IS23x-DS

Version 1.1

Intelligent Stepper Motor

TECHNOSOFT

Intelligent Motor

User Manual
Preliminary

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IS23x-DS
v1.1
User Manual

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Read This First

About This Manual

This book is the user manual for the **IS23x-DS** family of motors with integrated electronic. These motors incorporate, in a single case, both the motor and a high performance digital drive. The manual describes the **IS23x-DS** operation and explains how to set up IS23x-DS motors using the **EasySetUp** commissioning software. The IS23x-DS family includes the following motors:

- IS231-DS
- IS232-DS
- IS233-DS

Information about Cautions

This book may contain caution statements.

CAUTION !	**This is an example of a caution statement.** **A caution statement describes a situation that could potentially** **cause harm to you, or to the IS23x-DS intelligent servo drive unit**

If you Need Assistance …

If you want to …	Contact Technosoft at …
Visit Technosoft online	World Wide Web: http://www.technosoftmotion.com/
Receive general information or assistance (see Note)	World Wide Web: http://www.technosoftmotion.com/ Email: contact@technosoftmotion.com
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Make suggestions about or report errors in documentation (see Note)	Mail: Technosoft SA
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Note: You need to register your **IS23x** system in order to get assistance and support. Use the *License Number* of the **EasySetUp** software.

Contents

1. Key Features

- Fully digital servo drives and stepper motors embedded in the same case
- Cost efficient solution due to compactness and reduced wiring
- Ideal replacement / substitution of brushless axes, without hardware or software changes of the indexing system
- Available in 3 motor lengths, offering from 55 to 189 Ncm of boosted holding torque[**] (models IS231, IS232, IS233)
- Modes of operation:
  - Position control with 5…24 V pulse & direction commands
  - Speed control with ±10 V analogue input command
- Integrated Protections: short-circuit, over current, over temperature, over voltage and under voltage
- Dedicated inputs/outputs:
  - PULSE input (5…24 V)
  - DIRECTION input (5…24 V)
  - ENABLE input (5…24 V)
  - READY output (5…24 V)
- Logic and Motor power supply: 12-48 V_{DC};
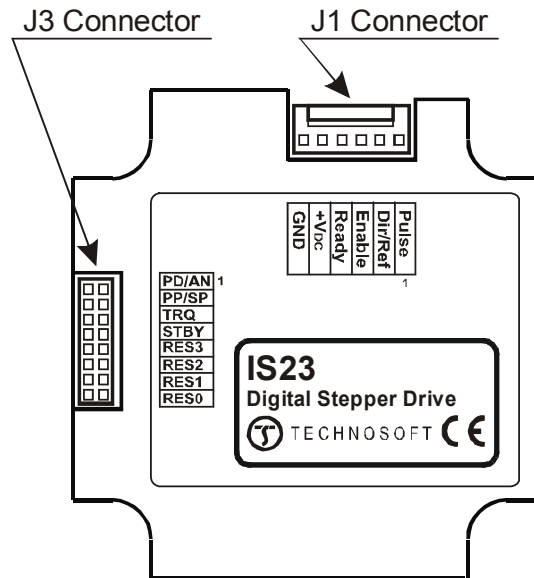- Operating ambient temperature: 0-40°C

[**] For operation up to 25°C ambient temperature

2. IS23x-DS Connection Diagrams

2.1. Connectors and label

Figure 2.1. *IS23x – DS v1.1 drawing – backward view*

2.2. Connector pins description

CAUTION !	BEFORE THE CONNECTING / DISCONNECTING ANY OF THE SIGNALS PLEASE TURN OFF ALL POWER SUPPLIES. ELSE SEVER DAMAGE MAY OCCUR.

2.2.1. J1 connector

Table 2.1 J1 Connector pins description

Pin	Pin name	Type	Function / Alternate function / Comments
1	**Pulse**	I	It is used as **PULSE** digital input in Pulse & Direction motion mode digital input; 5…24 V
2	**Dir/Ref**	I	• **Direction** digital input, 5…24 V, in *Pulse & Direction* motion mode • **Reference** analogue input, –10…+10V, in **Analog Reference** motion mode
3	**Enable**	I	It is used as **Enable** digital input. Connected to 5…24 V enable the PWM outputs.
4	**Ready**	O	Ready digital output.
5	**+V$_{DC}$**	I	Power supply
6	**GND**	-	Ground

The **Dir** line can be used as **DIRECTION** digital input in *Pulse & Direction* motion mode if pins 1-2 of the J3 connector are left open and as **Reference** analogue input if pins 1-2 of the same connector are shorted.

2.2.2. J3 connector

Table 2.2 *J3 Jumpers description*

Pins	Pin name	State	Description
1 - 2	**PD / AN**	**OPEN** (default)	**Pulse & Direction** motion mode
		SHORT	**Analog Reference** motion mode
3 - 4	**PP / SP**	**OPEN** (default)	**Position Control** – the motor is controlled in position
		SHORT	**Speed Control** – the motor is controlled in speed
5 - 6	**TRQ**	**OPEN** (default)	**Nominal Torque 2.5A**
		SHORT	**Boosted Torque 2.8A** The motor can be used at maximum ambient temperature of 25 °C.
7 - 8	**STBY**	**OPEN** (default)	**Stand-by current** is set to **100% I$_N$**
		SHORT	**Stand-by current** is set to **25% I$_N$**
9 - 10	**RES3**	See *Table 2.3.*	**Microstep Resolution**. See *Table 2.3.*
11 - 12	**RES2**		
13 - 14	**RES1**		
15 - 16	**RES0**		

The following table explains how to set the resolution (number of microsteps / step) using the **RES0**, **RES1, RES2** and **RES3** jumpers.

Table 2.3 *Jumpers combination for Resolution of microstep mode*

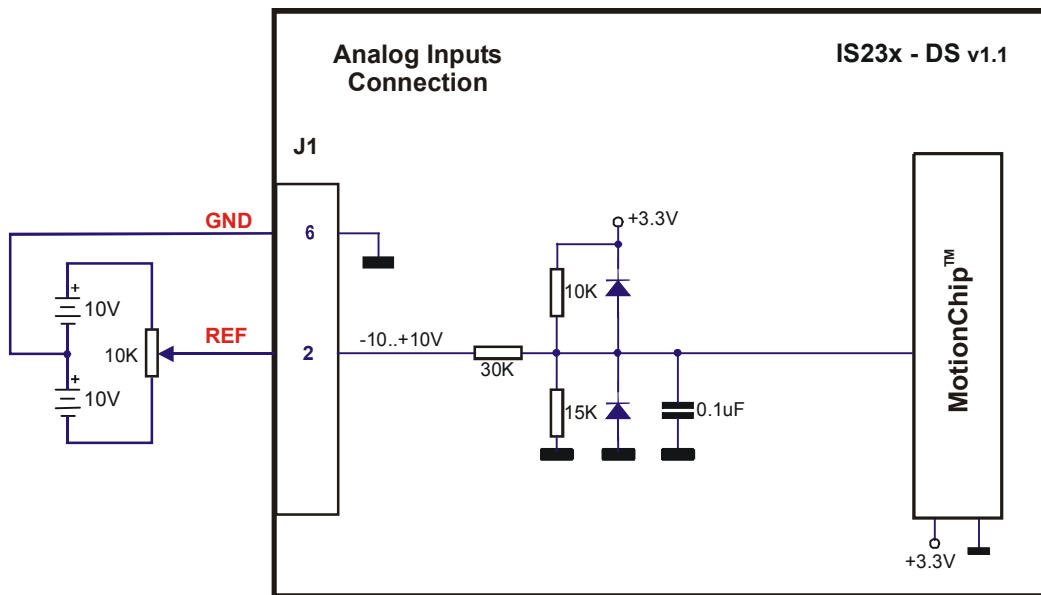| Res [µsteps/step]	RES3	RES2	RES1	RES0
256	OPEN	OPEN	OPEN	OPEN
128	OPEN	OPEN	OPEN	SHORT
64	OPEN	OPEN	SHORT	OPEN
32	OPEN	OPEN	SHORT	SHORT
16	OPEN	SHORT	OPEN	OPEN
8	OPEN	SHORT	OPEN	SHORT
4	OPEN	SHORT	SHORT	OPEN
2	OPEN	SHORT	SHORT	SHORT
1	SHORT	x	x	x

2.3. Analog inputs connection

Figure 2.2. *IS23x-DS v1.1 Analog inputs connection*
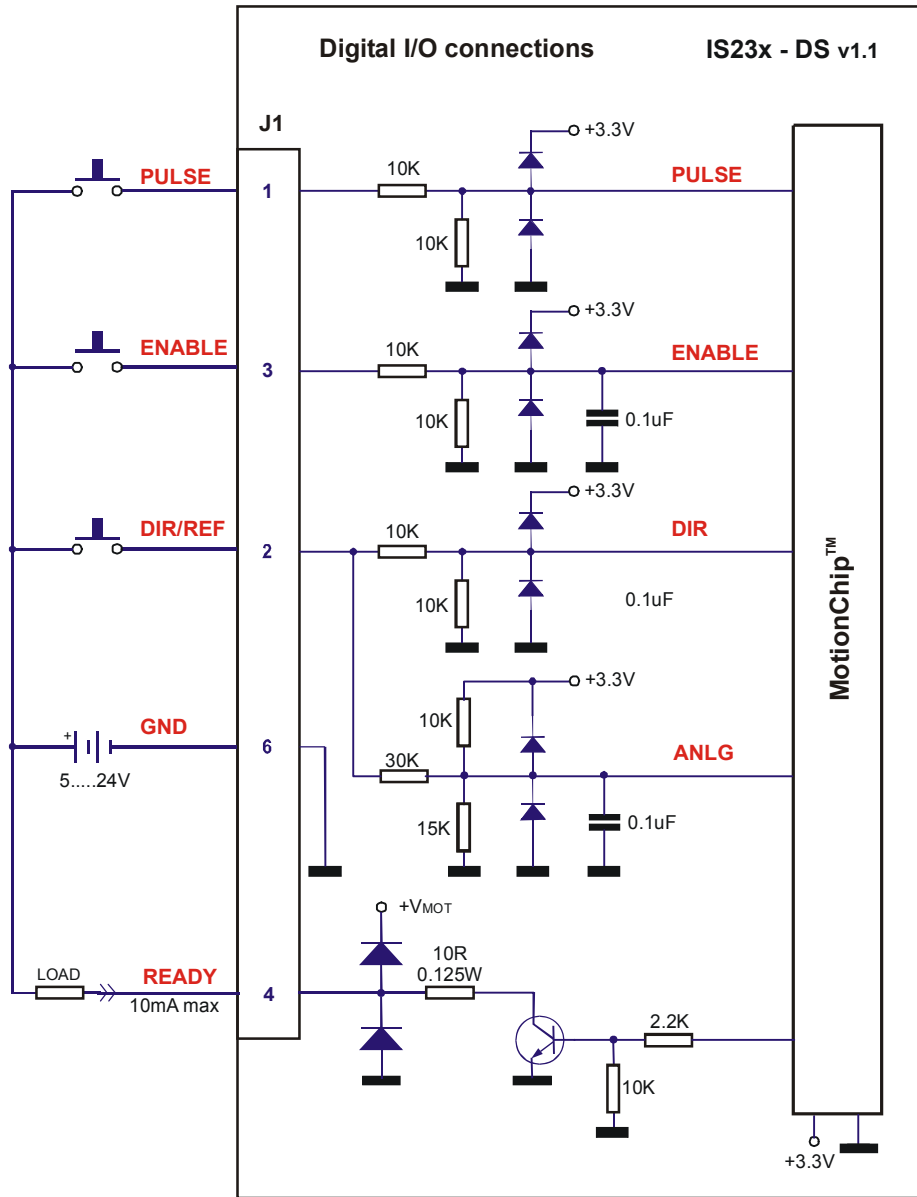
2.4. Digital I/O connection

Figure 2.3. *IS23x-DS v1.1 Digital input/output connection*
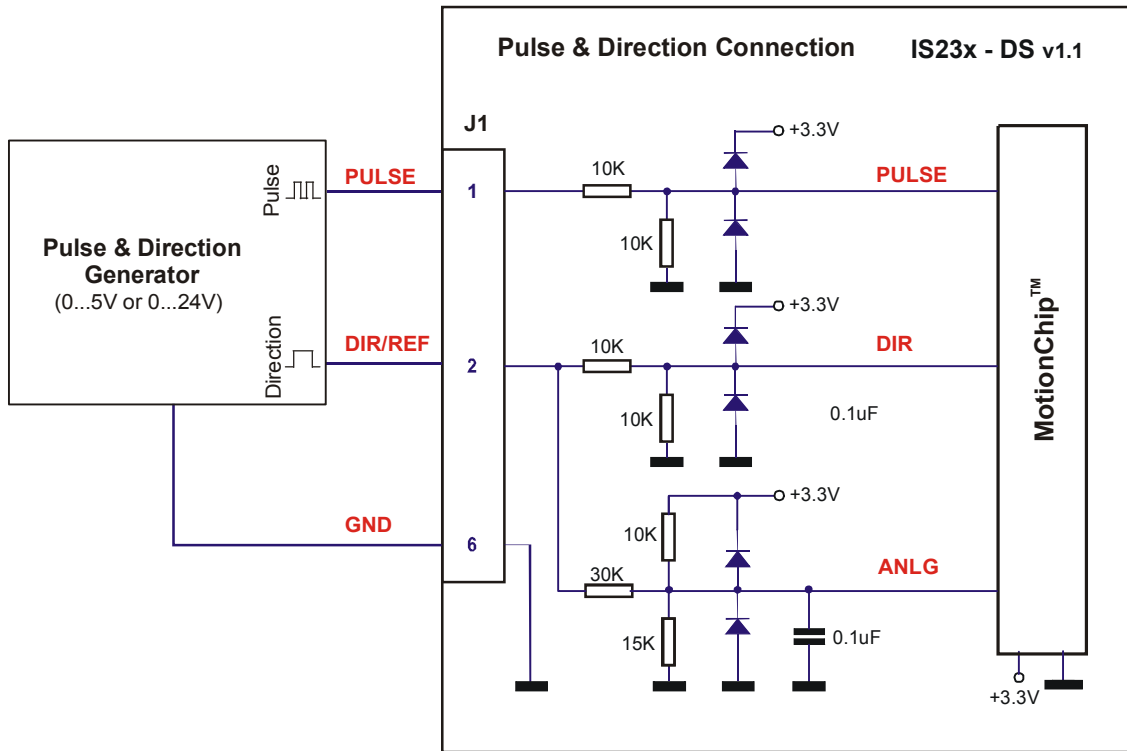
2.5. Pulse & Direction inputs connection

Figure 2.4. *IS23x-DS v1.1 Pulse & Direction inputs connection*
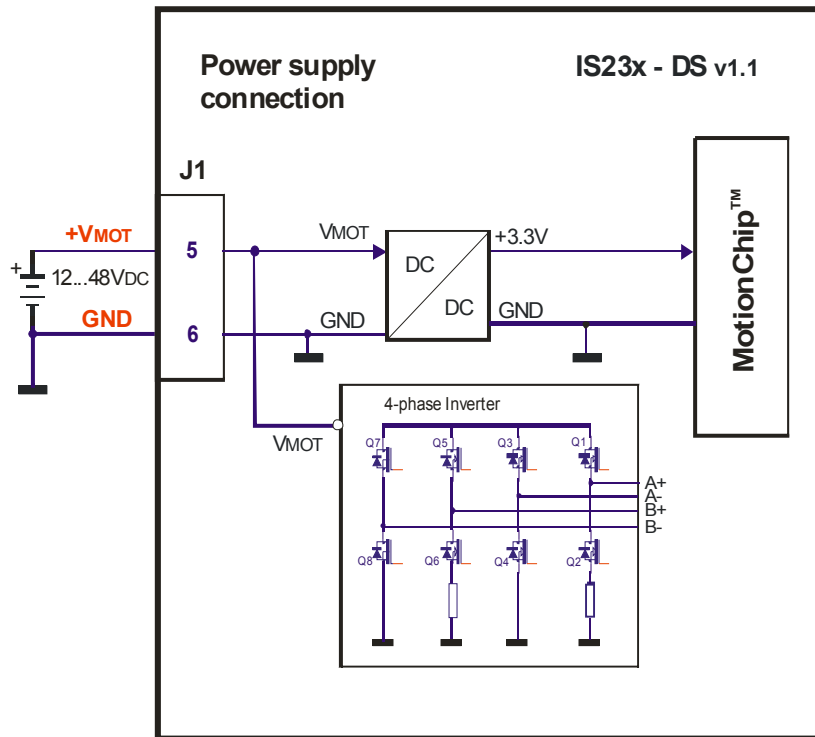
2.6. Supply connection

Figure 2.5. *IS23x-DS v1.1 Supply connection*

3. Electrical Specifications

Electrical characteristics:

All parameters measured under the following conditions (unless otherwise noted):
T_{amb} = 25°C, motor supply (V_{MOT}) = 24V_{DC} ;

Motor Supply Input

		Min.	Typ.	Max.	Units
Supply voltage	Nominal values	12		48	V_{DC}
	Absolute maximum values, continuous, including ripple	0		50	V_{DC}
	Absolute maximum values, surge (duration $\leq$ 10mS) †	-0.5		51	V
Supply current	Idle; V_{MOT} = 24V_{DC}		35	60	mA
	Operating	-6.5	±2.8	+6.5	A

Digital Inputs (Enable, Pulse, Dir/Ref)

		Min.	Typ.	Max.	Units
Input voltage	Logic "LOW"	- V_{MOT}	0	1.6	V
	Logic "HIGH"	4	5	V_{MOT}	
	Absolute maximum, surge (duration $\leq$ 1 S) †	-50		+55	
Input current	Logic "LOW"; Internal pull-down to GND	0	0	0	mA
	Logic "HIGH"; input voltage = 5V	-	0.1	0.2	
	Logic "HIGH"; input voltage = 24V	-	2	3	
Input frequency	Pulse, Dir	0		250	KHz
	Enable	0		0.25	
Pulse width	$0 \rightarrow 1 \rightarrow 0$ or $1 \rightarrow 0 \rightarrow 1$ Pulse, Dir	2			μs
	$0 \rightarrow 1 \rightarrow 0$ or $1 \rightarrow 0 \rightarrow 1$ Enable	2			ms
ESD Rating	Human body model (C=100pF, R=1.5KΩ	±1	±2		KV

Digital Output (Ready)

		Min.	Typ.	Max.	Units
Output voltage	Logic "LOW"; Output crt = 16mA		0.6	0.7	V
	Absolute maximum, continuous †	-0.5		V_{MOT} + 0.5V	
Output current	Logic HIGH leakage current (open collector); output voltage = 24 V			15µA	mA
	Logic "LOW"	16	50	100	
Clamp diodes current	Output voltage $\leq$ (-0.5V) or $\geq$ (V_{MOT}+0.5V); Absolute maximum, continuous †	-100		+100	
Output frequency	220 Ohm; External load to +5 V	0		500	KHz
Pulse width	220 Ohm; External load to +5 V	1			µs
ESD Rating	Human body model (C=100pF, R=1.5KΩ	±1	±2		KV

Analog Inputs (REF)

		Min.	Typ.	Max.	Units
Resolution			10		bits
Differential linearity	Guaranteed 10-bit no-missing-codes			0.09	% FS[1]
Offset error			± 1	± 3	% FS[1]
Gain error			± 2	± 6	% FS[1]
Bandwidth (-3dB)			250		Hz
Input voltage Operating range		-10		+10	V
Input voltage Absolute Maximum, continuous †	REF	-50		+50	V
Input impedance	REF		30		KΩ
External potentiometer	Recommended resistance	1	5	10	KΩ

Others

		Min.	Typ.	Max.	Units
Operating temperature		0		40	°C
Weight	IS231-DS		0.65		Kg
	IS232-DS		0.9		
	IS233-DS		1.3		
Storage temperature	Not powered	-40	85	°C	
Humidity	Non-condensing	0	90	% RH	

Motor parameters

		IS231-DS	IS232-DS	IS233-DS	Units
Step angle		1.8°	1.8°	1.8°	°
Step angle accuracy (full step, no load)		± 5%	± 5%	± 5%	%
Rated Voltage		2	2.3	3.2	V
Current / Phase		2.8	2.8	2.8	A
Resistance / Phase		0.7	0.83	1.13	Ω
Inductance / Phase		1.4	2.2	3.6	mH
Detent Torque		18	35	72	mNm
Holding Torque		0.45	0.85	1.60	Nm
Boosted Holding torque [**]		0.5	1.0	1.8	Nm
Rotor Inertia		120	276	480	g-cm²
Weight		0.45	0.65	1	Kg
Number of leads		4	4	4	n°.

[1] "FS" stands for "Full Scale"

[†] Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

[**] For operation up to 25°C ambient temperature
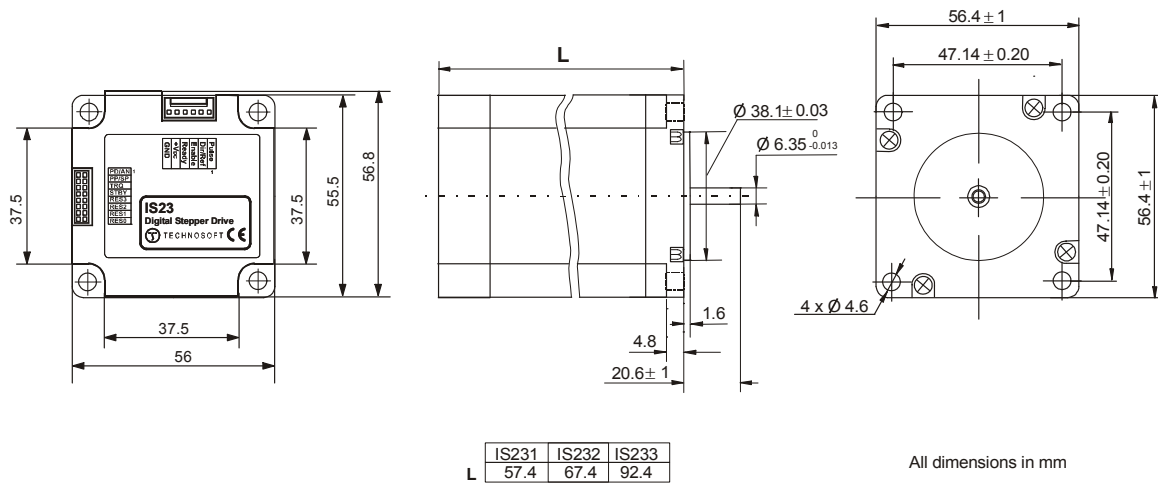
4. IS23x-DS Dimensions

	IS231	IS232	IS233
L	57.4	67.4	92.4

All dimensions in mm

Figure 3.1. IS23x-DS Dimensions

5. Mating Connectors

Connector	Manufacturer and part number	Details
J1	Molex 08-52-0123	Crimp-pins (6 pcs.)
	Molex 22-01-3067	Connector housing - 6 pins
J3	Fischer Elektronik CAB10	Jumpers 2 mm pitch

6. Motion modes and scaling factors

6.1.   Pulse & Direction motion mode

The **Pulse & Direction** mode allows you to set the drives working with an external **Pulse & Direction** command provided by another device. The **Pulse & Direction** command consists of 2 digital signals that must be connected to specially inputs of the drive:

- *Pulse* – a sequence of pulses. Each pulse represents a position unit. The sum of the pulses indicates the position displacement to be performed. The variation in number of pulses during one sampling period represents a speed reference.
- *Direction* - a digital signal which indicates the reference sign (motion direction)

Depending on the reference type, 2 pulse & direction modes are possible:

- Position pulse & direction - the motor is controlled in position.

- Speed pulse & direction - the motor is controlled in speed.

These modes are selected by PP / SP jumper.

The scaling factor for the motor position is:

$$\textbf{Motor position } [rot] = \frac{1}{N_S\ [st/rot] \times Res[\mu st/st]} \times No\_pls\ [pulses]$$

where N_S = 200 [steps/rot]   - number of steps
        Res = 1 … 256 [μst/st] - resolution, the number of microsteps / step; It depends by
                                    jumpers positions (RES0, RES1, RES2 and RES3).
        No_pls [pulses]   - the number of pulses applied to *Pulse* pin

The scaling factor for the motor speed is:

$$\textbf{Motor speed } [rot/s] = \frac{1}{N_S\ [st/rot] \times Res[\mu st/st]} \times No\_pls\_sec\ [pulses/s]$$

where N_S = 200 [steps/rot]   - number of steps
        Res = 1 … 256 [μst/st] - resolution, the number of microsteps / step; It depends by
                                    jumpers positions (RES0, RES1, RES2 and RES3).
        No_pls_sec [pulses/s]   - the number of pulses per second applied to *Pulse* pin

6.2. Analog Reference motion mode

In **Analog Reference** mode, an external device provides the target reference as an analog voltage connected to the *Dir/Ref* input;

The scaling factor for the motor speed is:

$$\textbf{Motor speed} \ [rot/s] = \frac{K_{SPD} \ [\mu st / s / V]}{N_S \ [st / rot] \times Res[\mu st / st]} \times REF \ [V]$$

where K_{SPD} = 32324.3 [µst / s / V]   - speed scale factor
  N_S = 200 [steps/rot]   - number of steps
  Res = 1 … 256 [µst/st]   - resolution, the number of microsteps / step; It depends
            by jumpers positions (RES0, RES1, RES2 and RES3).
  REF[V]   - external reference voltage applied to *Dir/Ref* pin

The scaling factor for the motor position is:

$$\textbf{Motor position} \ [rot] = \frac{K_{POS} \ [\mu st / s / V]}{N_S \ [st / rot] \times Res[\mu st / st]} \times REF \ [V]$$

where K_{POS} = 1656.57 [µst / V]   - position scale factor
  N_S = 200 [steps/rot]   - number of steps
  Res = 1 … 256 [µst/st]   - resolution, the number of microsteps / step;
            It depends by jumpers positions (RES0, RES1, RES2
            and RES3).
  REF[V]   - external reference voltage applied to *Dir/Ref* pin

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