7,5A 85Vdc Serially Controllable Microstepping Driver

- Complete remote control through two simple wire lines
- Resolution selection from full up to 1/128 step mode
- Automatic change resolution “on the fly”
- Possibility of controlling up to 32 drivers through one only serial line
- Possibility of mixed connections to drivers belonging to the same family or to the USD60xxx one
- Ramp sloping setting updating before each movement
- Maximum and minimum speed setting updating before each movement
- Commands for ended and endless movements
- Commands for absolute or relative movements compared with the start position
- Broadcast command for concurrency action
- Movement triggered from the I/O lines
- Driver status reading also while in movement
- Position on 32 bit of resolution
- General purpose I/O available
- Chopper frequency over 20KHz
- Full short circuit protection
- Automatic current reduction
- Open collector FAULT output
- Internal pull-up on all inputs
- Current up to 7.5A per phase
- Wide power supply range (24-85V)
- Compact size
- Easy to use
- Cost effective

High performance and cost effective USD50606 drive module has been designed to drive permanent bipolar stepping motors with phase current between 1A and 7.5A.
Each driver’s function can be controlled through a Rx/Tx serial line.

The transmission protocol allows to manage 32 drivers through one only serial line. Furthermore, it is possible to connect to the same serial line drivers of different sizes provided they belong to the same family or to the USD60xxx series.
This drive module allows the control of the microstepping motor rotation so to exploit the possibility given by stepping motors of carrying out open loop repetitive positioning and solving those resonances and resolution problems which up to now have made impossible to use stepping motors for certain applications. Step resolution can be changed “on the fly”, i.e. during motor rotation, without causing any irregularity to its operation. The speed range is consequently wider (from 0 to 3000rpm with 200 steps for revolution motor).
A bipolar MOSFET chopper current control guarantees high efficiency and low losses. Automatic current reduction minimizes heat losses when the motor is at rest.
Full short circuit protection (phase to phase, phase to ground and phase to supply) makes USD50606 very rugged.
Internal pull-up resistors on each input of USD50606 drive module allow easy connectivity.

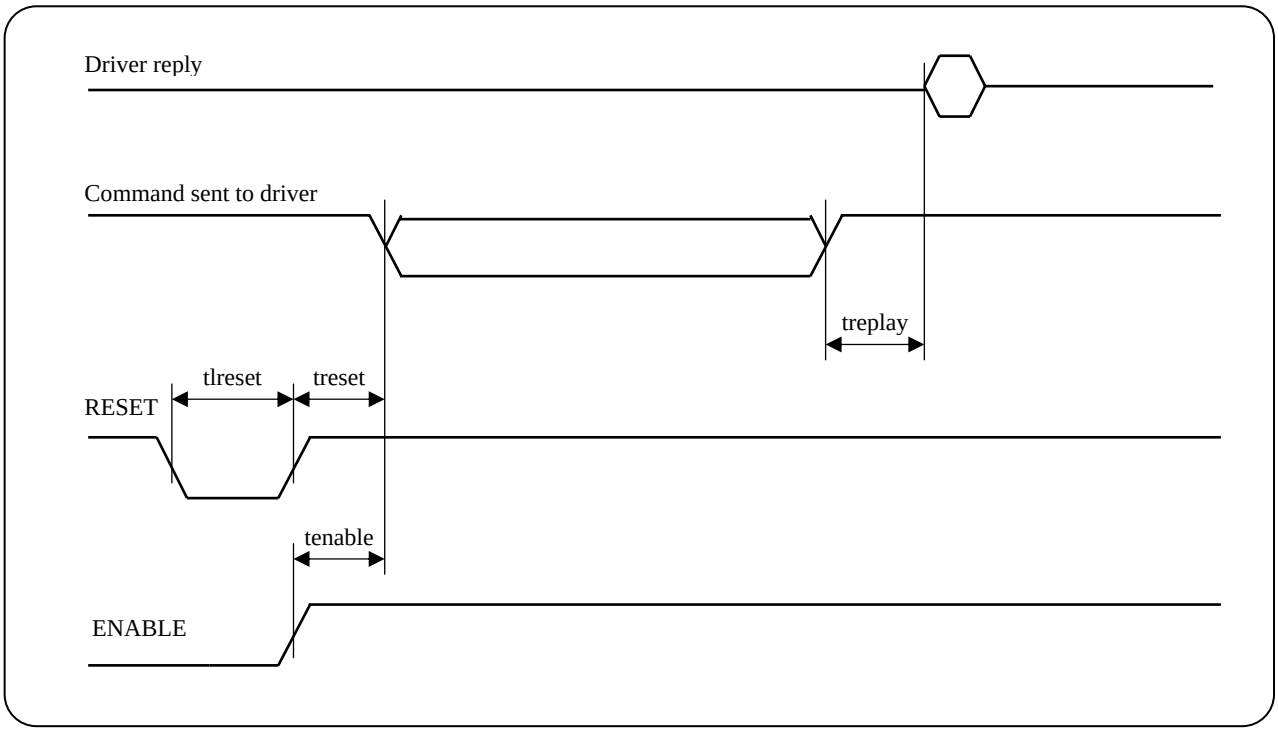
Operating parameters (@ Ta = 25^{o}C)

Symbol	***Parameter***	***Test***	***Value***			***Unit***
			Min	***Typ***	***Max***	
Vp	Power supply		22	60	85	V
Vcc	Logic power supply		4.75	5	5.25	V
In	Rated current		1		7.5	A
Istandby	Current reduction		0 - 25 – 50			% out of In
Res	Resolution selection		from full step to 1/128			Step fract.
Is	Quiescent current	ENABLE = low			100	mA
Icc	Logic current	All inputs low			150	mA
Iil	Low input current	Vi = low			500	uA
Iih	High input current	Vi = high			10	uA
Vil	Max low level for input				0.8	V
Vih	Min high level for input		2			V
fc	Chopper frequency	Vcc = 5V	19	20	21	KHz
Imax	Current protection trigger	Vp = 60V			10	A
Ifault	FAULT output current				200	mA
Vfon	Output voltage with FAULT on	Ifault = 100mA			0.4	V
Vfoff	Maximum voltage applicable to FAULT output				38	V
brate	Baud rate		9600, N, 8, 1 19200, N, 8, 1			baud
treset	Delay after RESET	Vcc = 5V	500			usec
tlreset	Min RESET pulse	Vcc = 5V	1			usec
treplay	Driver reply time		10	800	8000	usec
Tenable	Delay after ENABLE		0			usec
Tstandby	Current reduction operating time			80		msec
tfault	FAULT signal duration	Vcc = 5V Vp = 36V		200		msec
tvpon	Activation time after Vp > 24V	Vcc = 5V Vp = 36V		200		msec

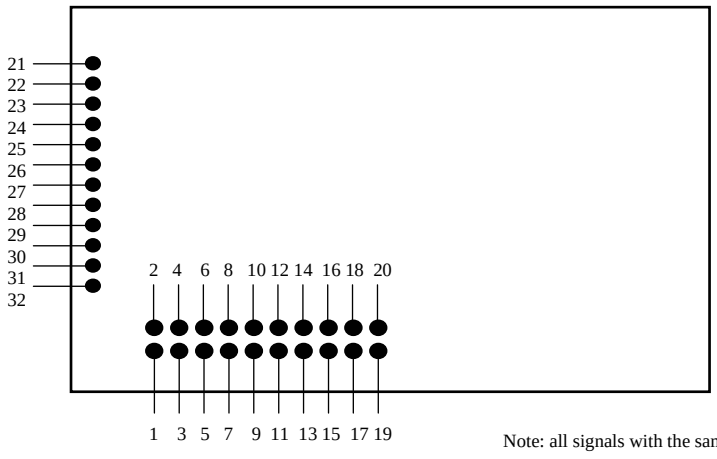
Absolute maxim range

Symbol	*Parameter*	*Value*	*Unit*
Vp	Power supply voltage	-0.5 / 110	V
Vcc	Logic supply voltage	-0.5 / 6	V
Vin	Input voltage (for all inputs)	-0.5 / 6	V
Vfault	Voltage applied to FAULT output	-0.5 / 48	V
Ifault	Current delivered by FAULT output	300	mA
Tcop	Case operating temperature	0 - 70	^{o}C

Signal timing



Pit out connections



Pin 1 - IO0
Pin 2 - reserved
Pin 3 - IO1
Pin 4 - RX
Pin 5 - IO2
Pin 6 - TX
Pin 7 - reserved
Pin 8 - ADD0
Pin 9 - TXON
Pin 10 - ADD1
Pin 11 - FAULT
Pin 12 - ADD2
Pin 13 - ENABLE
Pin 14 - ADD3
Pin 15 - reserved
Pin 16 - Isetb
Pin 17 - RESET
Pin 18 - ADD4
Pin 19 - VCC
Pin 20 - Iseta

Pin 21 - Vp
Pin 25 - FA
Pin 29 - FB
Pin 22 - Vp
Pin 26 - FA
Pin 30 - FB
Pin 23 - GND
Pin 27 - FAN
Pin 31 - FBN
Pin 24 - GND
Pin 28 - FAN
Pin 32 - FBN

Note: all signals with the same name must be connected together on the circuit board

Signals description

Pin	*Name*	*Description*
1	IO0	Input/output lines can be set by software. These general purposes lines allow to read the status of external switches or to command ON/OFF type actuators.
3	IO1	
5	IO2	
4	RX	Serial data input to the driver
6	TX	Serial data output from the driver.
9	TXON	Output normally at 0 logic level which it is brought to high logic level whenever the driver transmits data through the TX output.
8	ADD0	Inputs for driver's address selection.
10	ADD1	
12	ADD2	
14	ADD3	
18	ADD4	
11	FAULT	Open collector output. It is brought to low logic level when one of the short circuit protections is triggered or Vp voltage is beyond the minimum and maximum level allowed.
13	ENABLE	Enable input. When kept low, power stage is disabled.
16	IsetB	Inputs for phase current setting. The current delivered by drive module can be modified by connecting a resistor between these pins and GND.
20	IsetA	
17	RESET	Reset input.
19	Vcc	Logic supply input
21, 22	Vp	Power supply input
23, 24	GND	Ground for logic and power signals
25, 26	FA	Power stage output to be connected to stepping motor phase A (+)
27, 28	FAN	Power stage output to be connected to stepping motor reversed phase A (-)
29, 30	FB	Power stage output to be connected to stepping motor phase B (+)
31, 32	FBN	Power stage output to be connected to stepping motor reversed phase B (-)
2, 7, 15	Reserved	Reserved pins. They must not be connected.

Voltage supply

Only two supply voltages are necessary to operate USD50606 drive module. One supplies the logic section, while the other delivers energy to the power stage. Even though it is possible for the voltage supplies to reach or to leave the drive module in any sequence, it is better the Vcc supply reaches the drive module before Vp supply when turning the drive on and leaves the drive after Vp when turning it off.
If Vcc voltage rise time is higher than 200msec an external circuit is necessary to generate a reset pulse after Vcc has gone beyond min. level recommended.
A capacitive filter is placed inside the USD50606 drive between Vp and GND. Anyway when developing the printed circuit board it is necessary to provide for an external capacitor of at least 1000uF and of adequate voltage to be placed very near to 21/22 and 23/24 pins.
In case more drive modules are placed on the same printed circuit board, each drive must have its own capacitor at its side.

Phase current setting

The rated current for each phase can be set through two 1/4W resistors placed between pins 16/20 and GND. The value of the two resistors must be identical to avoid any unbalanced rotation in the stepping motor. The relationship between the value of each resistor and the output rated current is as follows:

$$In = \frac{4\left(\frac{Rx}{10000 + Rx}\right)}{0.5}$$

Where RX is the value to be used for both resistors.
The following table will provide you with the right resistor for the motor connected to the drive module:

Rx	***In***
1K5	1A
3K3	1.9A
4K7	2.5A
8K2	3.5A
10K	4A
22K	5.2A
47K	6A
100K	6.5A
>1M	7.5A

The layout of the printed circuit boards has to be designed so that the connection between the resistors' terminal and the pins of the drive module is as short as possible. We also strongly recommend to connect resistors to GND directly on 23/24 pins.
Phase rated current setting can be changed even during motor rotation. For instance the motor can be boosted during acceleration and deceleration, i.e. when rotor and load inertia are added to frictions so that the max. value of the resisting torque is reached. Then, during constant rotation speed the current can be brought back to rated value.
Two analogue switches (for example 1/2 CD4066) are the only components necessary to carry out the above described current change. They make resistor Rx (corresponding to the motor boost current) be in parallel with a second one, so that the two parallel resistors correspond to the rated current value.

Address setting

By the ADD0, ADD1, ADD2, ADD3 and ADD4 inputs it is possible to set the address of the drive, address used by the controller whenever this decides to communicate with the driver itself.
With 5 lines available it is possible to code up to 32 different addresses and to therefore control 32 different drivers through one only serial line. The address value is binary composed leaving disconnected the pins to be sent to 1 and connecting to ground the pins to be set to 0. The most significant bit (MSB) corresponds to ADD4 input while 1sb bit leads to the ADD0 input.

RX Signal

It is the input dedicated to receive the serial data.

TX Signal

This output is on during driver's data transmission. The line is normally at high logic level and only during transmission it changes to code the various bits. This particular operative form allows to link more drivers to the same serial line simply connecting together the RX signals and, through an electronic switch enabled by the TXON signal, all the TX signals of the various drivers. In this way in fact, all the drivers will receive the same commands but only the one which recognizes its own address will activate its on switch and transmit its reply to the received command. All the others will ignore the command maintaining the TXON low.
Another possibility is to use one only wire both for the transmission and receipt of data. By linking together the RX and TX signals (always through a switch) it is possible to drive the line while transmitting commands to the driver and then to leave it again and wait for the driver to get control of the line to send the reply message. A switch right for this purpose is the 4016 integrated circuit produced by a lot of I.C.'s manufacturers. Inside it there are 4 unconnected switches which allow, using only one I.C., to link together up to 4 drivers.

TXON Signal

This signal indicates if the driver is on transmission or in reception. When the logic level is low the driver is waiting for commands, i.e. it is on reception; on the contrary, when the line is at a high logic level it means that the driver is on transmission. As soon as the transmission is over the TXON line returns to the low logic level. This signal extremely simplifies the realization of a RS485 line. Using for example the driver for RS485 like SN75176B it is sufficient to connect together the driver's /RE and DE signals and then to link them to the driver's TXON line to automatically manage the exchange between transmission and reception.

I/O Lines

The three I/O lines, IO0, IO1 and IO2 can be set as input or output independently one from the other. The lines set as output have 5mA capacity and can drive directly, through an appropriate current limit resistor, optocouplers or transistors. Configured as input the lines can be used for example to read the status of proximity, micro switches, etc.

RESET Signal

This signal resets the internal logic circuit and restore the default parameters.
This signal is usually not used and the corresponding pin can be left disconnected. Only when the Vcc supply voltage rise time is more than 200msec, a RESET pulse must be externally generated, after Vcc voltage has reached min. value recommended. The reset signal must be released at least 1msec before the driver is enabled.

ENABLE Signal

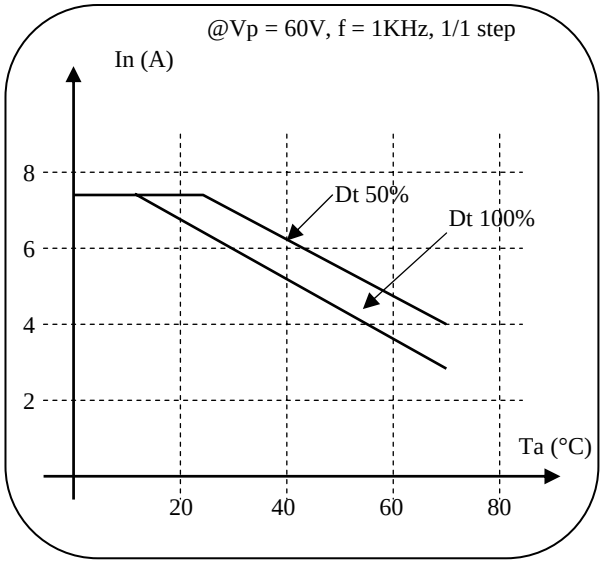
The output stage is disabled when bringing this input to low logic level. The stepping motor torque and the current are consequently turned off. When the application does not require motor torque while at rest, this input can be used to reduce to minimum the heat losses on the motor and in the drive module.

FAULT output

FAULT output starts up whenever a short circuit occurs between output phases (direct or crossed), or a phase is connected with GND or Vp, or Vp voltage is under 22V or over 85V. Even a temperature's rising of the case over 70°C can bring the protection to intervene. In this case the driver will restore to normal operation when the case temperature falls below 45°C.
This signal remains active as long as the fault occurs, plus about 200msec after the normal operating conditions have been restored. The special open collector configuration allows mutual connections between FAULT outputs of different drive modules, to then connect through an unique signal to the control logic.
The current capacity of this output allows the driving of small relays. While connecting a relay it is necessary to parallel with the coil a diode, protecting the FAULT output from extra voltages caused by inductive loads.

Current reduction at Ta>25 °C

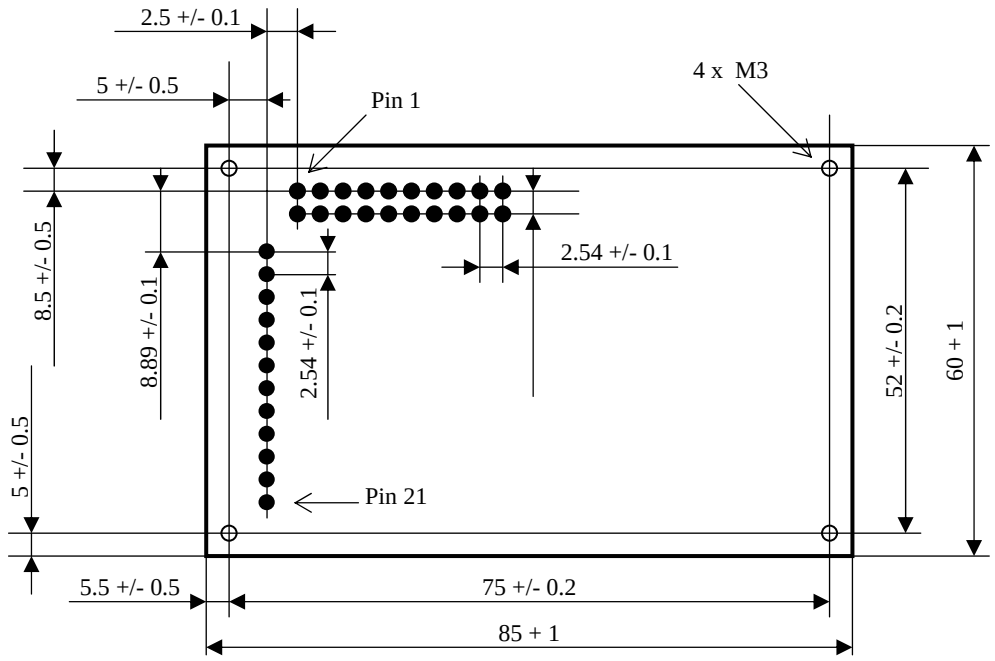
When the external temperature is over 25°C, you must consider the following waveforms to determine the max. deliverable current by the driver, in absence of a fan cooler.



It is important to take note that if the working cycle is at 50%, the reachable current limit is much higher compared to a motor driver continuously working.
The case's temperature can be effectively reduced through an external fan cooler. In this case it is possible to take the max. current continuously according to the efficacy of the cooling system**.**

For commands implemented on the driver see "The USD50xxx – USD60xxx Software Reference".

Mechanical dimensions



All pins have diameter 0.9 +/-0.1 Pin height 4 +/-2. Module height 40 +/-1.
Not-scale drawing. All dimensions are in mm.