MTA41120

ADB™ Mouse/Trackball Controller I.C.*

FEATURES

- Single-chip supporting Apple® Desktop Bus Mouse or trackball controller
- Built in collision detection so that multiple devices may be connected to the host interface without conflict
- Strobed motion encoders for reduced system power consumption
- Proprietary anti-jitter algorithm simplifies motion encoder interface
- Motion sampling rate of 6000 samples/second
- Available In:
  - 18-lead 300 mil PDIP
  - 18-lead 300 mil SOIC
  - 20-lead 209 mil SSOP

DESCRIPTION

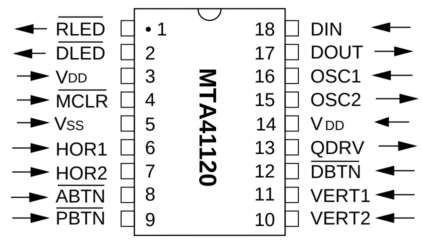
The MTA41120 is the heart of a simple, low-cost, mouse or trackball solution. It can be configured to operate as either an Apple Macintosh compatible mouse or trackball controller. The mouse select and drag operation can be performed with a trackball by using the optional drag lock input and drag lock LED. This allows for one handed select and drag operation when using a trackball. The MTA41120 does not require special host system device drivers.

MTA41120

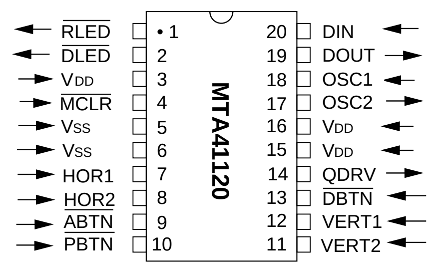
The MTA41120 is an 18-lead low-power CMOS integrated circuit. Combined with a few simple external components, a complete mouse or trackball system can be realized. An optional 2nd button is supported for systems with customized mouse drivers.

PACKAGE TYPES

PDIP, SOIC



SSOP



*Apple Macintosh Compatible Host Interface

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Apple Desktop Bus (ADB) is a trademark of Apple Corp.

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1.0 PIN DESCRIPTIONS

PIN NAME	TYPE	DESCRIPTION
QDRV	Output	Active high strobed encoder drive
HOR1	Input	Horizontal quadrature Input #1
HOR2	Input	Horizontal quadrature Input #2
$\overline{\text{PBTN}}$	Input	Primary mouse button. Active low, 0 = button depressed
$\overline{\text{ABTN}}$	Input	Alternate mouse button. Active low, 0 = button depressed
$\overline{\text{DBTN}}$	Input	Optional trackball drag lock button. Active low, 0 = button depressed. For mouse operation connect this pin to V_{DD}
VERT1	Input	Vertical quadrature input #1
VERT2	Input	Vertical quadrature input #2
$\overline{\text{RLED}}$	Output	Optional high resolution LED. Indicates mouse or trackball is in high resolution mode. If high resolution LED is not required then this pin is a no connect and should be left unconnected
$\overline{\text{DLED}}$	Output	Optional trackball drag LED. For mouse operation this pin is a no connect and should be left unconnected
OSC1	Input	4 MHz crystal or ceramic resonator connection
OSC2	Output	4 MHz crystal or ceramic resonator connection
DIN	Input	Input data port for host communication
DOUT	OC-Output	Open Collector output for data communication with host
$\overline{\text{MCLR}}$	Input	A “low” voltage on this pin causes a reset condition for the MTA41120 controller
V_{DD}	Pwr	+5V
V_{SS}	Pwr	Ground

2.0 OVERVIEW

The MTA41120 mouse and trackball controller is compliant with all specifications that apply to the Host Interface. Its collision detection and recovery algorithms allow it to be used in systems where one or more devices may be connected to the host interface.

The drag lock button input allows the MTA41120 to be used as either a trackball controller or a mouse controller.

The MTA41120 supports two LED indicators that indicate operation in high resolution mode and when a drag lock operation is occurring. High Resolution mode is entered in response to a command from a host and is indicated by the $\overline{\text{RLED}}$ pin being driven low.

3.0 MOTION ENCODER INTERFACE

The MTA41120 is designed to interface to both optical encoders that utilized LED and photo transistor pairs with a chopper wheel or mechanical encoders utilizing a commutator with wiper contacts.

The HOR and VERT inputs are sampled at ~6000 samples per second with a 4 MHz input clock. The sample rate may decrease slightly when communication traffic to or from the host is occurring. The sample rate is directly proportional to the clock frequency on the OSC1 and OSC2 pins.

Power consumption is reduced by strobing the motion encoder power each time the encoders are sampled. The MTA41120 will drive the QDRV output high 10 µS (with 4 MHz input clock) prior to sampling the HOR and VERT inputs to give the encoders time to stabilize. The QDRV output will be driven back low 2 µs after the sample is taken. If power consumption is not a concern then the QDRV output can be left unconnected and encoders can be powered directly from a constant supply (e.g., +5V power).

An anti-jitter algorithm is employed to eliminate false motion counting when the mouse or trackball is not moving. This is especially useful in designs employing optical encoders since the output of an optical detector is an analog signal. The anti-jitter algorithm eliminates false counting when a voltage that is not a well defined logic low or logic high is applied to either the HOR or VERT inputs.

The HOR and VERT inputs detect positive and negative delta motion. Motion direction is defined in the following state table and is illustrated in Figure 3-1 and Figure 3-2.

Positive Motion:

Hor1, Hor2 / Vert1, Vert2	Description
0,0	
0,1	
1,1	Positive Direction Sequence
1,0	
0,0	
etc.	

Negative Motion:

Hor1, Hor2 / Vert1, Vert2	Description
0,0	
1,0	
1,1	Negative Direction Sequence
0,1	
0,0	
etc.	

FIGURE 3-1: POSTIVE MOTION SEQUENCE

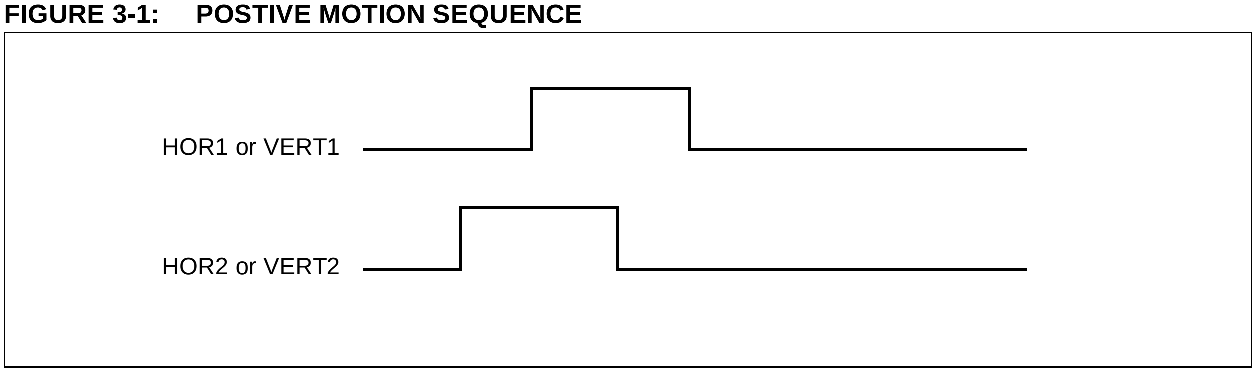
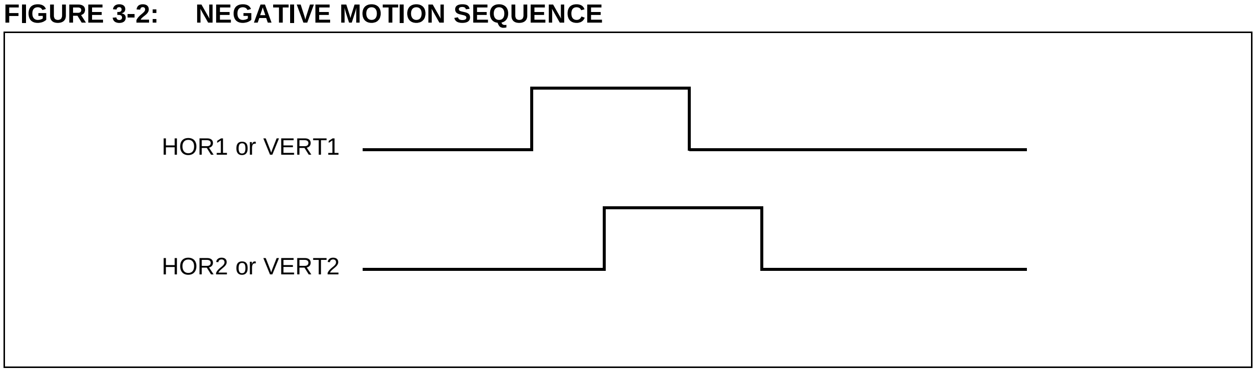


FIGURE 3-2: NEGATIVE MOTION SEQUENCE



4.0 PUSH-BUTTON INPUTS

The MTA41120 push-button inputs are defined to be active when the input pin is in the low state. The appropriate message data bit will be set equal to one when a low is sampled at a switch input. When a switch input is sampled in the high state the appropriate message data bit will be set equal to zero. The push-button inputs are internally debounced to eliminate “false” button status reporting.

5.0 TRACKBALL OPTION

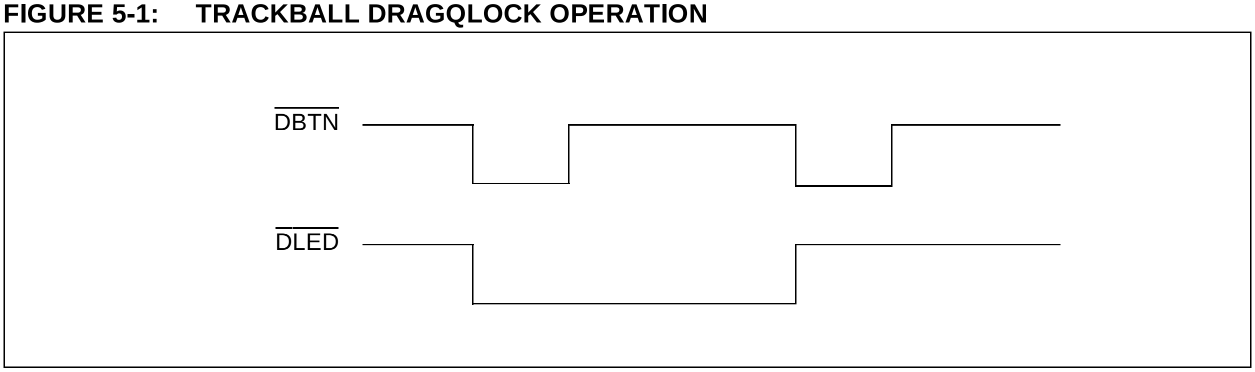
The MTA41120 can also function as a trackball controller. A trackball drag lock switch can be connected to the $\overline{\text{DBTN}}$ input and an LED indicator connected to the $\overline{\text{DLED}}$ output to aid in one-handed trackball operation.

When using a mouse a select and drag operation is performed by clicking on an object and holding the primary mouse button down. Moving the mouse then drags the object to the desired location. When the primary button is released the object is placed at the desired location. However, when the same select and drag operation is performed using a trackball, it may be difficult to hold the button depressed and guide the trackball with the same hand.

The MTA41120’s “drag lock” feature allows this function to be accomplished with one hand. The drag lock is set to the “locked” state by momentarily applying a low to the $\overline{\text{DBTN}}$ input. This “locked” state is equivalent to depressing and holding the primary mouse button. The user then guides the object to the desired location without having to hold a button depressed and simultaneously guide the trackball. The object is placed and the “lock” is released when a low (e.g., button depressed) is momentarily applied to any button input.

The $\overline{\text{DLED}}$ output is latched in the low state (0V) when the $\overline{\text{DBTN}}$ input is sampled low (Figure 5-1). The $\overline{\text{DLED}}$ output will remain low (“locked”) until the $\overline{\text{DBTN}}$ input is sampled high and then sampled low again. Exiting the locked state also occurs if the $\overline{\text{PBTN}}$ input or $\overline{\text{SBTN}}$ input is sampled low when the $\overline{\text{DLED}}$ output is low. When the $\overline{\text{DLED}}$ output is in low “locked” state, the Primary Button depressed bit in the status message is set high.

FIGURE 5-1: TRACKBALL DRAGQLOCK OPERATION



6.0 ELECTRICAL CHARACTERISTICS

6.1 Absolute Maximum Ratings †

Ambient temperature under bias . . . . -55°C to +125°C

Storage temperature . . . . -65°C to +150°C

Voltage on any pin with respect to V_{SS} (except V_{DD} and $\overline{MCLR}$) . . . . -0.6V to (V_{DD} +0.6V)

Voltage on $\overline{MCLR}$ pin with respect to V_{SS} . . . . 0V to +14.0V

Voltage on V_{DD} with respect to V_{SS} . . . . 0V to +9.5V

Total power dissipation (Note 2) . . . . 800 mW

Maximum current out of V_{SS} pin . . . . 150 mA

Maximum current into V_{DD} pin . . . . 50 mA

Maximum current into input pin . . . . ±500 mA

Maximum output current sinked by any I/O or output pin . . . . 25 mA

Maximum output current sourced by any I/O or output pin . . . . 20 mA

Notes:

1. Voltage spikes below V_{SS} at the $\overline{MCLR}$ pin, inducing currents greater than 80 mA may cause latch-up. Thus, a series resistor of 50 to 100Ω should be used when applying a “low” level to this pin, rather than connecting this pin directly to V_{SS}.
2. Total power dissipation should not exceed 800 mW for the package. The total power dissipation is calcu-lated as follows: $P_{DIS} = V_{DD} \times (I_{DD} - \sum I_{OH}) + \sum\{(V_{DD} - V_{OH}) \times I_{OH}\} + \sum(V_{OL} \times I_{OL})$
3.

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

6.2 DC Characteristics MTA41120 (Commercial)

DC CHARACTERISTICS		Standard Operating Conditions (unless otherwise stated). Operating Temperature 0°C < TA < 70°C for commercial. Operating Voltage V_{DD} = 3.0V to 5.5V unless otherwise stated.				
Characteristic	**Sym.**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
Supply Voltage	VDD	3.0		6.25	V	FOSC = DC to 4 MHz
VDD start voltage to guarantee power-on reset	VPOR		VSS		V	
VDD rise rate to guarantee power-on reset	SVDD	0.05*			V/MS	
Supply Current	IDD			3.3	mA	FOSC = 4 MHz , VDD = 5.5V
Input Low Voltage MCLR (Schmitt trigger) OSC1 (Schmitt trigger) All other Inputs	 VILMC VILOSC VIL			 .15 VDD .3 VDD .2 VDD	 V V V	
Input High Voltage MCLR (Schmitt trigger) OSC1 (Schmitt trigger) All other Inputs	 VIHMC VIHOSC VIH	 .85 VDD .7 VDD 2.0 .45 VDD .36 VDD		 VDD VDD VDD VDD VDD	 V V V	 4.45V ≤ VSS ≤ 5.5V VDD < 4.45V VDD > 5.5V
Input Leakage Current MCLR MCLR OSC1 (Schmitt trigger) All other Inputs	 IILMCL IILMCH IILMCH IIL	 -5 -3 -1	 0.5 0.5 0.5	 +5 +3 +1	 µA µA µA µA	 VPN = Vss + 0.25V VPN = VDD VSS ≤ VPN ≤ VDD VSS ≤ VPN ≤ VDD
Output Low Voltage OSC2 All other Outputs	 VOL VOL			 0.6V 0.6V	 V V	 IOL = 1.6 mA, VDD = 4.5V IOL = 8.7 mA, VDD = 4.5V
Output High Voltage OSC2 All other Outputs	 VOH VOH	 VDD - .7 VDD - .7			 V V	 IOH =-1.0 mA, VDD = 4.5V IOH =-5.4 mA, VDD = 4.5V

*These parameters are based on chartacterization and are not tested.

FIGURE 6-1: INPUT THRESHOLD VOLTAGE (V_{TH})OF ALL INPUT AND I/O PINS EXCEPT $\overline{MCLR}$ AND OSC1

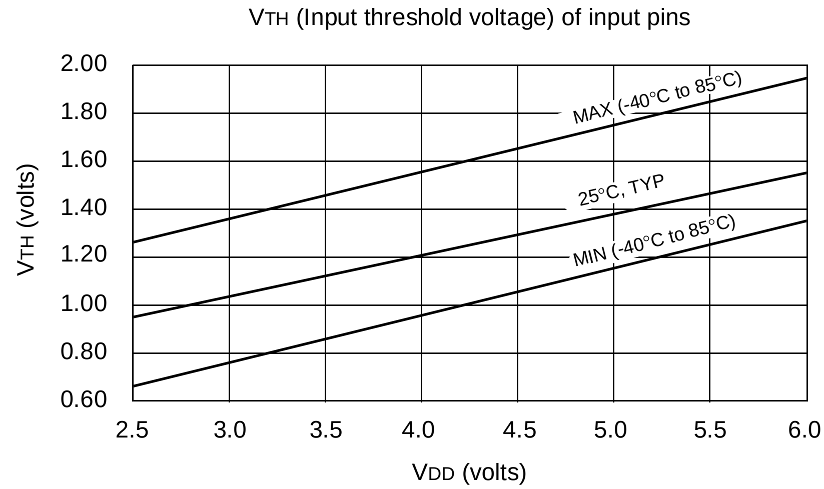
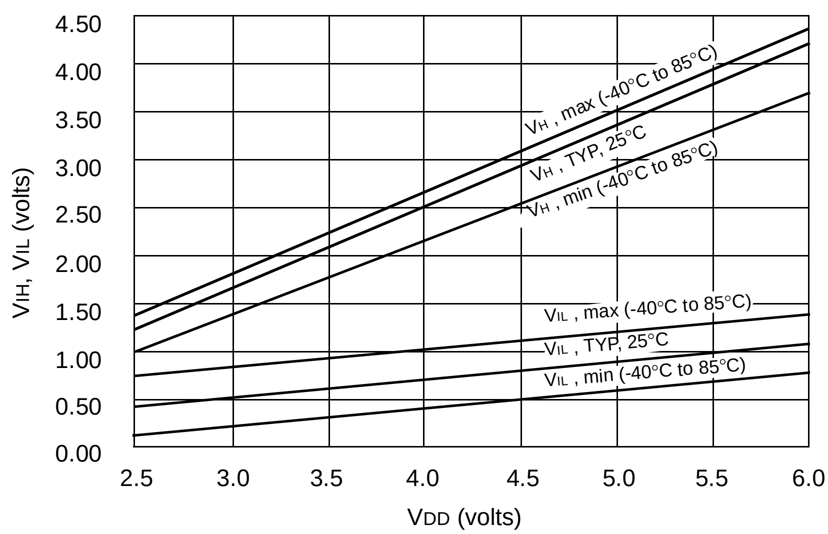


FIGURE 6-2: V_{IH}, V_{IL} OF $\overline{MCLR}$ VS V_{DD}



Note: These input pins have Schmitt trigger input buffer.

FIGURE 6-3: INPUT THRESHOLD VOLTAGE (V_{TH}) OF OSC1 INPUT

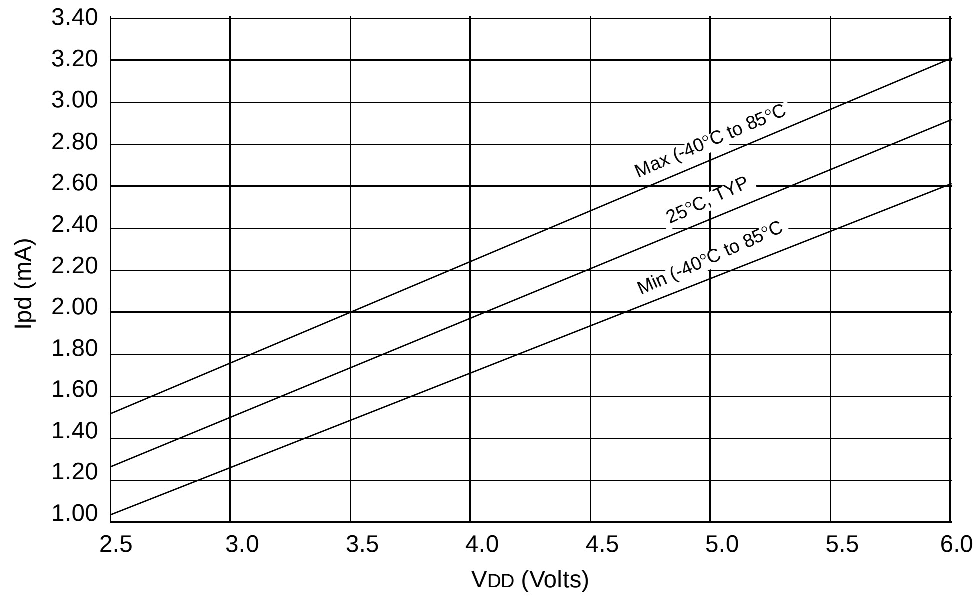


FIGURE 6-4: I_{OH} vs V_{OH}, V_{DD} = 3V

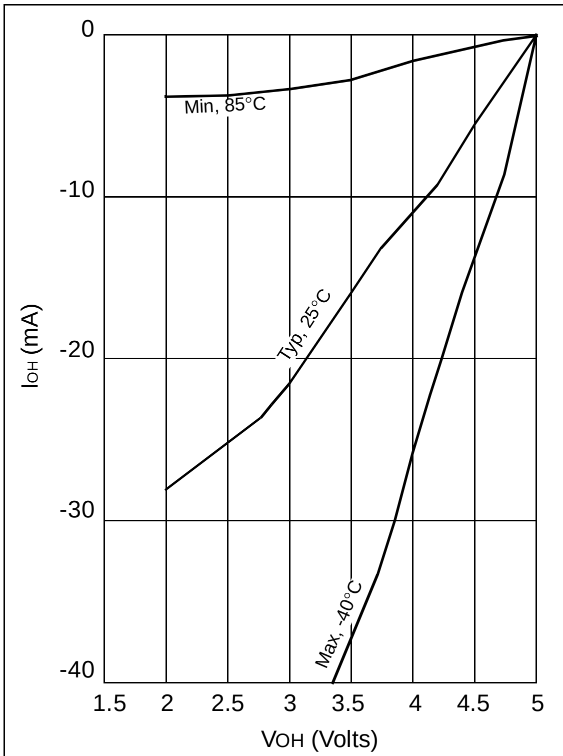


FIGURE 6-5: I_{OH} vs V_{OH}, V_{DD} = 5V

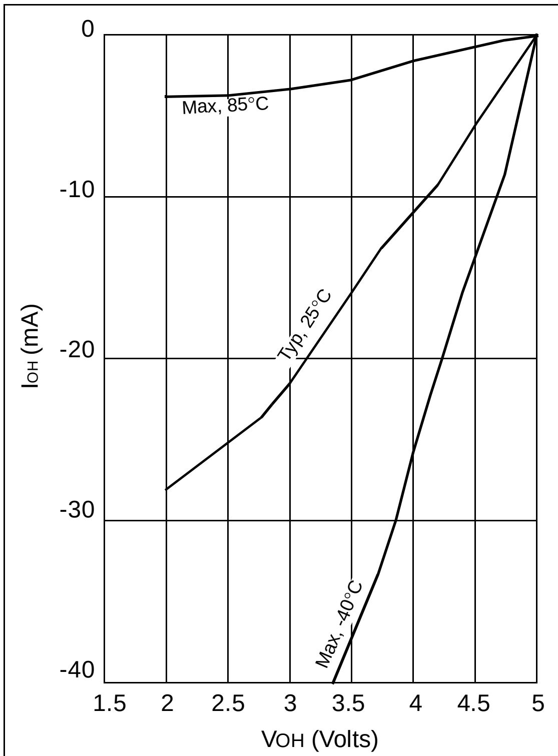


FIGURE 6-6: IOL vs VOL, VDD = 3V

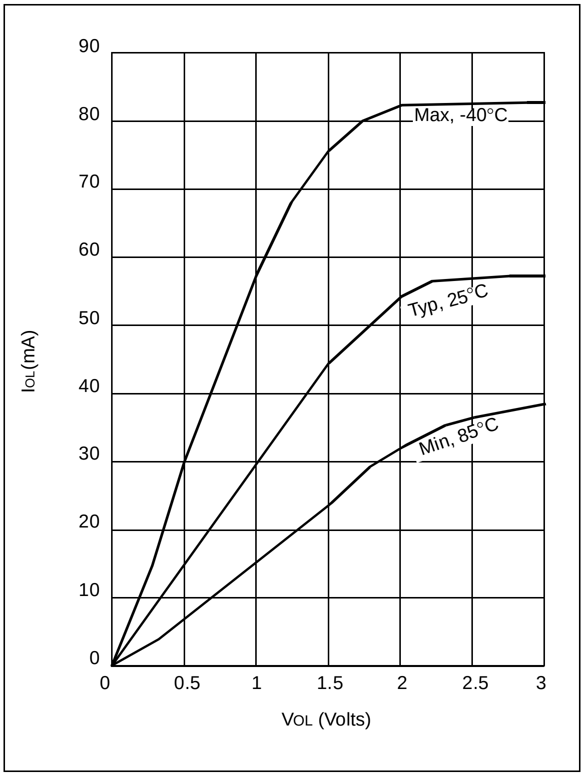
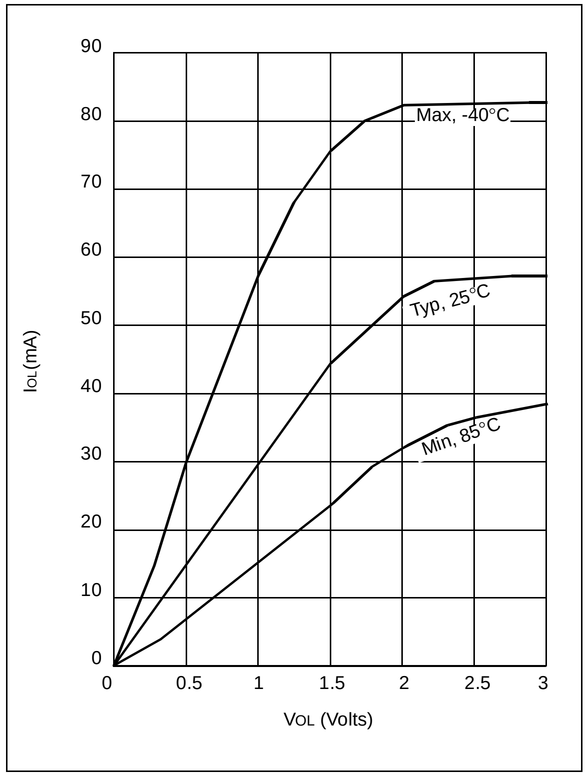


FIGURE 6-7: IOL vs VOL, VDD = 5V



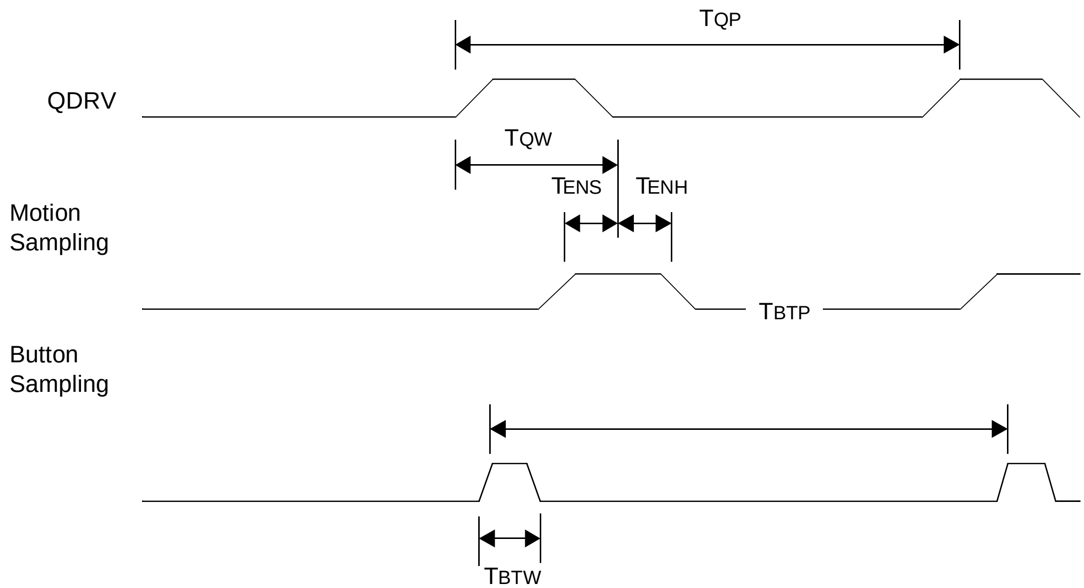
6.3 AC Characteristics MTA41120 (Commercial)

AC CHARACTERISTICS	Standard Operating Conditions (unless otherwise stated). Operating Temperature 0°C < TA < 70°C for commercial. Operating Voltage VDD = 3.0V to 5.5V unless otherwise stated. Oscillator Frequency = 4 MHz.					
Characteristic	**Sym.**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
Oscillator Frequency	FOSC	DC		4	MHz	
Motion Encoder Timing						
QDRV						
Pulse Period	TQP (NOTE 2)		166		µs	
Pulse Width	TQW	11	12	13	µs	
HOR1,HOR2,VERT1,VERT2						
Input Sample Setup Time	TENS	2			µs	Before QDRV falling edge.
Input Sample Hold	TENH			0	ns	After QDRV falling edge.
Button Input Timing						
PBTN,SBTN,DBTN						
Input Sample Period	TBP (NOTE 2)			10	ms	
Input Sample Window width	TBTU			280	ns	
RESET Timing						
MCLR Pulse Width (low)	TMCL	100			ns	
Oscillator Start-up Timer Period	TOST (NOTE 1)	9	18	30	ms	VDD = 5.0V

Notes:

1. These parameters are based on characterization and are not tested.
2. Sampling period can increase if device is receiving data from host or when transmitting to host.

FIGURE 6-8: TIMING DIAGRAMS



7.0 APPLICATION EXAMPLE

The MTA41120 controller can be configured as either a mouse or trackball controller. Trackball systems require the addition of the components labeled as trackball only. These components allow support of a drag lock switch and indicator. A pull-up resistor for the drag lock switch must be included in trackball systems. For a mouse the $\overline{\text{DBTN}}$ input is simply connected to VDD.

Three examples of motion encoders are shown in the schematics (Document number 41XXXEN). Two types of optical encoders and a mechanical type are shown. Since the MTA41120 employs an anti-jitter algorithm, the "basic" style of optical encoder or the mechanical encoder are both recommended for use with the MTA41120. Use of the "improved" style of optical encoder that employs comparators, may only be necessary in high noise environments.

All button switches should be of the momentary contact type, including the drag lock switch.

FIGURE 7-1: MTA41120 BASED MOUSE OR TRACKBALL

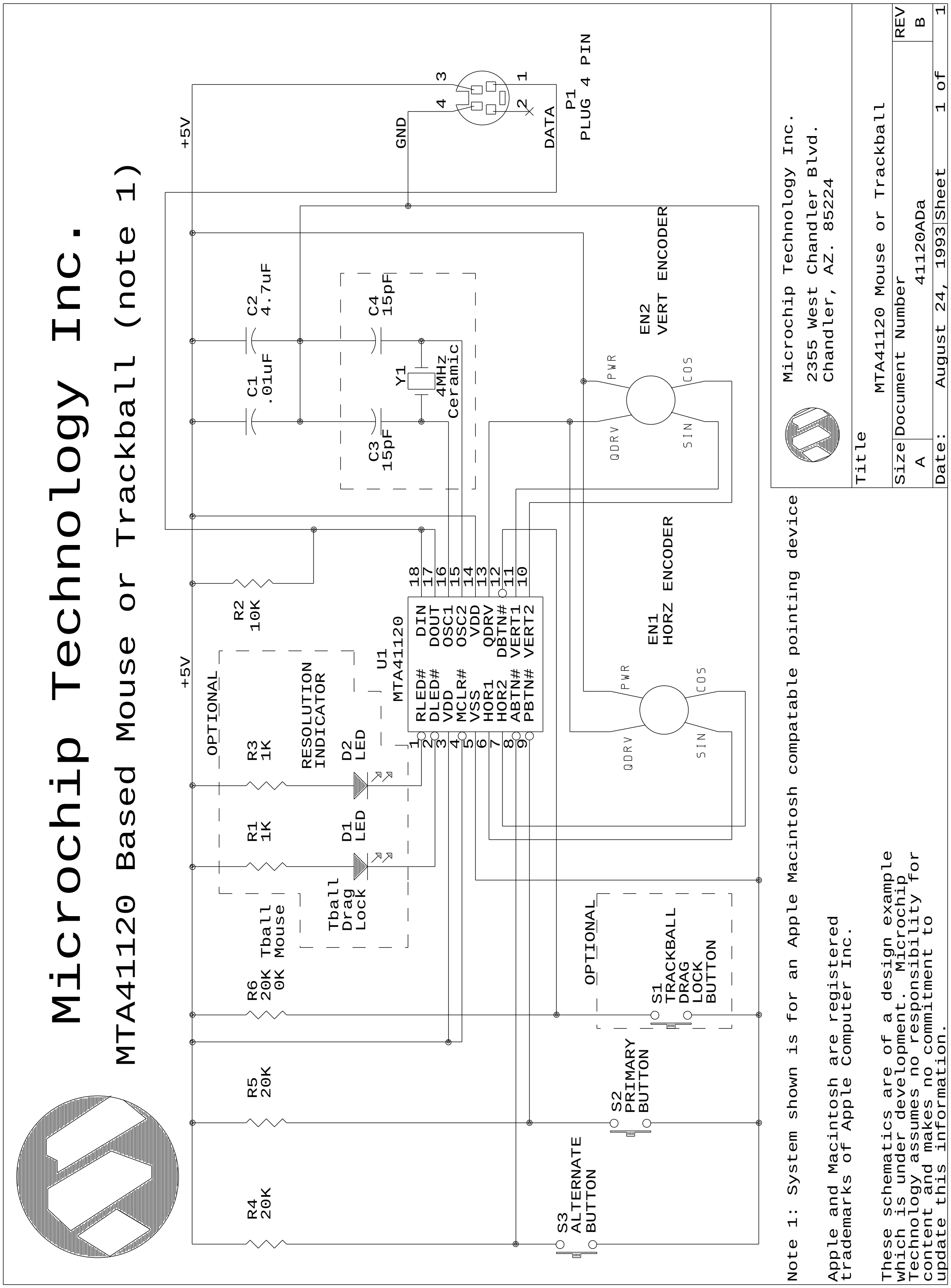


FIGURE 7-2: BASIC MOUSE/TRACKBALL OPTICAL MOTION ENCODER

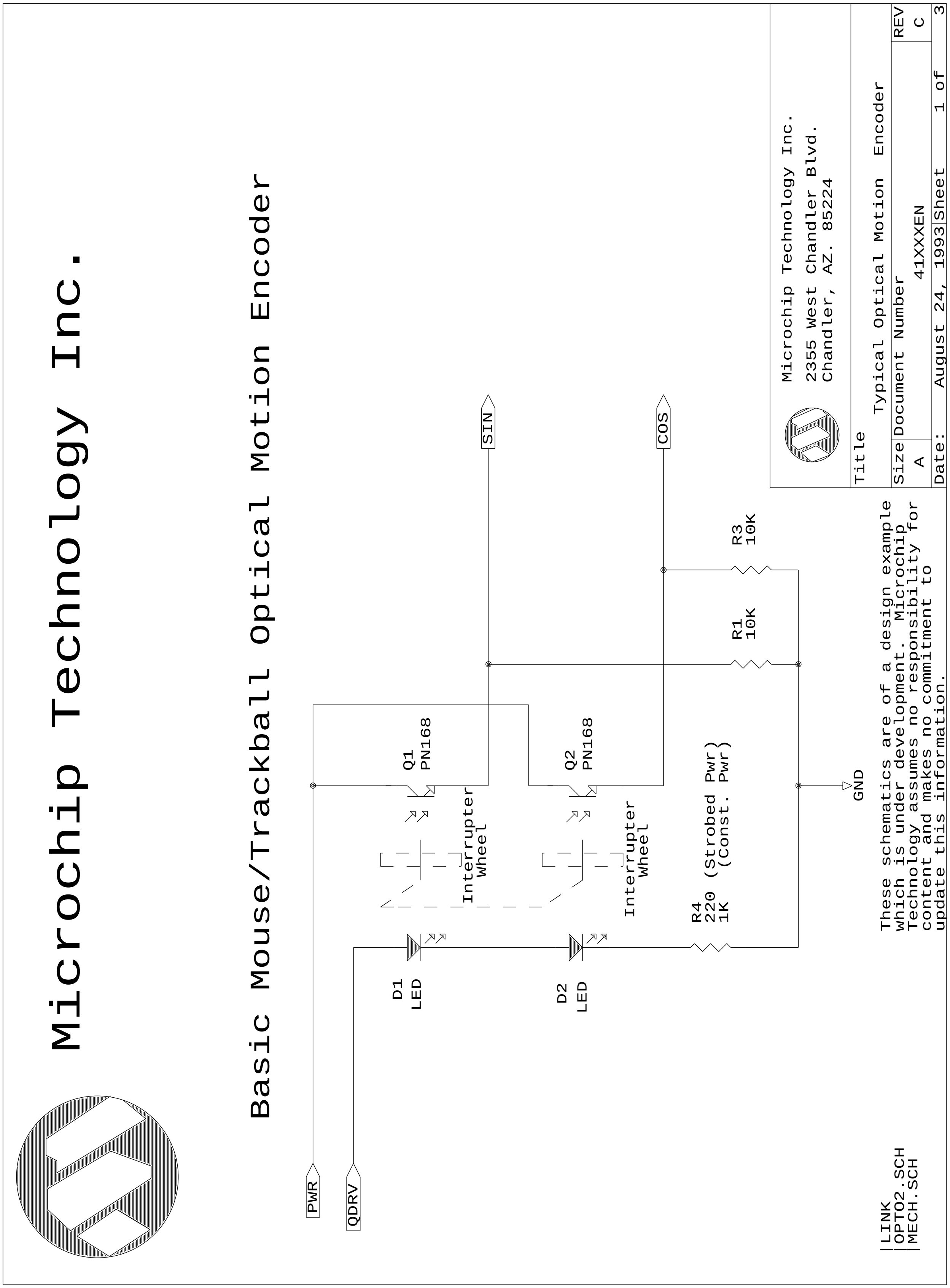


FIGURE 7-3: IMPROVED MOUSE/TRACKBALL OPTIONAL MOTION ENCODER

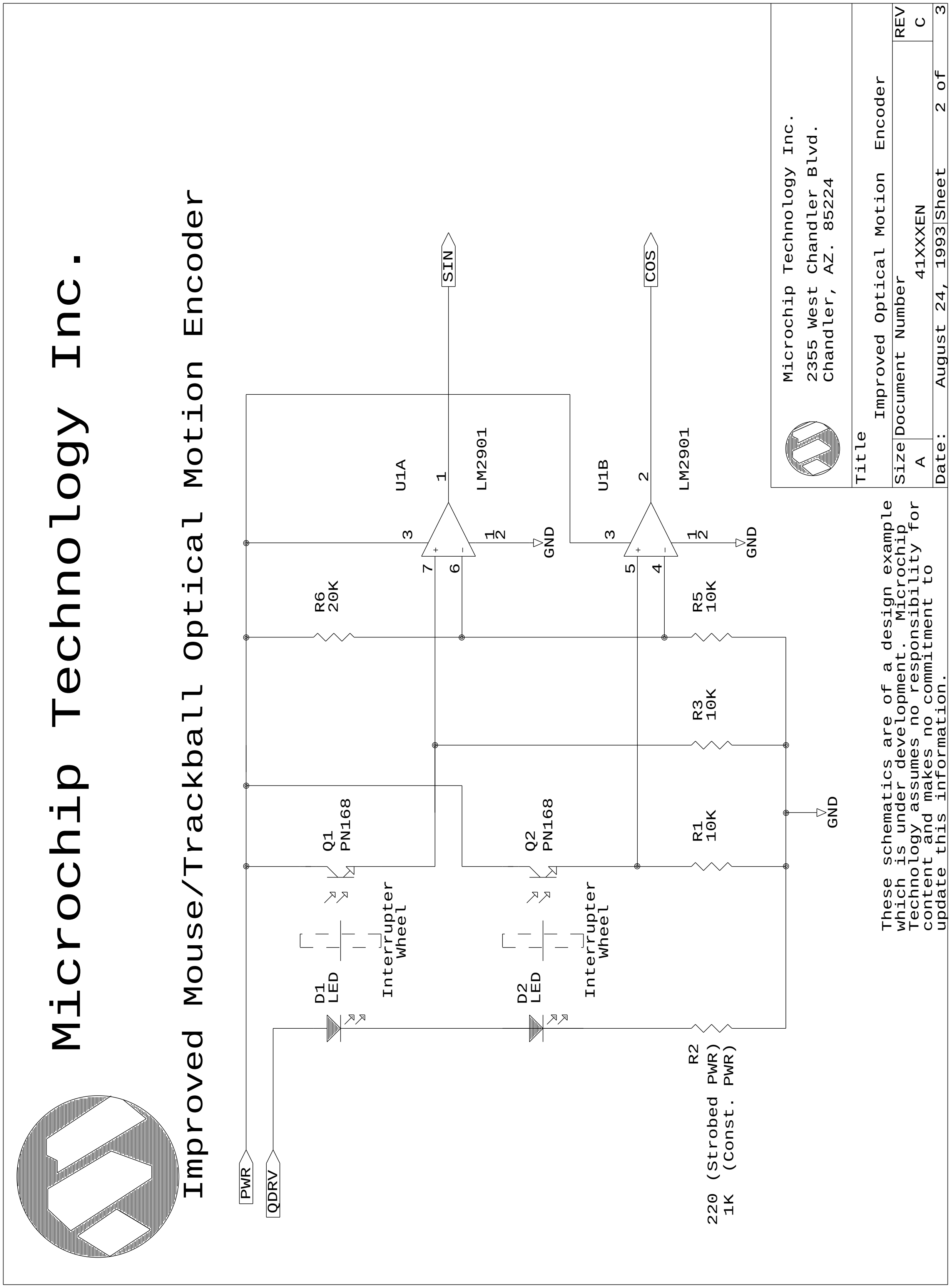
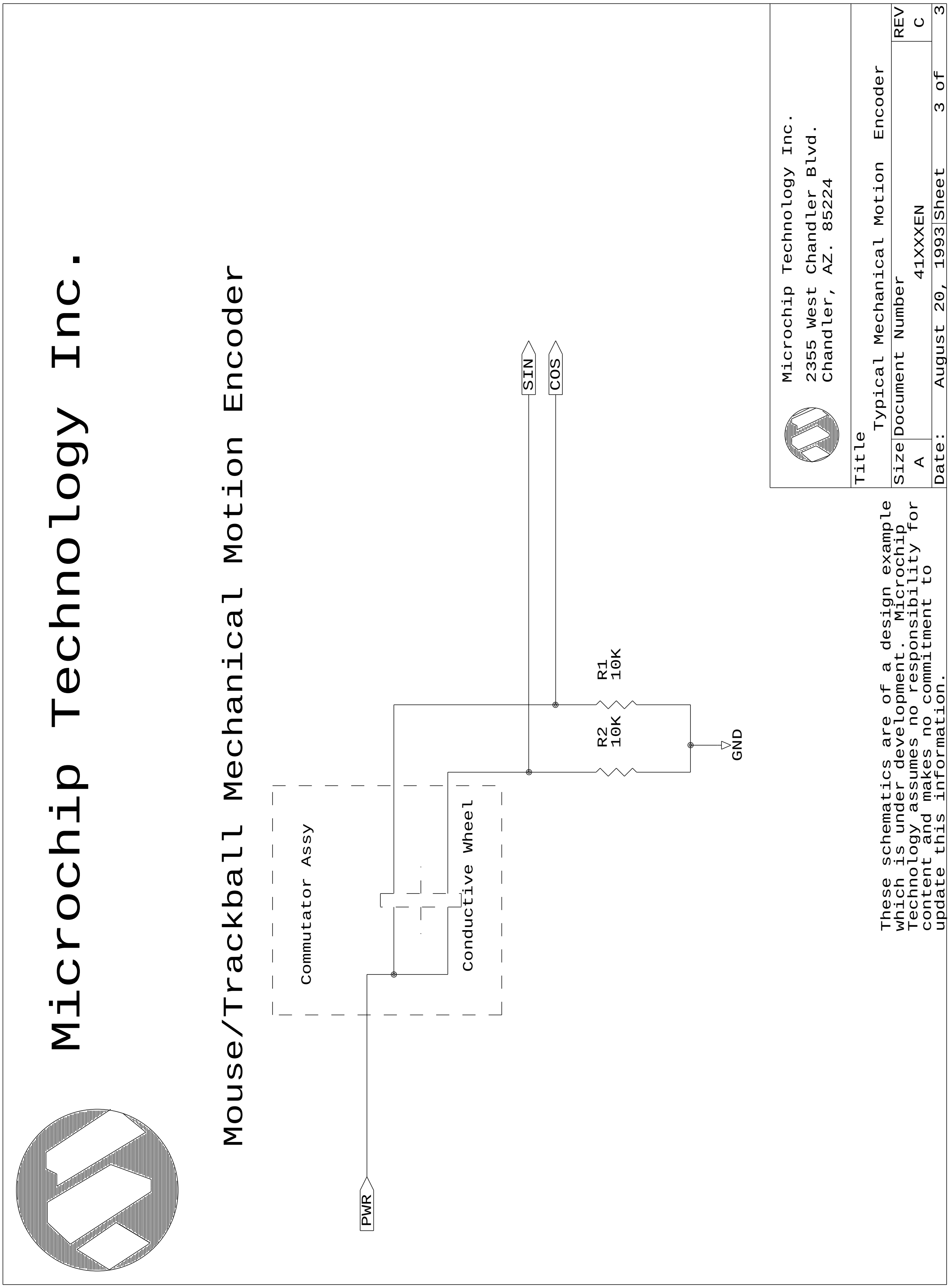
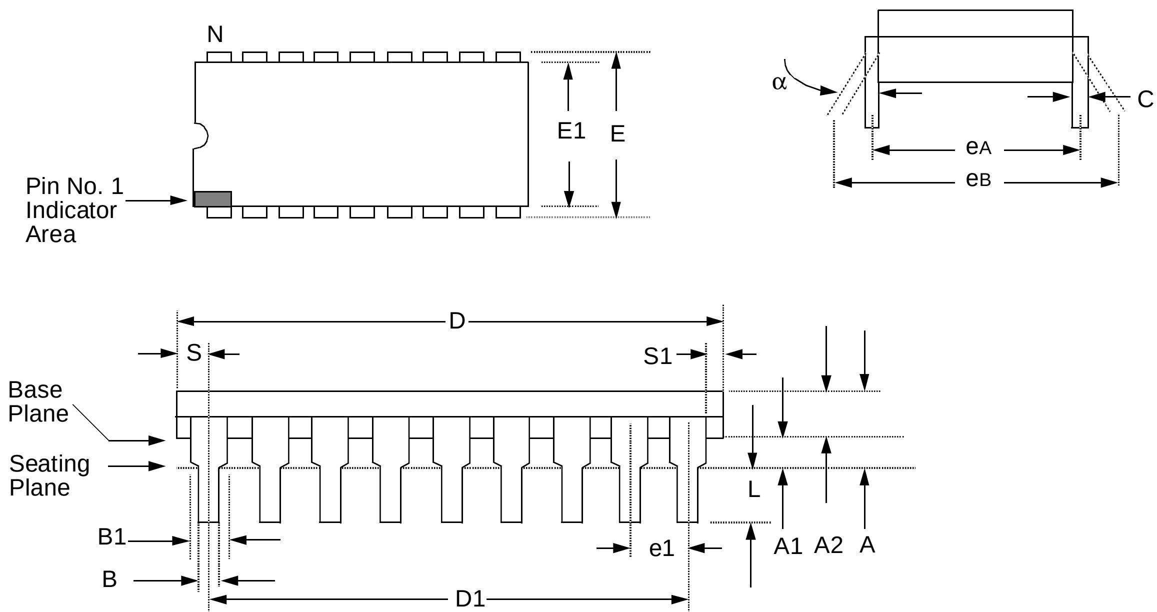


FIGURE 7-4: MOUSE/TRACKBALL MECHANICAL MOTION ENCODER



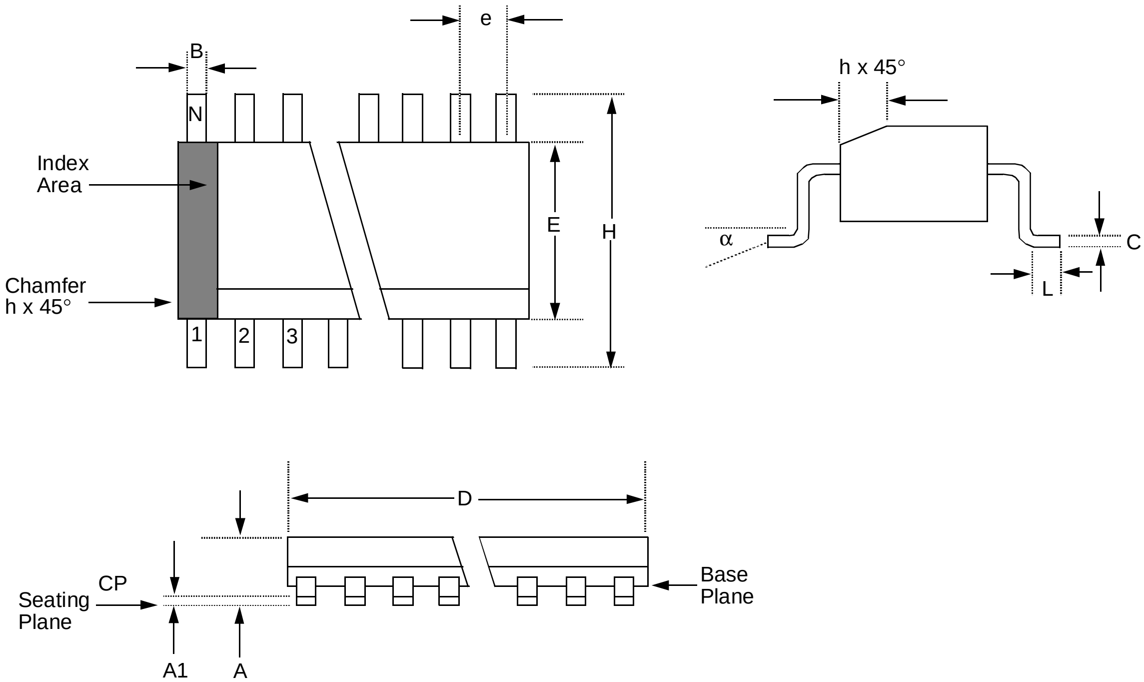
8.0 PACKAGING DIAGRAMS AND DIMENSIONS

8.1 18-Lead Plastic Dual In-Line (300mil)



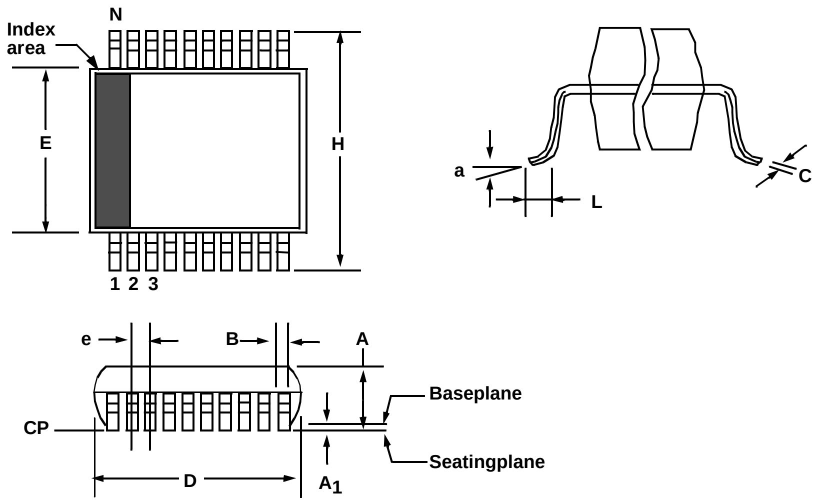
	Package Group: Plastic Dual In:-Line (PLA)					
	Millimeters			Inches		
Symbol	**Min**	**Max**	**Notes**	**Min**	**Max**	**Notes**
α	0°	10°		0°	10°	
A	-	4.064		-	0.160	
A_1	0.381	-		0.015	-	
A_2	3.048	3.810		0.120	0.150	
B	0.3556	0.5588		0.014	0.022	
B_1	1.524	1.524	**Reference**	0.060	0.060	**Reference**
C	0.203	0.381	**Typical**	0.008	0.015	**Typical**
D	22.479	23.495		0.885	0.925	
D_1	20.320	20.320	**Reference**	0.800	0.800	**Reference**
E	7.620	8.255		0.300	0.325	
E_1	6.096	7.112		0.240	0.280	
e_1	2.4892	2.5908	**Typical**	0.098	0.102	**Typical**
e_A	7.620	7.620	**Reference**	0.300	0.300	**Reference**
e_B	7.874	9.906		0.310	0.390	
L	3.048	3.556		1.120	0.140	
N	18	18		18	18	
S	0.889	-		0.035	-	
S_1	0.127	-		0.005	-	

8.2 18-Lead Plastic Surface Mount (SOIC - Wide, 300 mil Body)



	Package Group: Plastic SOIC (SO)					
	Millimeters			Inches		
Symbol	Min	Max	Notes	Min	Max	Notes
α	0°	8°		0°	8°	
A	2.3622	2.6416		0.093	0.104	
A_1	0.1016	0.29972		0.004	0.0118	
B	0.3556	0.4826		0.014	0.019	
C	0.2413	0.3175		0.0095	0.0125	
D	11.3538	11.7348		0.447	0.462	
E	7.4168	7.5946		0.292	0.299	
e	1.270	1.270	Reference	0.050	0.050	Reference
H	10.0076	10.6426		0.394	0.419	
h	0.381	0.762		0.015	0.030	
L	0.4064	1.143		0.016	0.045	
N	18	18		18	18	
CP	-	0.1016		-	0.004	

8.3 20-Lead Plastic Surface Mount (SSOP - 209 mil Body 5.30mm)



Package Group: Plastic SSOP						
	Millimeters			**Inches**		
Symbol	**Min**	**Max**	**Notes**	**Min**	**Max**	**Notes**
α	0°	8°		0°	8°	
A	1.73	1.99		0.068	0.078	
A_1	0.05	0.21		0.002	0.008	
B	0.25	0.38		0.010	0.015	
C	0.13	0.22		0.005	0.009	
D	7.07	7.33		0.278	0.289	
E	5.2	5.38		0.205	0.212	
e	0.65	0.65	**Reference**	0.0256	0.0256	**Reference**
H	7.65	7.90		0.301	0.311	
L	0.55	0.95		0.022	0.037	
N	20	20		20	20	
CP	-	0.1016		-	0.004	

Symbol LIst for Shrink Small Outline Package Parameter	
Symbol	**Description of Parameters**
α	Angular spacing between min. and max. lead positions measured at the gauge plane
A	Distance between seating plane to highest point of body
A_1	Distance between seating plane and base plane
B	Width of terminals
C	Thickness of terminals
D	Largest overall package parameter of length
E	Largest overall package width parameter not including leads
e	Linear spacing of true minimum lead position center line to center line
H	Largest overall package dimension of width
L	Length of terminal for soldering to a substrate
N	Total number of potentially usable lead positions
CP	Seating plane coplanarity

Notes:
1. Controlling parameter: mm.
2. All packages are gull wing lead form.
3. “D” and “E” are reference datums and do not include mold flash or protrusions.
   Mold flash or protrusions shall not exceed 0.15mm .006 package ends and .010” on sides.
4. A .25 mm visual index feature must be located within the crosshatched area to indicate pin 1 position.
5. Terminal numbers are shown for reference.

9.0 PACKAGE MARKING INFORMATION

18-Lead PDIP

XXXXXXXX
XXXXXXXX
AABB CDE

Example

MTA41120
P©95A
9501 CBA

18-Lead SOIC (.300")

XXXXXXXX
XXXXXXXX
AABB CDE

Example

MTA41120
SO©95A
9501 CBA

20-Lead SSOP

XXXXXXXXXX
XXXXXXXXXX
AABB CDE

Example

MTA41120
SS©95A
9501 CBA

Legend:	MM...M	Microchip part number information
	AA	Year code (last 2 digits of calendar year)
	BB	Week code (week of January 1 is week '01')
	C	Facility code of the plant at which wafer is manufactured. C = Chandler, Arizona, U.S.A.
	D	Mask revision number
	E	Assembly code of the plant or country of origin in which
Note:	In the event the full Microchip part number can not be marked on one line, it will be carried over to the next line.	

MTA41120 Product Identification System

To order or to obtain information (e.g., on pricing or delivery), please use the listed part numbers, and refer to the factory or the listed sales offices.

PART NO. -X /XX X

Revision:			
Package:	P	=	300 mil PDIP
	SO	=	300 mil SOIC (Gull Wing Lead)
	SS	=	209 mil SSOP
Temperature Range:	-	=	0°C to +70°C
Device:	MTA41120		

AMERICAS

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