

MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

SIEMENS

6SN1118-1NJ01-0AA2

RESOLVER POSITIONING CONTROL MODULE

Used with the applicable SIMODRIVE 611 universal HRS2 configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: SIMODRIVE 611 Configuration Manual, 10/2014: HRS2 control interfaces

Theoretic resolutions in SIMODRIVE modules

- Encoder sin/cos 1 Vpp
 - "High Performance" and SIMODRIVE 611 universal control units can be parameterized for encoders up to 65,535 incr./rev. The increment value is increased by the factor 2048 using pulse multiplication in the evaluation of the modules.
Encoders with 2048 incr./rev. are used in preference. The resolution is then approx. 4.2 million incr./rev. An increment then represents on a 10 mm spindle $(10 \text{ mm}/(2048 \cdot 2048) = 2.4 \text{ nm})$.
 - This means the "High Standard" control unit with a pulse multiplication of 128 with the standard encoder would then be resolved theoretically up to $(10 \text{ mm}/2048/128) = 38 \text{ nm}$ with the 10 mm spindle.
 - For direct measuring systems (internal pulse multiplication also 2048), an encoder pulse number up to 32 bits can be set.
 - Linear scales can be parameterized with grid divisions from 0 to 8,388,607 nm. Linear encoders with 20 μm grid division are used primarily; the resolution is then $(20 \mu\text{m}/2048) = 10 \text{ nm}$.
 - The encoder limit frequency f_G , with sin/cos 1 Vpp encoders, for "High Performance" and SIMODRIVE 611 universal control units can be as high as 350 kHz, with secondary conditions up to 420 kHz, and max. 200 kHz for "High Standard" control units.
 - With the encoder 2048 incr./rev., with $350 \text{ kHz} \cdot (60\text{s}/2048)$ up to 10,250 RPM can be processed.
 - The "High Standard" control unit with the standard encoder permits max. $200 \text{ kHz} \cdot (60\text{s}/2048)$ up to 5,860 RPM.
 - Linear encoders (20 μm grid) permit speeds with $350 \text{ kHz} \cdot (20 \mu\text{m} \cdot 60\text{s})$ up to 420 m/min.
- Resolver
 - The SIMODRIVE 611 universal control unit in the variant with resolver (1 – 6 pole pairs) permits resolutions with 12– or 14–bit and encoder limit frequencies up to 432 Hz or 108 Hz.
HRS2: 957 Hz or 479 Hz
 - For a resolver with 1 pole pair, 12– or 14–bit achieves the resolution 4,096/rev. or 16,384/rev. namely 4,096 incr./rev. or 16,384 incr./rev.
 - The position resolution with 10 mm spindle pitch corresponds theoretically to 2.5 μm or 0.6 μm . The values are correspondingly more favorable for resolvers with a higher number of poles, e.g. for six pole pairs.
 - Maximum speeds
HRS: can be achieved with 12 bits and for pole pair 1 to $432 \cdot 60 = 26,000 \text{ RPM}$ and with 14 bits up to approx. 6,500 RPM.
HRS2: can be achieved with 12 bits and for pole pair 1 to $957 \cdot 60 = 57,420 \text{ RPM}$ and with 14 bits up to approx. 28,740 RPM.
 Resolvers with a larger number of poles, e.g. six pole pairs, permit only correspondingly lower speeds.

Note

Because encoder systems (as result of excitation frequency, excitation amplitudes, windings, non-symmetry of the poles) can exhibit relatively high tolerances in the evaluation for analog/digital conversion, the actually achievable values are significantly lower in practice.

- Encoder with TTL signal

For the speed control of induction motors with SIMODRIVE 611 universal HRS control units, sin/cos 1 Vpp variant, TTL encoders can be connected and evaluated.

The limit frequency f_G can be as high as 420 kHz.

The SIMODRIVE 611 universal E HRS control unit allows only one TTL signal to be passed to a higher level controller using the PROFIBUS DP.

Note

The actually achievable system quality with regard to speed or positioning accuracy depends primarily on the quality of the used encoders and other influencing factors, such as:

- the mechanical system (rigidity, backlash, mass (GD^2)), and also
- the control–engineering configuration of motors, power, controller (interpolation and control cycles, control parameters, etc.)

In practice, the previously mentioned effects mean the quality that can be achieved in a real system is significantly lower than the theoretically achievable quality.

- Settings

All drive-related settings of the control board can be made as follows:

- Using the SimoCom U parameterizing and startup tool on an external PG/PC
- Using the display and operator control unit on the front panel
- Using PROFIBUS DP (parameter area, PKW area)

- Software and data

The firmware and the user data are saved on a memory module which can be replaced.

The software designation on the memory module refers to the system software including the initial program loader.

- Terminals and operator control elements

- 2 analog inputs, 2 analog outputs per drive
- 4 digital inputs, 4 digital outputs per drive
- 2 measuring sockets
- POWER-ON RESET pushbutton with LED
- Display and operator unit



Warning

When handling the operating unit or an interface for an external PG/PC (X471, X423 on the Profibus option) protective measures must be taken against electrostatic discharge:

- Working with a grounded ESD wristband or
 - Wearing ESD shoes in connection with ESD flooring.
-

- Safe start inhibit

The start inhibit is addressed via terminal 663 and is signaled back using a relay with positively-driven signaling contacts (AS1/AS2). Using the start inhibit, the energy feed from the drive to the motor is interrupted.

When the "safe start inhibit" function is correctly used, the signaling contacts AS1/AS2 must be included in the line contactor circuit or the EMERGENCY OFF circuit.

Caution

When using the "safe start inhibit" function, it must be ensured that the velocity goes to zero.

The "SIMODRIVE 611 universal HRS / HRS2" control board supports the "Safe standstill" function.

Detailed information about the "safe standstill" function is provided in Chapter 8.5.

4.3 "SIMODRIVE 611 universal HRS" and "HRS2" (from SW version 14.2) control board

- Serial interface (RS232/RS485)
- Option modules
 - Optional TERMINAL module,
8 digital inputs and 8 digital outputs for drive A
 - Optional PROFIBUS–DP module
- Expanded functions as of SW 5.1

The following expanded functionality is provided with a new control board for sin/cos 1Vpp encoders:

 - Higher internal resolution, interpolation factor 2048 (previously 128)
 - Pulse multiplication is possible (doubling) at the angular incremental encoder interface for absolute encoders
 - Pulse multiplication (doubling) and division (1:2, 1:4, 1:8) are possible at the angular incremental encoder interface, also for incremental encoders

4.3 "SIMODRIVE 611 universal HRS" and "HRS2" (from SW version 14.2) control board

**Control board for
1 axis**

The following 1-axis control boards are available:

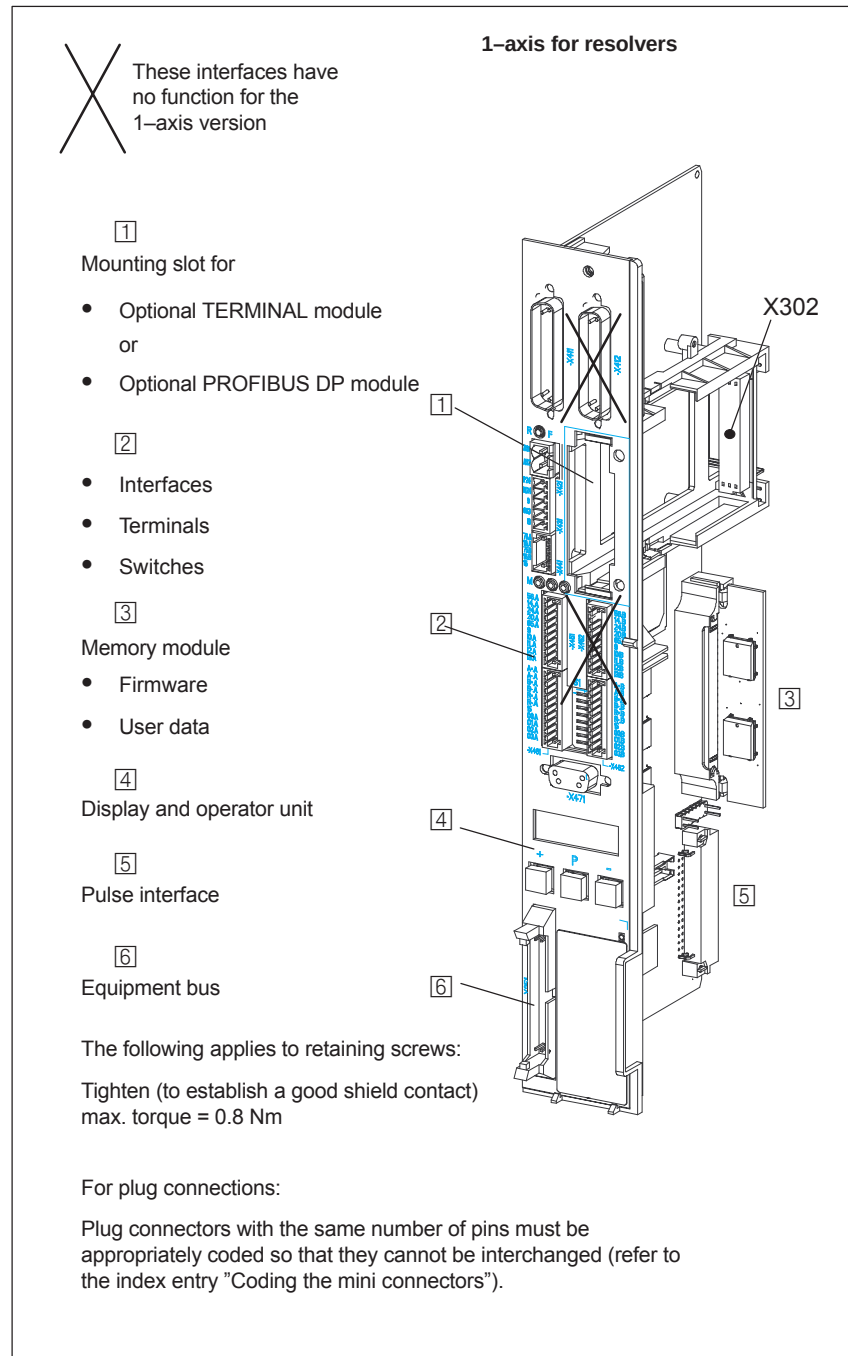


Fig. 4-5 Control board for 1 axis (SIMODRIVE 611 universal HRS / HRS2)

4.3 "SIMODRIVE 611 universal HRS" and "HRS2" (from SW version 14.2) control board

4.3.2 Description of the terminals and interfaces

Board-specific terminals and interfaces

The board-specific terminals and interfaces are available jointly for drive A and B of a 2-axis module.

Table 4-10 Overview of the board-specific terminals and interfaces

Terminal		Function	Type 1)	Technical specifications										
No.	Designa- tion													
Signaling terminal, start inhibit (X421)														
AS1 ³⁾	X421	Signaling contact	NC	Connector type:	2-pin conn. strip									
AS2 ³⁾		Start inhibit Feedback signal from terminal 663		Max. cond. cross-sect.:	2.5 mm ² Contact: Contact load capability:	Floating NC contact at 250 V _{AC} max. 1 A ⁴⁾ at 30 V _{DC} max. 2 A								
Pulses not enabled (T. 663) The gating pulses of the power transistors are inhibited. Pulses enabled (T. 663) The gating pulses of the power transistors are enabled.														
Terminals for supply and pulse enable (X431)														
	X431			Connector type:	5-pin conn. strip									
				Max. cond. cross-sect.:	1.5 mm ²									
P24	X431.1	External supply for digital outputs (+24 V)	S	Voltage tolerance (including ripple):	20,4 V to 28,8 V									
M24	X431.2	Reference for the ex- ternal supply	S											
The external supply is required for the following digital outputs: 8 outputs of the drive-specific terminals (X461, O0.A – O3.A/X462, O0.B – O3.B) 8 outputs of the optional TERMINAL module (X432, O4 – O11) When dimensioning the external power supply, the total current of all of the digital outputs must be taken into account. Maximum total current: - for the control board (all 8 outputs): 2.4 A - for the optional TERMINAL module (all 8 outputs): Max. 480 mA Example: <table><tr><td>Board/module</td><td>Outputs</td><td>Dimensioning the external supply</td></tr><tr><td>Control board</td><td>8</td><td>max. 1.5 A → 24 V/1.5 A</td></tr><tr><td>Control module + optional TERMINAL module 8 + 8</td><td></td><td>max. (1.5 A + 280 mA) → 24 V/1.8 A</td></tr></table>						Board/module	Outputs	Dimensioning the external supply	Control board	8	max. 1.5 A → 24 V/1.5 A	Control module + optional TERMINAL module 8 + 8		max. (1.5 A + 280 mA) → 24 V/1.8 A
Board/module	Outputs	Dimensioning the external supply												
Control board	8	max. 1.5 A → 24 V/1.5 A												
Control module + optional TERMINAL module 8 + 8		max. (1.5 A + 280 mA) → 24 V/1.8 A												

4.3 "SIMODRIVE 611 universal HRS" and "HRS2" (from SW version 14.2) control board

Table 4-10 Overview of the board-specific terminals and interfaces, continued

Terminal		Function	Type 1)	Technical specifications
No.	Designation			
9	X431.3	Enable voltage (+24 V)	S	Reference: Terminal 19 Maximum current(for the total group): Max. 500 mA Note: The enable voltage (terminal 9) can be used to supply the enable signals (e.g. pulse enable) as 24 V auxiliary voltage.
663	X431.4	Pulse enable (+24 V)	I	Voltage tolerance(including ripple): 21 V to 30 V Typ. current consumption: 50 mA at 24 V Note: The pulse enable acts simultaneously on drive A and drive B. When this pulse enable is withdrawn, the drives "coast down" unbraked.
19	X431.5	Reference (Reference for all digital inputs)	S	Note: If the enable signals are to be controlled from an external voltage source, the reference potential (ground) of the external source must be connected to this terminal.
Serial interface (X471)				
–	X471	Serial interface for "SimoCom U"	IO	Type: 9-pin D-sub socket connector Cable diagram and pin assignment for RS232 or RS485, refer to: Reference: /FB611U/ Description of Functions, SIMODRIVE 611 universal
Equipment bus (X34)				
–	X351	Equipment bus	IO	Ribbon cable: 34-pin Voltages: various Signals: various
Test sockets (X34)				
DAC1	X34	Test socket 1 ²⁾	M	Test socket: Ø 2 mm
DAC2		Test socket 2 ²⁾	M	Resolution: 8 bits
M		Reference	M	Rated operating voltage: 0 V to 5 V Maximum current: Max. 3 mA

1) I: Input; IO: Input/output; M: Measuring signal; NC: NC contact; S: Supply

2) Can be freely parameterized

3) When connecting contacts AS1/AS2 in series, a contact voltage drop up to max. 0.2 V must be taken into account for the lifetime of the contacts (100000 switching operations). For a 24 V switching voltage, due to the non-linear contact characteristics, from experience, five contacts can be simply connected in series without encountering any problems.

4) In accordance with EN 60204-1 (machine safety) control-power transformers should be provided when AC control voltages are used.

4.3 "SIMODRIVE 611 universal HRS" and "HRS2" (from SW version 14.2) control board

Drive-specific terminals

The drive-specific terminals are available for both drive A and drive B.

Table 4-11 Overview of the drive-specific terminals

Terminal				Function	Type 1)	Technical specifications
Drive A		Drive B				
No.	Designa- tion	No.	Designa- tion			
Encoder connection (X411, X412) ⁵⁾						
–	X411	–	–	Motor encoder connection Drive A	I	See Chapter 3 Type: 25–pin D–sub plug connector Note: Encoder limit frequencies:
–	–	–	X412	Motor encoder connection Drive B or connection, direct measuring system (as of SW 3.3)	I	- Encoder with sin/cos 1 V_{pp}: 350 kHz - Resolver HRS: 12 bits 423 Hz 14 bits 106 Hz Resolver HRS2: 12 bits 957 Hz 14 bits 479 Hz - Enc. with TTL signal: 420 kHz For the encoder connection, refer to Tables 4-12 and 4-13
Analog outputs (X441)						
75.A	X441.1	–	–	Analog output 1 ²⁾	AO	Connector type: 5–pin conn. strip
16.A	X441.2	–	–	Analog output 2 ²⁾	AO	Wiring: Connect the cable with the braided shield at both ends
–	–	75.B	X441.3	Analog output 1 ²⁾	AO	Max. cond. cross–section for finely– stranded or solid cond.: 0.5 mm ²
–	–	16.B	X441.4	Analog output 2 ²⁾	AO	Rated operating voltage: –10 V to +10 V
15	X441.5	15	X441.5	Reference	–	Maximum current: 3 mA Resolution: 8 bits Update: In the speed–contr. clock cycle short–circuit proof
Terminals for analog inputs and digital inputs/outputs (X451, X452)						
	X451		X452	Connector type: 10–pin conn. strip Max. cond. cross–section for finely–stranded or solid cond.: 0.5 mm ²		
56.A	X451.1	56.B	X452.1	Analog input 1	AI	Differential input
14.A	X451.2	14.B	X452.2	Reference		Rated operating voltage: –12.5 V to +12.5 V
24.A	X451.3	24.B	X452.3	Analog input 2		Input resistance: 100 kΩ
20.A	X451.4	20.B	X452.4	Reference		Resolution: 14 bits (sign + 13 bits)
65.A	X451.5	65.B	X452.5	Controller enable Drive–specific	I	Wiring: Connect the cable to the braided shield at both ends
						Typ. current consumption: 6 mA at 24 V Signal level (incl. ripple) High signal level: 15 V to 30 V Low signal level: –3 V to 5 V Galvanic isolation: Ref. is T. 19/ T. M24

Table 4-11 Overview of the drive-specific terminals, continued

Terminal				Function	Type 1)	Technical specifications
Drive A		Drive B				
No.	Designa- tion	No.	Designa- tion			
9	X451.6	9	X452.6	Enable voltage (+24 V)	S	Reference: Terminal 19 Maximum current (for the total group): 500 mA Note: The enable voltage (terminal 9) can be used to supply the enable signals (e.g. con- troller enable).
I0.A	X451.7	I0.B	X452.7	Digital input 0 ²⁾ Fast input ³⁾ e.g. for equivalent zero mark, external block change	DI	Voltage: 24 V Typ. current consumption: 6 mA at 24 V Signal level (incl. ripple) High signal level: 15 V to 30 V Low signal level: -3 V to 5 V sampling time, fast input: 62.5 µs Galvanic isolation: Ref. is T. 19/T. M24 Note: An open-circuit input is interpreted as 0 signal.
I1.A	X451.8	I1.B	X452.8	Digital input 1 ²⁾ Fast input	DI	
I2.A	X451.9	I2.B	X452.9	Digital input 2 ²⁾	DI	
I3.A	X451.10	I3.B	X452.10	Digital input 3 ²⁾	DI	
Drive-specific terminals (X461, X462)						
	X461		X462	Connector type: 10-pin conn. strip Max. cond. cross-section for finely-stranded or solid cond.: 0.5 mm ²		
A+.A	X461.1	A+.B	X462.1	Signal A+	IO	Incremental Shaft Encoder Interface (AIE int.) Wiring: - Cable with braided shield, connected at both ends. - The reference ground of the connected node should be connected to terminal X441.5 or X461.7. - Condition to maintain the surge strength: Cable length < 30 m
A-.A	X461.2	A-.B	X462.2	Signal A-	IO	
B+.A	X461.3	B+.B	X462.3	Signal B+	IO	
B-.A	X461.4	B-.B	X462.4	Signal B-	IO	
R+.A	X461.5	R+.B	X462.5	Signal R+	IO	
R-.A	X461.6	R-.B	X462.6	Signal R-	IO	
15	X461.7	15	X462.7	Ground reference	—	
	Note: Devices (stations) can be connected which conform to the RS485/RS422 standard. The angular incremental encoder interface can either be parameterized as an input or output. - Input To enter incremental position reference values - Output To output incremental actual position values					
O0.A	X461.8	O0.B	X461.8	Digital output 0 ⁴⁾	DO	Rated current per output: 500 mA Maximum current per output: 600 mA Maximum total current: 2.4 A (valid for these eight outputs) Voltage drop, typical: 250 mV at 500 mA short-circuit proof Example: If all eight outputs are simultaneously con- trolled, then the following is valid: Σ Current = 240 mA → OK Σ Current = 2.8 A → not OK, as the total current is greater than 2.4 A.
O1.A	X461.9	O1.B	X461.9	Digital output 1 ⁴⁾	DO	
O2.A	X461.10	O2.B	X461.10	Digital output 2 ⁴⁾	DO	
O3.A	X461.11	O3.B	X461.11	Digital output 3 ⁴⁾	DO	
Note: - The power switched via these outputs is supplied via terminals P24/M24 (X431). This must be taken into account when dimensioning the external supply. - The digital outputs only "function" if there is an external supply (+24 V/0 V at terminals P24/M24).						

4.3 Regelungsbaugruppe "HRS / HRS2" (ab SW 14.1)

Beschreibung

Die Regelungsbaugruppe "SIMODRIVE 611 universal HRS" (SW ≥ 8.3) wird im System SIMODRIVE 611 eingesetzt und enthält zwei voneinander unabhängige Antriebsregelungen. Die Baugruppe kann jedoch auch 1-achsig bzw. in 1-achsigen Leistungsmodulen betrieben werden.

Hinweis

Die Regelungsbaugruppe ist ausführlich beschrieben in:

Literatur: /FBU/, Funktionsbeschreibung SIMODRIVE 611 universal

Die in dieser Funktionsbeschreibung unter "SIMODRIVE 611 universal" angegebene Funktionalität gilt auch für "SIMODRIVE 611 universal HRS" und "HRS2".

Funktionsmerkmale

Die Regelungsbaugruppe hat folgende Funktionsmerkmale:

Varianten

Tabelle 4-7 Regelungsbaugruppe, Optionsmodule, Datenträger

lfd. Nr.	Beschreibung		Bestell-Nr. (MLFB)
	Hardware	Firmware	
Regelungsbaugruppe			
1	2-Achs ¹⁾ für Geber mit sin/cos 1 Vpp	n-soll	6SN1118-0NH01-0AA1
2		Positionieren	6SN1118-1NH01-0AA1
4	2-Achs ¹⁾ für Resolver	n-soll	6SN1118-0NK01-0AA2 ⁴⁾
6		Positionieren	6SN1118-1NK01-0AA2 ⁴⁾
8	1-Achs für Resolver	n-soll	6SN1118-0NJ01-0AA2 ⁴⁾
10		Positionieren	6SN1118-1NJ01-0AA2 ⁴⁾
Optionsmodul (alternativ in die Regelungsbaugruppe einsetzbar)			
1	KLEMMEN	–	6SN1114-0NA00-0AA0
3	PROFIBUS-DP ²⁾	–	6SN1114-0NB00-0AA2
4	PROFIBUS-DP ³⁾	–	6SN1114-0NB01-0AA1
Software			
1	Download	SimoCom U, Antriebs-Firmware, Toolbox, GSD-Datei, readme-Datei, usw.	Ab SW-Stand 10.2 über Internetdownload erhältlich, Link siehe Vorwort.

1) Bei 2-Achs-Regelungsbaugruppen ist auch ein 1-Achs-Betrieb möglich

2) □: Platzhalter für Software-Version

3) Voraussetzung: Regelungsbaugruppe ab SW 3.1

4) Bei HRS: 0AA2 ersetzen durch 0AA1