"SMC-40"
STEPPER MOTOR CONTROL I.C.
AND PERHIPHERAL DEVICE (SMO-40, SME-40)
HARDWARE MANUAL

Product Overview

Support Hardware

Specifications

Peripheral Devices

SMC-40 Features

The SMC-40 is a microcomputer chip capable of indexing stepping motors. This advanced controller is fast, low power and comes in a small package size.

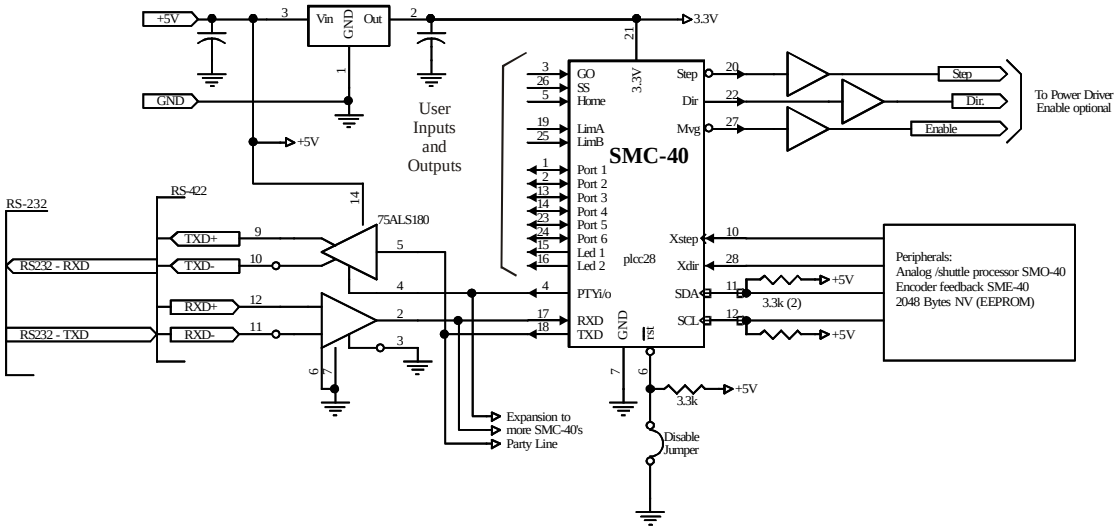
- NO crystal oscillator required
- NO reset circuit required
- Self contained non volatile memory
- Maximum step rates above 65,000 SPS
- Non-volatile memory for stand alone operation
- Multiple axis control from a single COM port
- Limit and Home inputs
- Go and soft stop inputs
- Six user ports
- Moving/Driver Enable output
- Small 28 pin PLCC28 and TSSOP28 surface mount packages sizes

Available single chip (I^2C) peripherals

- Additional NV (EEprom) memory
- Analog input processor
- Encoder feedback processor
- SIN-11 smart serial communication processor

Minimum Circuit Requirements

Only a few components are necessary to create a complete single axis controller. All user inputs and outputs are 3-5 volt logic and should be appropriately buffered.



SMC-40 Minimum Circuit Requirements

Note: The SMC-40 is a derivative of the microprocessor used in Advanced Micro Systems IBC-400 control module. Thus, the IBC-400 is a low cost way to evaluate designs without the initial prototype expense.

Power-up Program

On reset a special non-volatile (NV) memory address (192) is tested for executable instructions. The program can include home sequences or other special operations.

Party Line

The SMC-40 has the ability to be operated in a multiple axis Party Line mode. The architecture is analogous to a mini network. This parallel mode permits full duplex communications with all SMC-40 devices. Listening simultaneously to incoming commands, it is a much faster communication protocol in systems with many axes. Signals to control line driver "output enable"(pin 4) are provided when the requested axis wakes up.

Trip Point

The Trip Point is a programmable position that allows pre-defined operations to be executed when the motor position matches the Trip Point value. A typical application may be to turn on a valve when a desired position is passed.

Bi-directional Ramping

The SMC-40 can ramp either up or down to the specified constant velocities. The ramp slope may be altered prior to changing speeds. A Trip Point can be used to trigger velocity changes. The SMC-40 also supports independent deceleration ramping.

Program/Constant Storage

The SMC-40 includes 512 bytes of nonvolatile memory (EEPROM) and 512 bytes of RAM. Programs are written to and executed from the high speed RAM. Store commands copy the RAM image into the EEPROM. During power up reset the "shadow" EEPROM image (512 bytes) is copied into the RAM. These memories also retain all parameters and modes

Provision is made to implement up to 2,048 bytes of external NV memory. The low cost NV (EEPROM) memory is connected via a two wire (I^2C) interface. Direct read and write commands allow host use of the memory.

Go Input

A Go input is provided that allows execution of user sequences that have been preloaded into the NV memory. A simple pulse will start the sequence any time. Use of a terminal, host, etc., is not required thus allowing low cost, stand-alone operation.

Jog Capability

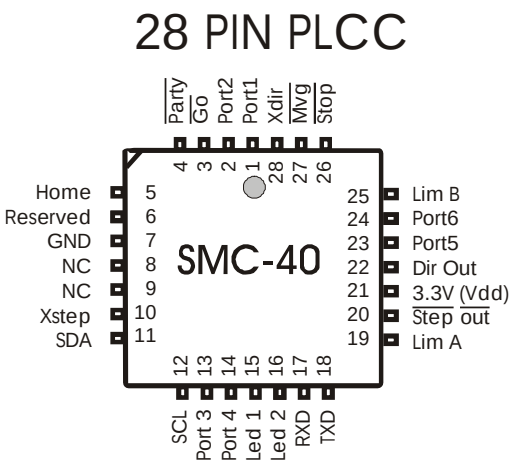
The SMO-40 is an analog/digital converter, offered by AMS that provides analog joystick interface. This peripheral processor implements A to D and D to A converters to digitize voltage input. The input can be either uni-directional (single direction) or bi-directional.

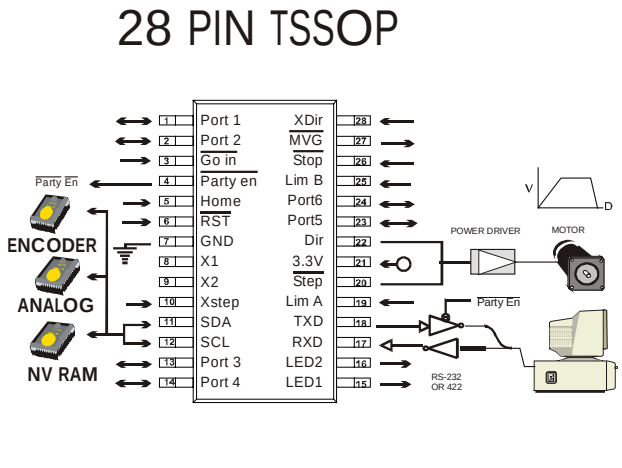
Once digitized, the generated motor speed is managed by software. Parameters include start and maximum speed. A dead zone parameter prevents drift and hysteresis to reduce hunting. Acceleration supervision prevents motor stall that could occur with abrupt input changes.

In addition to analog input the OSC-40 provides step/direction or A/B quadrature inputs. The quadrature inputs can accept signals from standard encoders, converting them to a step/direction motion. A most useful application is a "shuttle follower" control. A panel mounted rotary encoder permits position adjustment, with speed and position following the operator's rotation.

This single chip system is interfaced using Xstep/Xdirection inputs and I^2C bus communications.

Pin Description





Note: Signal pin numbers are the same for either package.

Pin	Name	Function
1	Port1	General purpose input or output Port
2	Port 2	General purpose input or output Port
3	GO	Input starts user program at address zero
4	Party	Output enables RS-422 bus driver
5	Home	Input used for home routine, can also be read as input
6	Reset	Input – pull to high
7	GND	Power supply and logic common
8	Xtal1	Not currently used (oscillator is built in)
9	Xtal2	Not currently used (oscillator is built in)
10	Xstep	External step pulse input – analog joystick, encoder
11	SDA	I^2C bus clock for memory expand or other options – requires pull-up
12	SCL	I^2C bus data for memory expand or other options – requires pull-up
13	Port 3	General purpose input or output port
14	Port 4	General purpose input or output port
15	Port 5	General purpose input or output port
16	Port 6	General purpose input or output port
17	RXD	Serial data input – from host computer
18	TXD	Serial data output – to host computer
19	Lim A	Travel Limit input, invertible
20	Step	Output to driver – pulse (65K SPS or square wave 32K SPS
21	3.3V	Power supply input – 25Ma maximum
22	Dir	Direction control to driver
23	Led 1	Optional activity LED
24	Led 2	Optional activity LED
25	Lim B	Travel limit input, invertible
26	Stop	Input stops executing user program
27	MVG	Output indicates moving, can be ‘off’ delayed, invertible
28	Xdir	External direction input, used with Xstep (pin 10) input

While the SMC-40 operates from a 3.3-volt power supply, all specified inputs and outputs are 5 volt tolerant. You should use pull-up resistors for interface to standard 5-volt logic. Because any pin could be configured as an output or input, all input pins (especially those designated as I/O) should be interfaced with open collector/drain with pull-up resistors to avoid possible damage.

Signals configured as outputs have an absolute maximum rating of 20 mA (sinking). The recommended maximum output sink current should be designed to be 2 mA or less. While the outputs have weak pull-up resistors, external pull-up resistors may be necessary. PCB lead length should be as short as possible, preferably less than 2 inches. Failure to use buffering to and from connectors can expose the SMC-40 IC to damage.

Note: The following descriptions assume that all used signals use pull-up (to +5 volt) resistors. Unused inputs should be tied together and then pulled up to 5v volts for noise immunity.

User Ports (pins 1, 2, 13, 14, 15, 16)
Ports 1 through port 6 can be used as either outputs or inputs. The hardware (buffer) design will define the type. The off condition is defined as a high (5-volt) level. Some or all of the ports can be designed as outputs as the application requires. Low numbered ports are selected as inputs because loop and branch commands employ these as inputs. The 'A' command is used to set, reset or read these inputs.

Go, Stop Inputs (pins 3, 26)
These inputs are useful for starting and stopping previously stored "program" sequences in stand-alone applications. Program execution can be initiated in three ways:

1. The 'G' (Go) command
2. Auto start on power up (or reset)
3. An input (low going) pulse to pin 3

The Go input pulse width should be a minimum of 10 mS. The program will start execution at memory location 0 (zero). If the program does not loop (run continuous) the Go input is sampled and if it is still low, execution will repeat.

The Stop (Soft Stop) will terminate motion and program execution, returning the SMC-40 to an idle state. If the Go input is active, a new start is triggered.

Party Output (pin 4)
This output is used to enable a differential RS-485 line driver in Party Line designs. Party Line operation permits a number of distributed controllers to operate in a 4-wire, full duplex RS-422 architecture. The output is high after reset, enabling the driver. On entry into Party Line mode, pin 4 will go low, disabling the line driver when not communicating.

Home Input (pin 5)
The home input is used during execution of the "find home" command, commonly used after power up or to re-zero a position. It is possible to read this as a general purpose input if this type of homing is not required.

Reset (pin 6)
The SMC-40 has a built in reset at power up. There is no need for external components. If the reset signal is held low when power is applied, the processor will be held in a reset condition. This can be used to disable an axis in a multiple SMC-40 design where disabling other controllers allows naming of one single controller.

XSTEP, XDIR) Input (pins 10, 28)
These inputs allow stepping from external sources. Enabled under control of software, these are used with the SMO-40 analog joystick controller IC and SME-40 encoder controller IC.

SDA, SCL (pins 11,12)
This is an I^2C bus interface. The 2 wire Inter-Integrated Circuit provides a small network for slave components including EE Proms (NV memory), and slave processors such as the SMO-40. Both these signals must be pulled up with 3.3k resistors to 5 volts. As of this time, external memory expansion to 2048 bytes is available.

RXD Input (pin 17)
This signal receives data (9600 baud) from a host computer. ASCII command/data is used to execute commands. To avoid errors, echoed character-by-character handshake must be performed. Software operating with DOS or Windows98 can be done, while Windows 2000, ME, and XP can be difficult. In all cases a SIN-11 serial adapter is recommended. It performs all the necessary functions and simplifies programming.

TXD Output (pin 18)
This output signal transmits serial data to the host via the line driver. Functions include handshake and reading data, status and position. In Party Line designs, the line driver is enabled from the party enable signal (pin 4).

Limit Inputs (pins 19, 25)
Two limit inputs (LIM A, LIM B) are sampled on each step of motion. Depending on direction, each input will prevent motion in that direction, for instance LIM A will prevent CW motion while permitting CCW movement. Conversely, LIM B will stop motion in the opposite direction. Actual definition of direction depends on a number of factors including motor wiring, driver type, mechanics, etc.

By default a low input voltage will activate a limit, however, the l (lower case L) command can be used to invert the polarity. In this case both limits will have to be held at a low (0 volt) to permit motion.

Step, Direction Output (pins 20,22)
These are the control signals for your driver. The step pulse is low going, about 10 uS wide. For drivers that do not respond, the l (lower case L) command will insert a virtual flip-flop on the output, producing a square wave. This also has the effect of dividing the step rate by 2, reducing the maximum step per second to about 32,000.

LED Outputs (pins 23,24)
Connect a bi-color LED between these two pins with 1k pull-up resistors. These are useful for some status displays.

MVG Output (pin 27)
The moving signal is activated when motion is generated (output steps). This signal (low when moving by default) is turned off after stepping stops. This signal may be used to control motor driver enable or current setback. Often it is desirable to allow a “settling” time before the winding current is removed This programmable delay time is specified using the ‘E’ command. The l (lower case L) command can be used to invert the output polarity.

Power

GND (pin 7) is the logic power common.
VDD (pin 21) is the controller logic supply and is a regulated 3.3 Vdc.

Design Considerations

The SMC-40 requires a minimum of external components for operation. Good design practice with CMOS devices, such as the SMC-40, desires buffering or isolation of all input and output signals that have to travel more then a couple of inches, especially off of a circuit board and in noisy environments.

Simple local buffering may be achieved through use of logic buffers such as 74HC04's, 7406's, 7407's or other low cost devices. Noisy environments may dictate use of optical isolation. The low input sink requirements (800ua. max.) of the SMC-40 permit most isolators to directly drive the inputs. Outputs should be buffered to increase L.E.D. drive current.

An excellent input design uses the LM-339 quad comparator. It has open collector and withstands 36 volts on the inputs. Reference the IBC-400 schematic.

Clock

The SMC-40 has a built in clock. No external hardware is required.

Hardware Reset

The SMC-40 has a built in reset. No external hardware is required.

NV Memory

The SMC-40 contains 512 Bytes of NV (EEprom) memory. The relatively slow NV memory image is copied into a 512 byte RAM during reset initialization. The NV memory retains all stored parameters and user program commands.

If a user program is extensive, this internal memory may not be sufficient. External NV memory may be attached via the SDA/SCL lines. Currently 2048 bytes of EEPROM is supported. The external memory has an access time of about 1mS per byte. Suppliers of suitable NV memory products include:

Ramtron (FM24C16)
Xicore (X24C16)
Catalyst (CAT24WC16)

I/O Ports

Six general-purpose I/O ports are available on the SMC-40. To the SMC-40 they all look the same. They can be written to and be read back. In order to be used as inputs, the open drain portion of the output must be off, as in the power up condition.

An SMC-40 command that contains zeros in the binary mapped value will also set the desired ports "off." The command "A 0" will turn all the outputs to the off (all 1's) or open condition. Usually external hardware defines the port direction.

Most Advanced Micro Systems products buffer ports 1, 2 and 3 as inputs, port 4 as input and output, and port 5 and 6 as outputs. Resistors should be inserted on "inputs" driven by totem-pole drivers to prevent excessive current should the port be turned on as an output conflict.

The SMC-40 can view all ports as inputs and outputs, restricted by contention with external hardware. Any "output" port can be modified, then subsequently used in conjunction with the L, G2048, or A129 (read) commands.

Serial Interface

Two-signal (TXD and RXD) data lines with ASCII characters do all communication to an external computer. The COM port interface must be used either to initialize and load sequences in the beginning or to communicate to a permanent host computer. One IC line driver and receiver is used per system (a system is defined as one or more axis located on a single PCB or in very close proximity to one another).

Three 5-volt logic signals (TXD, RXD and PTY) are connected in parallel. The maximum recommended number of axis is 15. Each axis must be named individually with a unique name character.

The naming process is as follows:

1. With power off, install disable jumpers in all axis except the one to be named.
2. Apply power. The one enabled axis will operate in the “single” line mode.
3. Refer to the IBC-400 manual for naming and single axis functions.

This product is equivalent to the device used in the AMS product- IBC-400. Please refer to the IBC-400 manual for all software procedures and command usage, including single axis and party line operations.

DC Characteristics

Parameter	Description	Condition	Min	Typ	Max	Units
Idd	Power supply current			15	25	Ma
Vdd	Logic supply voltage			3.3	3.6	V
Vin max	Absolute maximum	Any pin	-.5		5.5	
Vil	Input low Schmitt threshold		0.73	1.32		V
Iil	Input low current	Vin=0.4V			-50	μa
Vith	Input high Schmitt threshold			1.98	2.31	V
Iih	Input high current	Vi=vcc-1.5			500	μa
Vol	Output low voltage	Iol=3.2ma			0.3	V
Voh	Output high voltage	Ext pull-up			5.5	V
I/O Max	Output current per I/O pin				20	Ma

AC Characteristics

Parameter	Description	Min.	Typ	Max.	Units
Baud Rate	8 bits, no parity, 1 start, 1 stop		9600		
Step Rate	Range (internal clock)	57		65000	SPS
Step Pulse Width	Output to driver	5		7	μs
Swl	Limit/home switch response	2			Step Clk

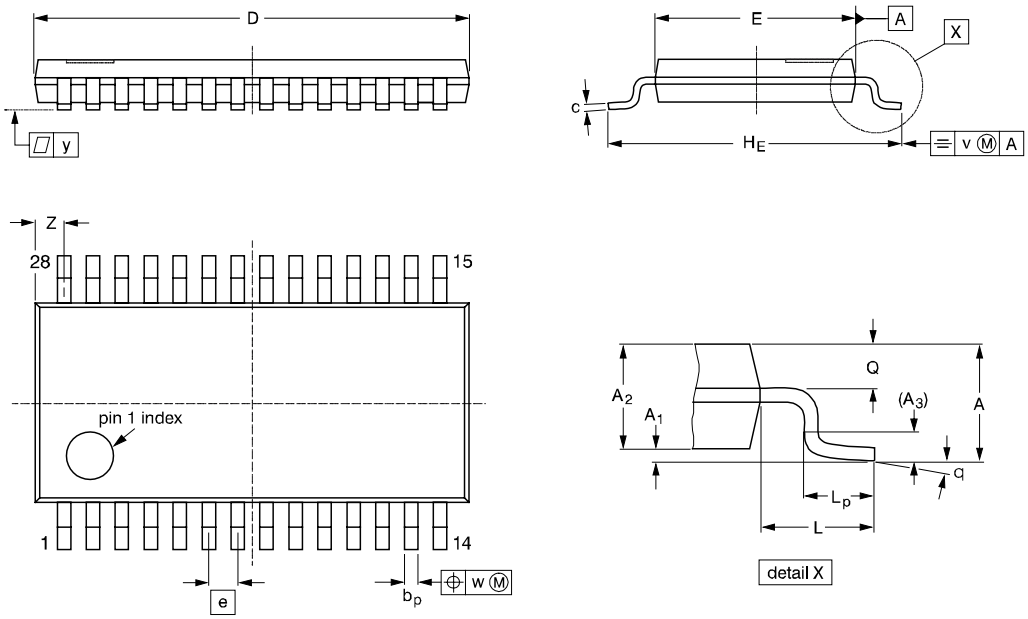
Operating Temperature: -40^{o} to $+85^{o}$ C

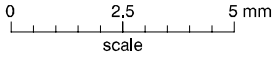
Non-Volatile Memory Operation

Instruction	Condition	Typ	Units
Fetch and execute cycle	Loop	1.7	Ms
Save parameters	Store	63	Ms

TSSOP28 Package Specifications

TSSOP28: plastic thin shrink small outline package; 28 leads; body width 4.4 mm





DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	q
mm	1.10	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	9.8 9.6	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.8 0.5	8° 0°

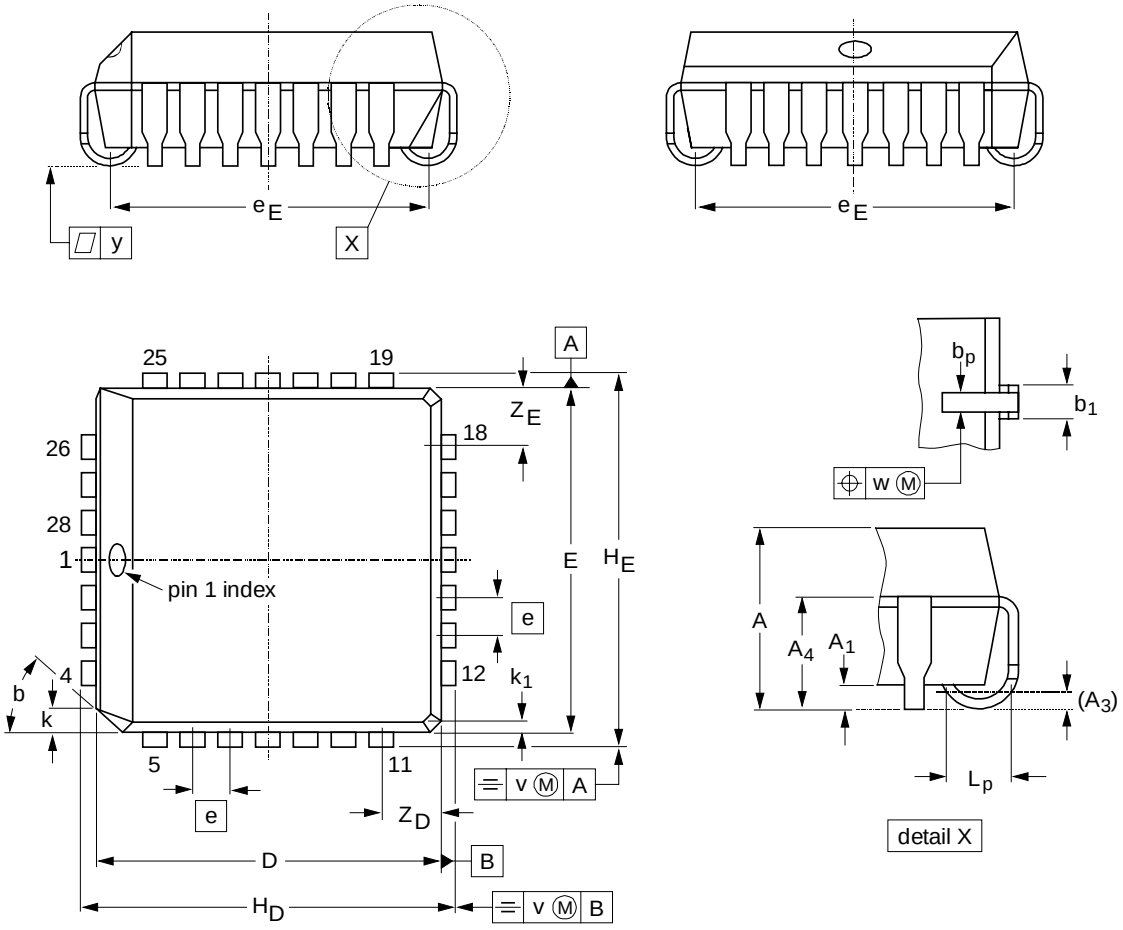
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT361-1		MO-153AE				~~93-06-16~~ 95-02-04

PLCC28 Package Specifications

PLCC28: plastic leaded chip carrier; 28 leads



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	b
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	11.58 11.43	11.58 11.43	1.27	10.92 9.91	10.92 9.91	12.57 12.32	12.57 12.32	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.456 0.450	0.456 0.450	0.05	0.430 0.390	0.430 0.390	0.495 0.485	0.495 0.485	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

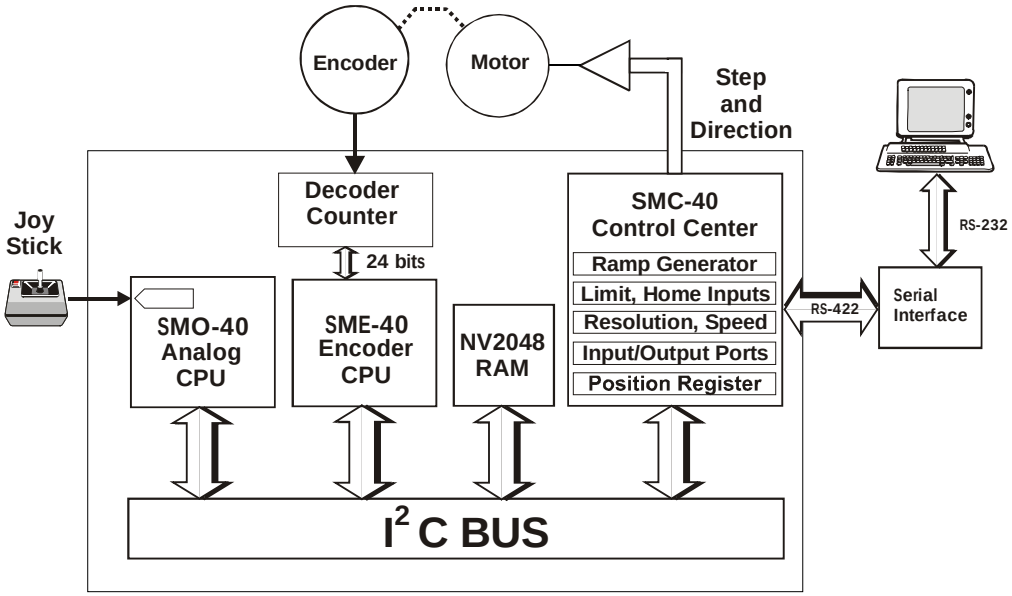
Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

Overview.

Note: These peripheral products are the core devices used in the AMS model "IBC-400" step motor controller. Please refer to the IBC-400 manual for all software procedures and command usage, including single axis and party line operations.

Three peripheral devices, the SMO-40, SME-40 and NV2048, are available to enhance the functionality of the SMC-40 controller. These "slave" devices communicate over the standard I^2C wire bus. Like the SMC-40, these products stand-alone and do not require external crystals, memory or reset circuitry.



Two of the devices are low power controllers powered by 5-volts and are supplied in a 20-pin (SO20) small outline surface mount package.

-SMO-40 Analog "Joystick" Inter face- In addition to the analog input, remote step and direction or quadrature A/B logic signal inputs are available.

-SME-40 Encoder Interface- Provides servo like position control and error detection.

The third device, **NV2048**, adds 248 bytes of serial EEPROM to expand program storage beyond the 512 bytes already contained in the SMC-40.

None of these devices are necessary for SMC-40 operation. The SMC-40 will detect and install these devices at power-up reset. Simple interface to the SMC-40 "master" processor requires only four or five connections.

Design Considerations

These devices require a minimum of external components for operation. Good design practice with HMOS and CMOS devices, calls for buffering or isolation of all input and output signals that have to travel more then a couple of inches, especially off of a circuit board and in noisy environments.

Simple buffering may be achieved through use of low cost comparators such as the tried and true LM339 or equivalent. In addition to isolation, their inputs will withstand over 30 volts. These comparators have open collector outputs and may require external pull-up resistors.

Noisy environments may dictate use of optical isolation. The low input sink requirements (800ua. max.) allow most isolators to directly drive the inputs. Outputs should be buffered to increase drive current and noise isolation.

Analog Input Overview (SMO-40)

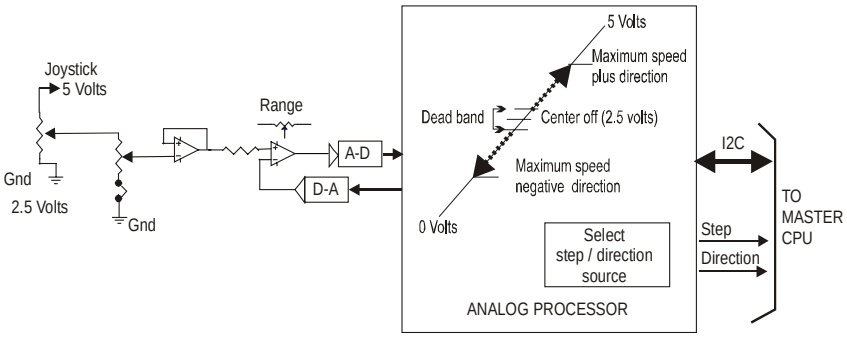
The newest products from Advanced Micro Systems are available with analog input. This input is used to generate a variable step rate frequency. The system is more than a simple voltage-to-frequency design. Input voltage is digitized with an Analog to Digital converter, and then digitally processed. The result is a stable, controlled step rate and direction function. A special processor, part number SMO-40 is used to provide the analog conversion. The SMO-40 is a slave to the SMC-40, communicating by a 4-wire buss.

Products with the "A" option (IBC-400A and *mStep407-A*) have this system implemented.

The analog "joystick" interface adds yet another dimension of motion control possibilities by providing the capability of speed that is proportional to the input voltage. Features include:

- A digitized analog input
- A "dead-zone" that is applied before stepping starts
- Stepping that starts at a specified rate
- Speed, governed by an acceleration setting, increases as voltage increases
- Speed, governed by a deceleration setting, decreases as voltage decreases
- A maximum speed setting
- An auto-zero function that can remove any offset
- The Auto-mode function selects Uni-directional or bi-directional mode
- Two multi-turn potentiometers adjust range and gain

Probably the most advanced feature is the ability to constrain acceleration and deceleration rates. This function helps prevent step motor stall conditions that can occur when the step rate is changed abruptly. As the input voltage changes, the step rate is determined by a lookup table. The acceleration/deceleration profile is governed using the same algorithm as the standard "index" function used in the master CPU.



Analog Joystick Block Diagram

Caution- the input buffering op-amp's are not necessary, but without them the processor input is easily subject to damage.

Joystick Input -Accepts analog voltage and produces either uni-directional or bi-directional motion control with the speed proportional to the input voltage. Input voltage range is either 0 to 5 volts (uni-directional) or 0 to 2.5 to 5 volts bi-directional, where 2.5 volts equals zero speed center. An analog output is used for an "auto-zeroing" function.

Digital Inputs- These may be specified by mode command, as either step/direction or A/B inputs. The step and direction mode permits motion from an external step pulse and direction source. In the A/B mode it accepts two-phase input signals such as those produced by incremental encoders. Encoder resolution is specified in line count (slots in encoder wheel) the SMO-40 multiplies this by 4, thus a 400 line encoder will produce 2000 step pulses per revolution.

These encoders (usually optical) are available in panel mount versions. It is useful to simply implement a shuttle or position adjustment feature. The motor will "follow" the encoder rotation in both speed and position. Speeds and position ratio are dependent on encoder counts (X4) per revolution, motor steps per revolution, and any mechanical gearing.

SMO-40 Pin Description

Pin	Signal	Description
1		
2	Xstep	Step pulse to SMC-40
3	Dac	
4	Reset	Pull-up to +5 volts
5	GND	Power common
6		
7		
8		
9	SDA	I^2C communication with SMC-40
10	SCL	I^2C communication with SMC-40
11		
12		
13	Xdir	Step and direction to SMC-40
14	Joy	Analog input 0-5 volts or 2.5 volts $\pm$ 2.5 volts
15	VCC	+5 volt power input
16		
17		
18	Step/A	External step pulse (low going) or phase A of an encoder
19	Dir/B	External direction pulse (low going) or phase B of an encoder
20		

Note:
1. Absolute maximum voltage +5.5 volts on any input.
2. All external inputs must be isolated with appropriate buffer circuitry, using LM339 comparators is recommended.
3. Minimum setup times and pulse width 10uS.

Encoder Feedback (SME-40)

The encoder feedback module is comprised of two essential components:

1. A 24 bit quadrature counter accepts the A-B quadrature encoder signals. After filtering and decoding with a 4X decoder, a 24 bit binary bi-directional counter tracks the position. While seldom encountered, clock rates to 25mHZ are possible. The count range is ±8,388,607.

   With a quality disc and properly phased encoder, this 4X signal will be accurate to better than 1/2 count. A 500-line encoder mounted to the rear of a stepper motor will generate 2,000 counts per revolution.

2. SME-40 controller that performs encoder functions. Modes include
   a. Stall detection – During indexes the encoder position is constantly sampled and tested for progress in the desired direction. Should excessive lag be detected, the host CPU (SMC-40) is notified. The SMC-40 will perform corrective action as defined by the settings.
   b. Position maintenance – The encoder position is compared with the "target" position. If an error is detected (the position error is greater than the "dead band") then Xstep and Xdirection signals are generated to correct the error.

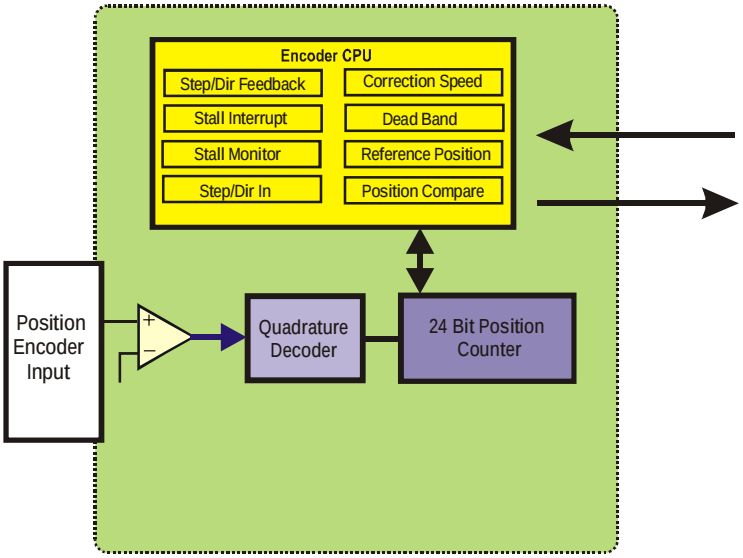
Command and data exchanges are accomplished over the two-wire I^2C bus.

In addition to the two channel inputs, index pulse homing is possible. A feature with the SME-40 includes provision for battery backup to prevent position loss and operation with almost any resolution encoder. The encoder option (E) may co-exist with the analog option (A).

Features include:

- Use with 50-1024 line (CPR) encoders
- Monitor for stall condition during index
- Retry index "n" times upon stall detect
- Position maintenance mode with deadband
- Battery backup input to keep position registers

Block Diagram (SME-40)



ENCODER PROCESSOR

Operation

The encoder system is composed of the following components:

1. Quadrature input that decodes encoder A-B signal to obtain 4X resolution. For instance, a 500 "line" encoder will produce 2,000 counts per revolution.

2. A 24 bit bi-directional counter that tracks incremental encoder position at count rates to 1 MHZ.

3. A Control Microprocessor (CPU) that provides stall detection, and re-position outside dead zone control and math functions to convert encoder motion commands into step motor index distance. The CPU communicates with the master (SMC-40) microcomputer via serial bus and step and direction signals to maintain/monitor target position and encoder counter position.

The encoder CPU receives the parameter information: encoder resolution, microstep resolution, deadband size, allowed lag, and hunt speeds. On receipt of an index command, the CPU calculates a number for the "step index" and stall monitoring is started by loading the retry counter. The CPU counts the master (SMC-40) step motor steps and samples the actual encoder position periodically. If the distance traveled is less than the specified lag distance, then a stall condition is triggered. The CPU decrements the stall-retry counter and notifies the SMC-40 of the stall event. One of two operations are triggered:

1. If the retry count is not zero, a new index is computed from the actual position and target position. The SME-40 will initiate a new (hopefully shorter) index. If subsequent stall detects occur, the retries continue until the retry counter reaches zero. The position maintenance mode is then started.

2. Hunt (position maintenance) is used when the encoder position wanders outside of the specified deadband (encoder count) distance. The encoder CPU generates step and direction signals to force the position to be equal the target position. The "hunt" speed is specified with the "v" (lower case V) command. The step-rate is without ramp and is RPM compensated for the specified microstep resolution.

If the hunt mode is triggered because of an early stall exhaust, the step distance can be large. If the motor motion is obstructed, stepping attempt will be continuous, until an abort is executed. Whenever the position drifts outside the deadband, repositioning to the target position will be exact (as opposed to just within the deadband).

SME-40 Pin Description

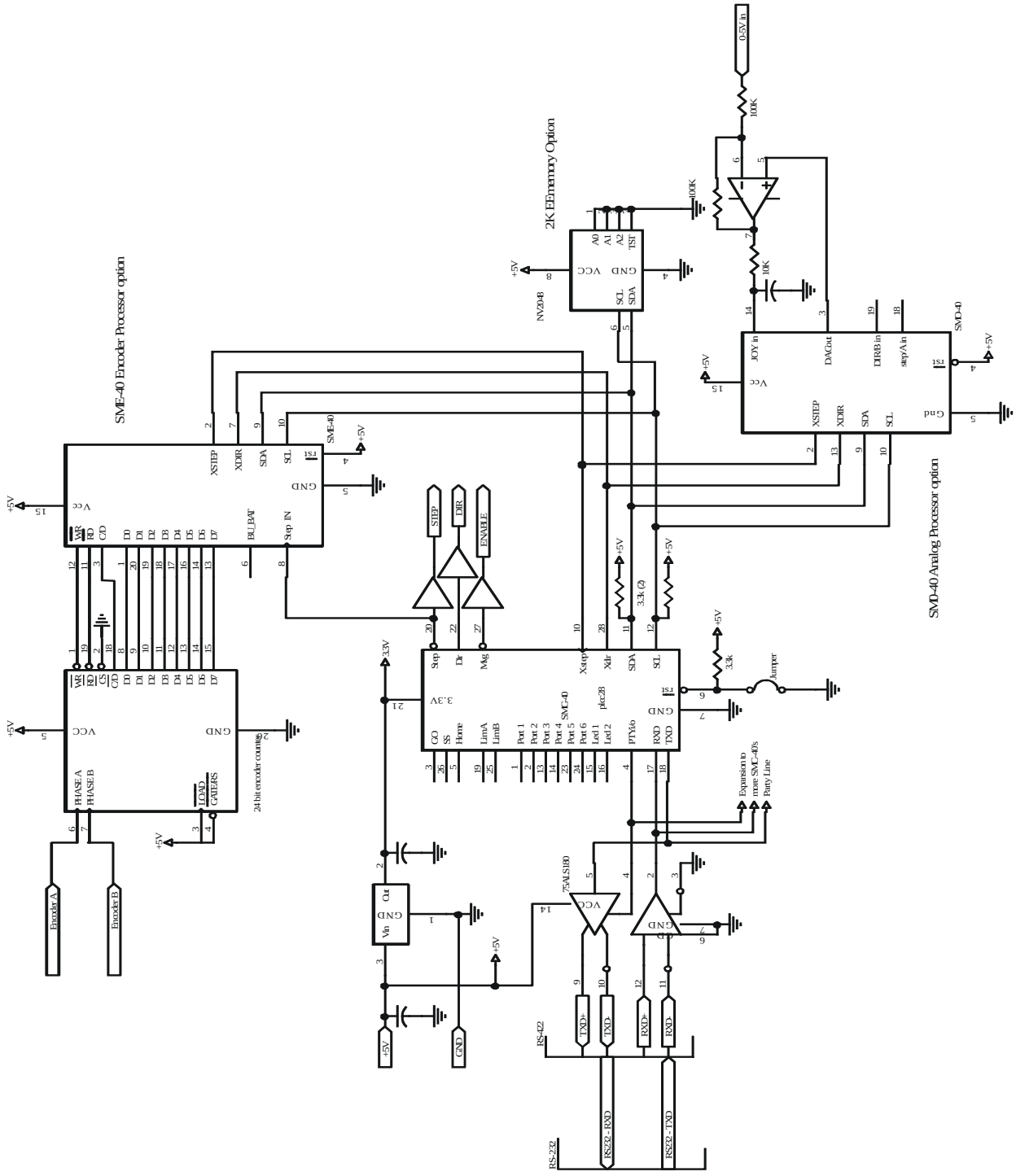
Pin	Signal	Description
1	D0	Position data 0
2	Xstep	Step feedback/error status to SMC-40
3	C-D	Data control
4	Reset	Pull-up to 5 volts
5	GND	Power ground
6	bu_bat	Used when implementing battery backup
7	Xdir	Direction feedback error status to SMC-40
8	Step	Motor step pulse input (SMC-40 output) –used for stall detection
9	SDA	Bi-directional I^2C bus
10	SCL	Bi-directional I^2C bus
11	RD	Read counter pulse
12	WR	Write counter pulse
13	D7	Position data 7
14	D6	Position data 6
15	VCC	+5 volt power input
16	D5	Position data 5
17	D4	Position data 4
18	D3	Position data 3
19	D2	Position data 2
20	D1	Position data 1

Note:
1. Absolute maximum voltage +5.5 volts on any input.
2. All external inputs must be isolated with appropriate buffer circuitry, using LM339 comparators is recommended.

Peripheral Device Interconnect Diagram

Please refer to the IBC-400 product manual for complete schematics- with buffering.

Note: Not shown here is the SIN-11 serial interface adapter, which is highly recommended to simplify serial software.

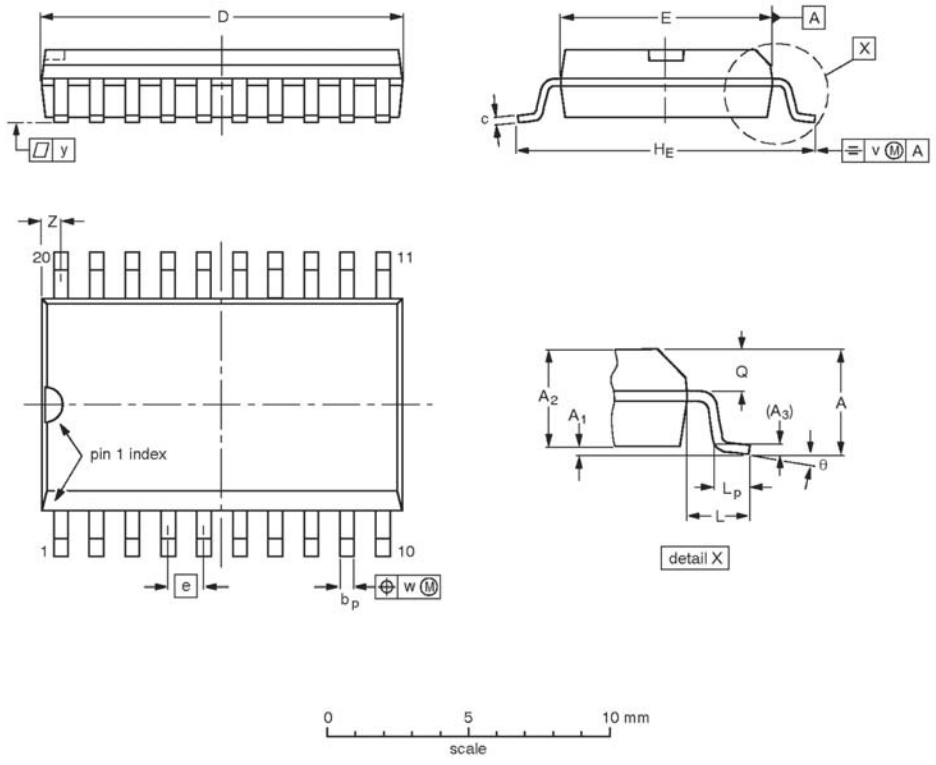


SMO-40, SME-40 Specifications

Vdd= 4 to 6Vdc, Ta= –85 to +85 degree C

Sym	Parameter	Test conditions	Min	Typ	Max	Unit
Icc	Power supply current	Vdd=5 volts		15	25	mA
Ain	Analog inputs	Vdd=5 volts	-0.5		5.5	V
Vinl	Logic inputs	4.0V<Vdd<6.0 volts	-0.5			V
Vinh	Logic inputs	4.0V<Vdd<6.0 volts			Vdd+0.5	V
Iinl	Input low current	Vin=0.4 volts			-50	uA
Ilh	Input leakage	Vin=Vil or Vih			+2	uA
Vol	Output low	Iol=3.2mA			0.4	V
Iol	Output sink current	Absolute maximum			20	mA
Voh	Output high	Ioh=-30uA,Vdd=4.5 volts	Vdd-0.7			

SO20 Package Specifications



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT163-1	075E04	MS-013				~~97-05-22~~ 99-12-27