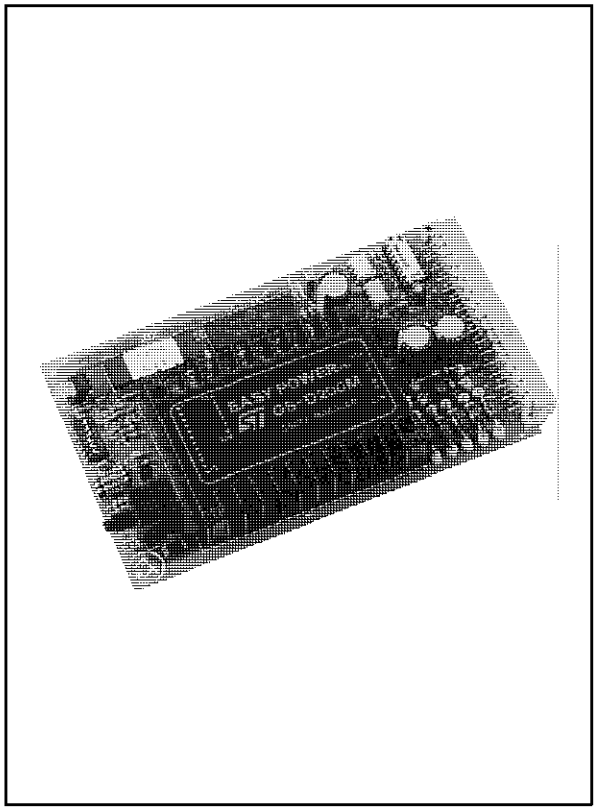
SGS-THOMSON MICROELECTRONICS

GS-D250M

2.5A MICROSTEP DRIVE BOARD FOR STEPPER MOTORS

FEATURES

- 2.5A/phase peak current
- 5, 10, 25, 45, 90, 100, 127, microsteps/step selection
- Full step selection possibility
- User programmable phase current
- User programmable phase current ripple
- Automatic ripple reduction at rest
- 4/8 wires motor drive
- Step clock in excess of 200kHz
- Single unregulated supply voltage
- TTL, 12V, 24V programmable input level
- Input signal galvanic isolation
- Thermal protection



DESCRIPTION

The GS-D250M is a single-Europe board for microstepping drive of 4/8 wires stepping motors.
Thanks to a very large number of embedded functions, the interfaces to the external environment are reduced to a minimum: just three commands are needed as inputs (step clock, direction, enable) and the outputs can drive directly the stepping motor windings.
The availability of user's selectable hardware allows a very high flexibility to meet all possible application needs.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	DC Supply Voltage	42	V
I_i	Logic Input Current	30	mA
I_o	Logic Output Current	10	mA
T_{stg}	Storage Temperature Range	– 20 to +85	°C
T_{hop}	Max Operating Heatsink Temperature (GS-D200M)*	+85	°C

* Thermal protection intervention @ T_h 90°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C and V_S=24V unless otherwise specified)

	Parameter		Min	Typ	Max	Unit
V_S	DC Supply Voltage		12		40	V
I_i	Logic Input Current**			10		mA
V_o	Logic Output Voltage (TTL compatible)	Low High	 2	 2	0.8 5	V
I_{ph}	Phase Peak Current*			0.5	2.5	Apk
f_c	Clock Pulse Frequency				140	kHz
V_{is}	Isolation Voltage		500			Vdc

Note: The unit requires an input filtering capacitor 4700µF/50V, with low ESRand located as close as possible to the board

* Output shorts protection phase-to-phase and phase-to-supply
** TLL, 12V, 24V Programmable input voltage level.

Figure 1. Signal Timing

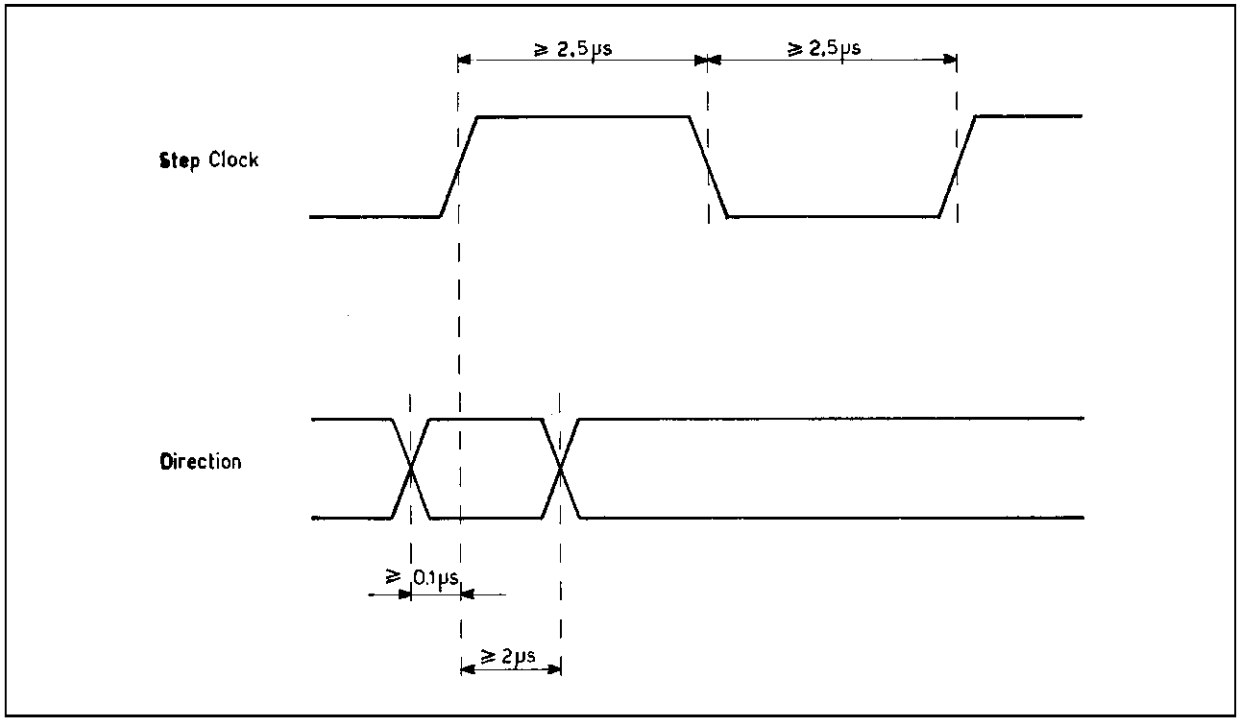
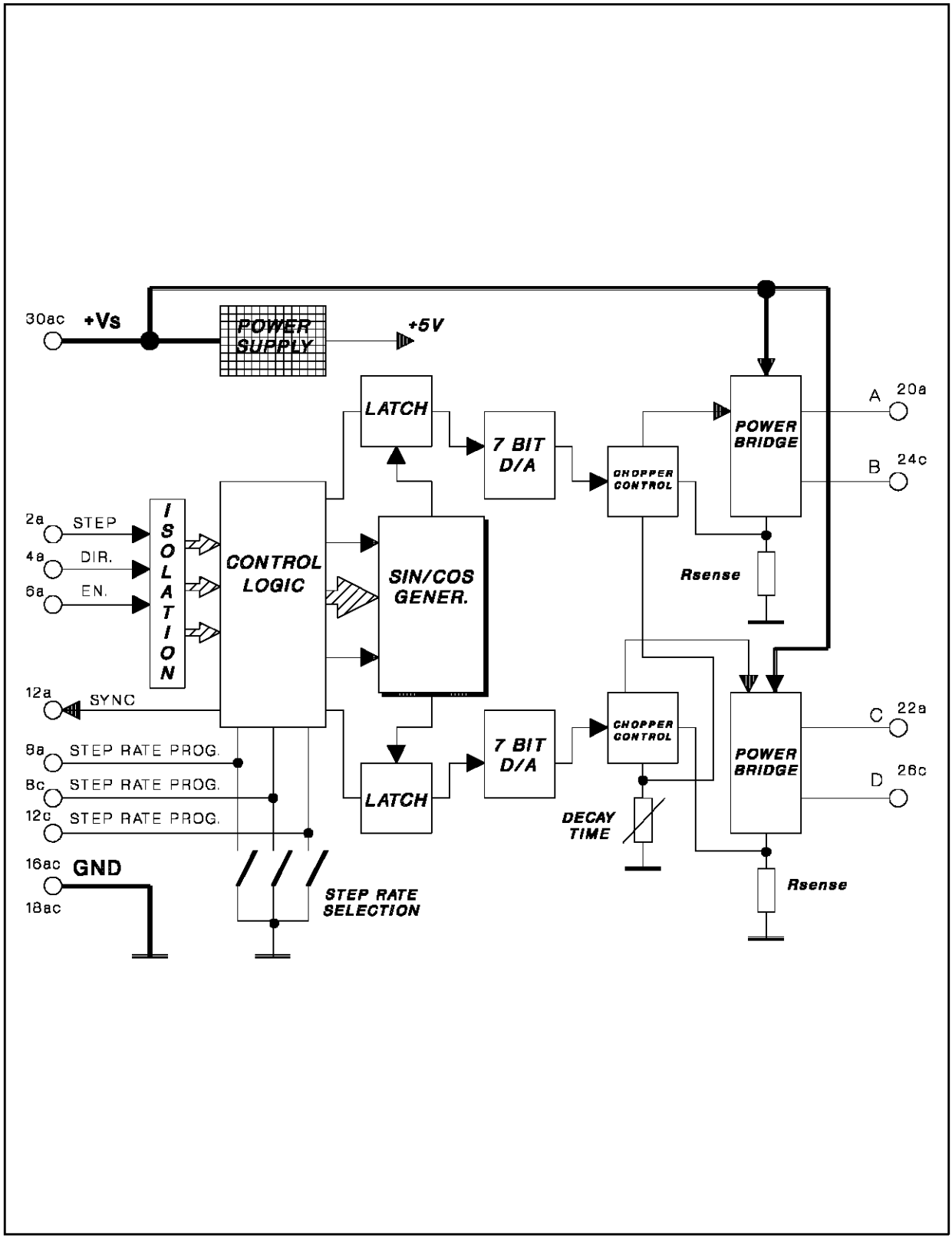
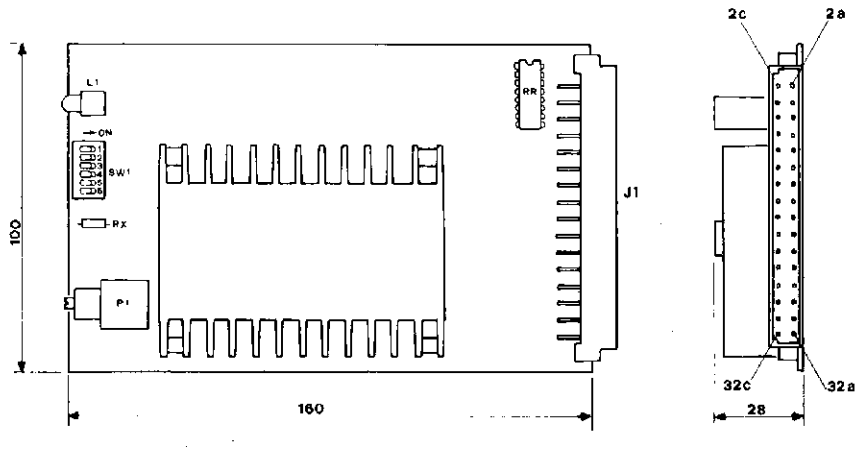


Figure 2. GS-D250M Block Diagram



CONNECTION DIAGRAM AND MECHANICAL DATA



Dimensions in mm

GS-D250M BUS CONNECTOR PINS DESCRIPTION

The GS-D250M uses a 32 pins (16+16) DIN 41612 - VG95324 male connector

Row a	Pin	Row c
Step pulse input	2	Step pulse return
Direction input	4	Direction return
Disable input	6	Disable return
Microsteps/step programming	8	Microsteps/step programming
Not used	10	Not used
Sync Output	12	Microsteps/step programming
Not used	14	Not used
Supply ground	16	Supply ground
Supply ground	18	Supply ground
Phase A output	20	Not used
Phase C output	22	Not used
Not used	24	Phase B output
Not used	26	Phase D output
Not used	28	Not used
Supply voltage	30	Supply voltage
Not used	32	Not used

GS-D250M hardware available commands.

SW1, SW2, SW3	Microsteps/step programming
SW4	Selection of step clock transition
SW5	Direction polarity selection
SW6	Current ripple reduction at rest
Rx	Maximum peak current setting
P1	Phase current ripple programming
RR	Resistor array for logic level setting

GS-D250M DESCRIPTION

The GS-D250M single-Europe board has been designed by taking into account the maximum semplicity and flexibility in use.
It is based around the GS-D200M (microstep drive module, see the relevant data sheet) and it implements all the functions needed for a microstepping signal generation, so reducing the burden of external microprocessors, and the power stage to drive the stepper motor windings.
In its simplest application, the GS-D250M needs just three commands inputs: step clock, direction, disable.
Because this extreme semplicity could prevent the adaptability to different types of application, hardware selectable options are offered to the user to best program the board to his/her needs.
The various functions are described in the following.

Supply Voltage

The supply voltage can have any value between 12V and 40V maximum. No well regulated DC voltage is needed.
The supply voltage must be connected between pins 30a, 30c (positive rail) and 16a, 16c, 18a, 18c (negative rail).
The GS-D250M is permanently damaged by a supply voltage larger than 42V. The recommended maximum supply voltage is 40V.

During the phase current control by chopping method, the phase current is returned to supply voltage at each fast recirculation period. These current pulses can bring the supply voltage well above the recommended 40V max if the output impedance of the power supply feeding the GS-D250M is not adequately low.
A 1000µF/50V capacitor with low ESR at high frequency should be connected as close as possible to the supply voltage pins to provide a low impedance path for the recirculating current pulses.

An internal step-down switch mode regulator provides the 5V/± 5% requested by the internal logic blocks and it provides an automatic reset at POWER ON.
The POWER ON is indicated by on LED available of the front edge of the board.

Microstep Programming

The microsteps/step can be programmed by the user.
The digitized sine and cosine functions required for a microstepping control are stored in Lock-Up-Table inside the board. The user has two options to select the adequate number of microsteps/step.

Microstep programming by hardware

Three switches (SW1, SW2, SW3) are available on the front edge of the board.
The following table defines the microsteps/step rate.

SW1	SW2	SW3	Microsteps/step
OFF	OFF	OFF	127
ON	OFF	OFF	100
OFF	ON	OFF	90
ON	ON	OFF	45
OFF	OFF	ON	25
ON	OFF	ON	10
OFF	ON	ON	5
ON	ON	ON	1

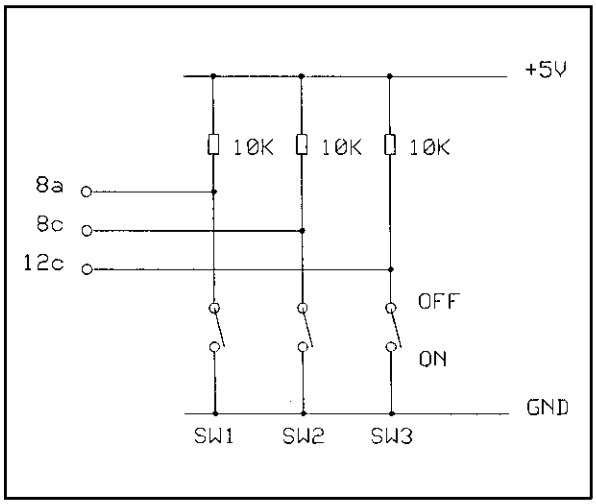
The last condition defines a full step operation of the board.
The switches are in the OFF condition when the knob is pulled versus the board edge.

Microstep programming by microprocessor software

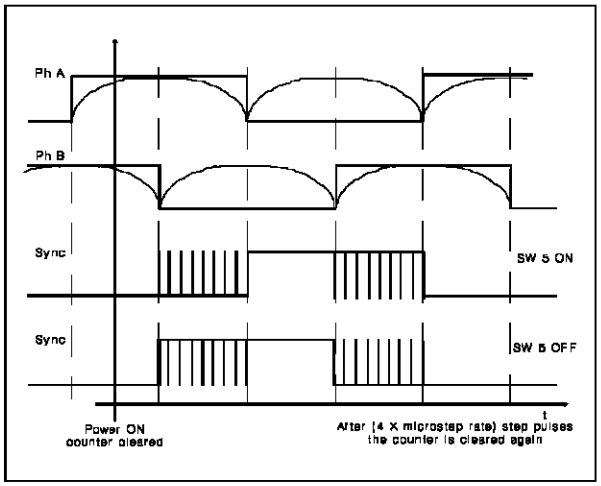
The microsteps/step rate can also be changed on-the-fly by using the three logic inputs available on the bus connector (pin 8a, 8c, 12c).
These pins correspond, respectively, to SW1, SW2, SW3.
If the selection is performed remotely, the switches SW1, SW2, SW3 must be in the OFF position.

Fig. 3 clarifies the interaction between internal switches and external command signals.

Figure 3. Remote Microstepping Programming



The remote change from one rate to another cannot be implemented asynchronously by it must be forced only when the phase currents are respectively at 45 electrical degrees.
That corresponds to have the internal microstep counter to zero.
This counter is zeroed at power on and then cleared again at every (4 x microstep rate) step pulses.



To change the pulses ratio:

– The system controlling GS-D250M must take in count the pulses

– Every 4 x microstep rate pulses respect to the power on it can change the microstep rate

– The changing must take place more than 5 microseconds after the active edge of the clock pulse and before the next step pulse.

Setting of the Active Step Clock Transition

The step clock applied between pins 2a and 2c can be active i.e. advancing the motor by one step on the rising or falling edge of the clock pulse.
The user can select the proper transition condition by setting the SW4 switch according to the following table:

SW4	TRANSITION
ON	Low-to-high active step clock transition
OFF	High-to-low active step clock transition.

Setting of the Direction Polarity

The rotation direction signal must be applied between pin 4a and 4c. To add flexibility to the GS-D250M board the proper direction signal is combined with the position of an internal switch (SW5) according to the following table:

DIR SIGNAL	SW5	ROTATION
HIGH	ON	CCW
HIGH	OFF	CW
LOW	ON	CW
LOW	OFF	CCW

Phase Current Programming

The GS-D250M can be used to drive 4 wires motors or 8 wires motors. The phase peak current level can be programmed by a resistor according to the following formula:

$$Rx = \frac{3.2}{I_{pk}} - 1 \quad (k\Omega)$$

where I_{pk} is expressed in Amperes.
The factory setting is for a peak current of 1.6A.
The user can replace R_X (located close to the front edge of the board) by a new resistor according to the desired current level. The minimum value of R_X is 270Ω that corresponds to I_{pk} = 2.5A.

Phase Current Ripple Programming

The phase current control is performed by a chopping method with fixed off-time (about 32µs).
Therefore the chopping uses Frequency Modulation to keep the phase current at a desired level.
Being the off-time fixed, the amount of current decay i.e. of current ripple depends on the supply voltage, the back EMF, the L/R constant of the motor and on the method used for current recirculation (fast or slow, see the GS-D200M data sheet).

The GS-D250M board uses a mixed recirculation method:
fast recirculation for a time t_f, slow recirculation for the remaining period ($t_{off} – t_f$) of the off-time.
The time t_f and, therefore, the amount of phase

current ripple can be adjusted by the proper setting of the potentiometer P1 provided on the front edge of the board.

Current ripple programming allows the optimization of the electromechanical characteristics of the system and the reduction of power dissipation inside the motor.

To further improve the performance of the GS-D250M board, the current ripple can be automatically reduced at rest.
The user can select this option by setting the switch SW6 in the ON position. When SW6 is OFF this feature is eliminated and normal operation restored.

Input Commands

In the most straightforward application the GS-D250M board needs just three commands: step clock, direction, disable.
The module is disable when pin 6a is at high level.
To reduce the noise sensitivity, the three signals are applied to the board through internal optocouplers.
The pins 8a, 8c, 12c (optional commands for remote microsteps/step programming) are not galvanically isolated.
The signal level can have TTL compatibility (factory setted) or voltage levels of 12V or 24V, by changing the resistor array RR as shown in fig. 4.

Environmental Data

The GS-D250M board uses powerfet transistors in the two H-bridges that drive the motor windings.
This allows reduced conduction and switching power dissipation inside the GS-D200M.
Nevertheless, according to the application and to the ambient temperature, the GS-D200M case temperature can eventually increase to above 85°C. In such a case, cooling by forced ventilation is needed.

Figure 4. Input Signal Level Programming