL DESCRIPTION**

The EMC ADB Mouse Controller is a mouse controller for apple mouse system.

- The following functions are supported:
- Controller receives command or data from Host.
- Controller transmits data to Host.

## FEATURES

- Two-button mouse and trackball controller.
- Key Lock function is available.
- Both photo discharge and non-discharge modes are available.
- Discharge mode can reduce X,Y DC offset level.
- Dynamic LEDs Control to reduce system power consumption.
- Four stages sample rate at 1KHz,2.5KHz,5KHz,10KHz.
- Include Noise Immunity methodology to avoid false entry.
- Operating frequence at 3.58MHz.
- 18 Pin DIP.

# PIN ASSIGNMENTS





### **PIN DESCRIPTIONS**

Symbol	I/O	Function
DISC	Ι	H=discharge mode,L=non-discharge mode.(internal pull low)
LLED	0	Trackball lock led display.
V <sub>DD</sub>	-	+5v power.
RESET	Ι	Low active for chip reset.
V <sub>ss</sub>	-	GND.
X1,X2	Ι	Horizontal direction status for x counter data.
R	Ι	Right mouse key. (internal pull high)
M	Ι	Main mouse key. (internal pull high)
Y1,Y2	Ι	Vertical direction status for y counter data.
LOCK	Ι	Optional trackball key lock button to lock /M key. (internal pull high)
DLED	0	Active low to turn on photo LEDs.
OSCO	0	Crystal clock output.
OSCI	Ι	Crystal clock input.
DOUT	0	Transmit data to Host.(open drain)
DIN	Ι	Receive data or command from Host.

### FUNCTION DESCRIPTIONS

The ADB Mouse Controller is communicated with Host by the ADB bus.Only Host sends command to mouse controller, the mouse doesn't send any command to the other devices or Host on the bus. The signal of the data or command is transmitted by asynchronous protocol.First, Host sends Attention and Sync signals to synchronize all devices on the bus, then sends command or data according the command defined.

If the addess which the device receives in command is the same as the device address, then the device will execute this command. If there are more then two devices to contend the ADB bus, then the bus collision will happen. Therefore, every devices must have capability to detect and to solve collision. On the contrary, if the address in the command is not the same with the address in the device, the device will discard the command, or sends SRQ signal to Host when device has data to be send.

	COMMANDS								
COMMAND	B7	B6	B5	B4	B3	B2	B1	<b>B</b> 0	DESCRIPTION
FLUSH	USH A3 A2 A1 A0 0 0 0 1 Mouse will clear all X,Y counter data(R0=0).								
SENDRESET	-	-	-	-	0	0	0	0	Soft Reset(equal power-on reset).
TALK	A3	A2	A1	A0	1	1	Rh	R1	Controller transmits data to Host.
LISTEN	A3	A2	A1	A0	1	0	Rh	R1	Controller receives data from Host.
OTHER									Reserved command.
1.B7 ~ B4:Device	1.B7 ~ B4:Device Address(0~F)is the position of the device.(Ref table 2)								
2.B0 ~ B1:Selected Register(R0~R3), each register has two bytes.									
R0:Mouse count	ter da	ata re	gister	r(read	l only	by H	Host)		
R3:Control regis	ster(c	an be	e reac	l or w	ritter	n by H	Host)		
R1,R2:No use ir	n mou	use.							
3.B3,B2=11:TAL	K coi	mmar	nd.(1	byte)	)				
TALK R0:IF mo	ouse	has d	ata to	o repo	ort,mo	ouse v	will s	end ty	vo bytes (R0)to Host.
IF mouse has't d	data t	o rep	ort,H	lost w	ill co	ontinu	ie pol	ling(H	R0) or execute other command.
TALK R3:Host	can r	ead r	nous	e R3 1	regist	ter(2	bytes	).	
TALK R1,R2:N	lo use	e in m	nouse						



## 4.B3,B2=10:LISTEN command.(3 bytes)

LISTEN R3:Host writes controll status to mouse R3.

LISTEN R0 ~R2:No use in mouse.

Host must send 3 bytes. (1 byte command and 2 bytes register data to mouse R3)

### TABLE 1

#### DEVICE ADDRESS

Device Address	Device Type	Addressing	Example
0	Reserved	Extended	
1	Appliances	Extended	
2	Encoded Device	Movable	Keyboard address for initial address.
3	<b>Relative Device</b>	Movable	Mouse address for initial address.
4	Absolute Device	Movable	Tablet address for initial address.
5	Reserved		
6	Reserved		
7	Reserved		
8 ~ F	Soft address		
1 Device address-0.	F	•	

1. Device address=0~F.

2. Movable: Host can change device address to new address(ex:Soft, reserved address) by LISTEN R3command.

## TABLE 2

		DITTIBILICETER						
COMMAND	LENGTH	DEVICE ECHO	DESCRIPTION					
SENDRESET	1 BYTE	NO						
FLUSH	1 BYTE	NO						
TALK R0	1 BYTE	2 BYTES	If mouse has data to report, device echoes two					
			bytes(R0) to Host, otherwise no echo data.					
TALK R1			No use.					
TALK R2			No use.					
TALK R3	1 BYTE	2 BYTES	Device always echoes two bytes(R3) to Host.					
LISTEN R0			No use.					
LISTEN R1			No use.					
LISTEN R2			No use.					
LISTEN R3	3 BYTES	NO	Host sends control status (R3) to mouse.					
			First byte:command.					
			Second and last bytes:R3 control register.					
1. CODE:First byte reference TABLE 1.								
2. LISTEN R3 com	mand reference TAE	BLE 4.						

#### DATA STRUCTURE

TABLE 3

### LISTEN R3 COMMAND

CODE				DESCRIPTION
Listen	SRQ	Device	ID	
R3	(B13)	Address	Number	
	B15	~ B8	B7~B0	*
3B			FF	Self Test.
3B		A3 A2 A1 A0	FE	Device will change to new address(A0~A3)if no collision
				has been detected.
3B		A3 A2 A1 A0	FD	Device will change to new address(A0~A3)if no collision
				and /Mkey is pressed.
3B	01-1	A3 A2 A1 A0	00	IF no collision has been detected, device will change to
				new address (A0~A3)and set (or clear)SRQ depend on B13(R3).
3B			01	2 counts/dot for X/Y axis.
3B			02	1 count/dot for X/Y axis.

1. LISTEN R3:Host transmits data to device.

2. IF mouse Address=3 and Command=Listen R3 then command data=3B.(Ref table 1)

3. B0 ~ B 15:R3 control register.

TABLE 4

#### **REGISTER DESCRIPTION**

REGISTER 0 (R0):mouse counter data.

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
M	Y6	Y5	Y4	Y3	Y2	Y1	Y0	R	X6	X5	X4	X3	X2	X1	X0

1. X0 ~ X6:X direction counter data.

- 2. Y0 ~ Y6:Y direction counter data.
- 3. X6(Y6)=0:Positive count when mouse move to right(down).

X6(Y6)=1:Negative count when mouse move to left(up).

Negative count uses 2'S complement form.

- 4.  $\overline{R}$ :When right key is pressed, B7 is cleared to zero, otherwise B7 status is set to one.
- 5.  $\overline{M}$ :When main key is pressed, B15 is cleared to zero, otherwise B15 status is set to one.

REGISTER 3 (R3):control register.

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
0	EE	SRQ	1	A3	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0

- 1. D0 ~ D7:Device Handler ID number. (00h ~ FFh)
- 2. A0 ~ A3:Device Address can be changed when host send LISTEN R3 command with ID=00,FE,FD.
- 3. B12: Always be"1".
- 4. SRQ:Can be set or cleared when host send LISTEN R3 command with ID=00.
  - SRQ=1:Device can transmit data to Host.
- SRQ=0:Device can't transmit data to Host.
- 5. EE(Exception Event status):No use=1.
- 6. B15:Always be"0".

#### SIGNAL PROTOCOL

- 1. Attn(800us)+Sync(65us):Synchronous signal.
  - Host out Attn+Sync signals to tell device when to get command code.
- 2. Data and command code:Data bit is discriminated by pulse code modulation.



3. Tit (200us)signal: If no collision has been detected,

LISTEN command:Device waiting until Tit="0" then device start to read data in.

TALK command: Device send two bytes data after Tit.

- 4. Stop bit("0").
- 5. Start bit("1").
- 6. Service Request: When the device has data to report with SRQ=1, it will pull the ADB bus to be low for 300us after first stop bit of the command send by Host.

### COLLISION:

1. Host send one command, but many devices respond to it.

- 2. Losing device:
  - a. Device detects "0" at Tit-time before device wants to send start bit.
  - b. Data line must hold "1" at Tit-time, but device detects "0" by another device send.
  - c. Device detects"0" while sending"1".
- 3. Losing device must give up ADB bus and data is saved.
- 4. Every devices must have detecting collision ability.

#### DYNAMIC SAMPLING RATE

When the mouse is moved, the frequence of sampling rate depends on the mouse's speed. If the mouse is still, the sampling rate is at low speed(1KHz). It can reduce system power consumption.

DPI	DOTS	SPEED(cm/sec)	SAMPLING RATE						
	0		1KHz						
	1	2.54	2.5KHz						
200	2	5.08	5KHz						
	4	10.16	10KHz						
	0		1KHz						
	1	1.5875	2.5KHz						
320	2	3.175	5KHz						
	4	6.35	10KHz						
	0		1KHz						
	1	1.27	2.5KHz						
400	2	2.54	5KHz						
	4	5.08	10KHz						
	0		1KHz						
	1	0.907	2.5KHz						
560	2	1.814	5KHz						
	4	3.632	10KHz						
Formula:speed=[ ( dots / DPI ) * 2.54 ) ] / Tb. EX:dot=1,DPI=200 dots/inch,Tb(Time Base)=5ms speed=[ ( 1 / 200 ) * 2.54 ] / 5ms=2.54 cm/sec									



# ABSOLUTE MAXIMUM RATINGS

0°C to 70°C
-65°C to 150°C
-0.3V to +6.0V
-0.3V to +6.0V

# **DC ELECTRICAL CHARACTERISTICS**

 $(T_A = 0^{\circ}C \sim 150^{\circ}C, V_{DD} = 5.0V \pm 5\%, V_{SS} = 0V)$ 

Parameter	Sym.	Min.	Тур.	Max.	Unit	Condition
Input High Voltage	V <sub>IH</sub>	2.0	-	-	V	$V_{IN} = V_{DD}, V_{SS}$
Input Low Voltage	V <sub>IL</sub>	-	-	0.8	V	$V_{IN} = V_{DD}, V_{SS}$
Output High Voltage	V <sub>OH</sub>	2.4	-	-	V	I <sub>он</sub> =-12.0mА
Output Low Voltage	V <sub>OL</sub>	-	-	0.4	V	I <sub>OH</sub> =12.0mA
Clock Input High Voltage	V <sub>IHX</sub>	3.5	-	-	V	OSCI
Clock Input Low Voltage	V <sub>ILX</sub>	-	-	1.5	V	OSCI
Input Leakage Current	$I_{IL1}$	-	-	±10	μA	$V_{IN} = V_{DD}, V_{SS}$
for input pin						
Pull-high current	I <sub>PH</sub>	-50	-100	-240	uA	Pull-high active, input pin at V <sub>ss</sub>
Pull-down current	I <sub>PD</sub>	20	50	120	uA	Pull-down active input pin at V <sub>DD</sub>
Operating supply current	I <sub>cc</sub>	-	-	4	mA	RESET=HIGH, Fosc=3.58MHz

# AC ELECTRICAL CHARACTERISTICS

 $(T_A = 0^{\circ}C \sim 70^{\circ}C, V_{DD} = 5.0V \pm 5\%, V_{SS} = 0V)$ 

Parameter	Sym.	SPEC	Min.	Тур.	Max.	Unit
Attention signal time	Attn	800±3%	550	-	2150	μs
Sync pulse time	Sync	65±3%	-	-	286	μs
From first stop bit to start bit.	Tit	200±30%	150	-	-	μs
Service request time	Tsrq	300±30%	290	-	315	μs
Reset time	Tres	3	2.15	-	-	ms
Bit cell time	Tcyc	100±30%	-	100	-	μs
Bit"0" low time	TO	65±30%	-	65	-	μs
Bit"1" low time	T1	35±30%	-	35	-	μs
DLED low time	DLED	-	23	-	-	μs



WAVE FORM

## LISTEN COMMAND:

Host out control status to device.





# **APPLICATION CIRCUIT**







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