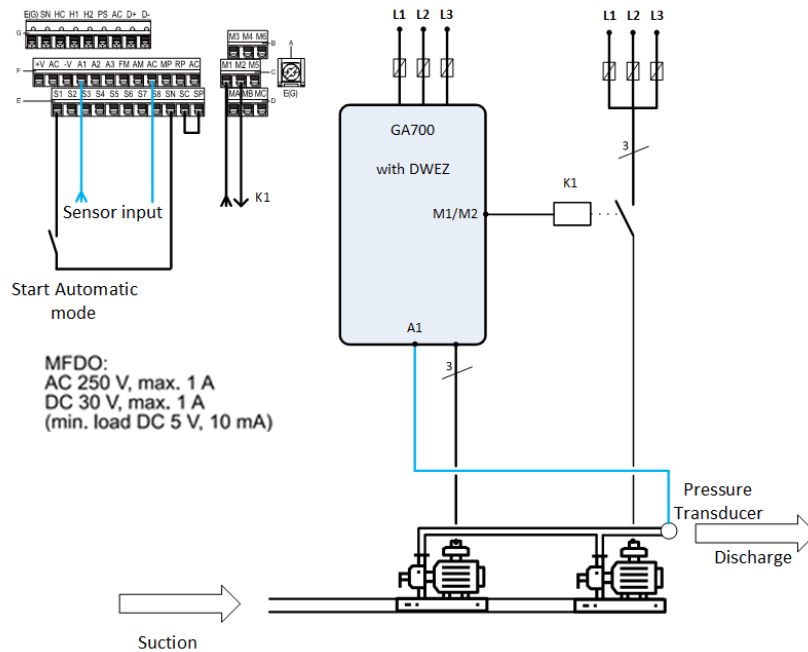### 2.4 Lag Duplex

Figure 8: Overview lag duplex function.

The automatic mode starts when a TRUE signal is set to digital input 1 (S1).
Then the main pump (drive) will be started. It can be set to a fixed speed or can be controlled via PID-Controller.

If the automatic mode is selected the main pressure is controlled. If the main pressure falls below "Pressure Low Level" (Q1-01) for "Time 1" (Q3-01) the lag pump will be started.

If the main pressure is over "Pressure High Level" (Q1-02) for "Time 3" (Q3-03) the lag pump will be stopped. The main pump will be stopped by a FALSE signal set to digital input 1 (S1).
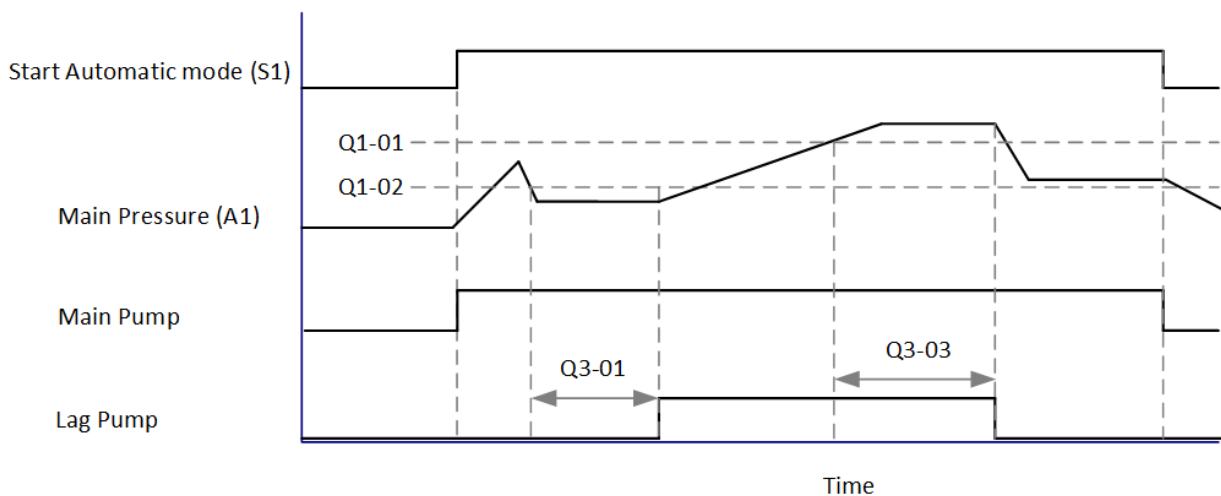
2.4.1 DWEZ Parameter

Figure 9: Time diagram lag duplex function.

In this section the parameters of the lag duplex function are described. To better understand the descriptions, the following terms and abbreviations are defined:

Start automatic mode refers to the signals received by the drive to operate the pumps.

Digital Input 1	Drive Operation
OFF	Stops all pumps immediately
ON	Starts main pump immediately and if necessary starting or stopping the lag pump

Q1-01 *"Pressure Low Level"*: This level corresponds with the signal connected to analog input 1.
With this level the controller decides to switch ON the additional lag pump.

The actual signal level of A1 can be seen in monitor U1-13.

No.	Parameter Name	Setting Range	Default
Q1-01	"Pressure Low Level"	0.00-655.35%	20%

Q1-02 *"Pressure High Level"*: This level corresponds with the signal connected to Analog Input 1.
With this level the controller decides to switch OFF the additional lag pump.

The actual signal level of A1 can be seen in monitor U1-13.

No.	Parameter Name	Setting Range	Default
Q1-02	"Pressure High Level"	0.00-655.35%	90%

Q3-01 *"ON Time 1"*: This is the delay time for switching ON the lag pump

No.	Parameter Name	Setting Range	Default
Q3-01	"Time 1	0.0-600.0s	5.0s

Q3-03 *"OFF Time 1"*: This is the delay time for switching OFF the lag pump

No.	Parameter Name	Setting Range	Default
Q3-03	"Time 1	0.0-600.0s	5.0s

Q1-10 *Lag Pump Time Reset* The cumulative operation time of the lag pump can be reset by setting "01" to Q1-10. After resetting the counter it is necessary to set parameter Q1-10 back to "00". Otherwise the counter will always show zero.

No.	Parameter Name	Setting Range	Default
Q1-10	Lag Pump Time Reset	00 - FF	00

2.4.2 Monitors

U4-01 *Monitor for Time of Pump 1*: Shows the cumulative operation time of the drive.

The maximum number displayed is 99999h, after which the value is reset to 0.

No.	Parameter Name	Setting Range	Default
U4-01	Monitor for Time of Pump 1	0-99999h	0h

U8-23 *Monitor for Time of Lag Pump 1*: Shows the cumulative operation time of the lag pump.

The maximum number displayed is 99999h, after which the value is reset to 0.

No.	Parameter Name	Setting Range	Default
U8-23	Monitor for Time of Lag Pump	0-99999h	0h

3 Drive Parameter Additionall to DWEZ

In this section the drive parameter which have to be changed for each function are described.

3.1 Triplex/Duplex Parameters Drive No. 1

3.1.1 Communication

Parameter	Description	Value
F6-16	Sets the gateway mode operation and the number of connected slave Drives. 0 : Disabled 1 : Enabled: 1 Slave Drive 2 : Enabled: 2 Slave Drives	1 (Duplex) 2 (Triplex)

3.1.2 PID Control

Parameter	Description	Value
b1-01	Sets the input method for the frequency reference. 0 : Keypad	0
b5-01	Sets the type of PID control. 1 : Standard	1
b5-02	Sets the proportional gain (P) that is applied to PID input. Can be changed to tune the PID Control.	1.00
b5-03	Sets the integral time (I) that is applied to PID input. Can be changed to tune the PID Control.	1.0s
b5-18	Sets the function that enables and disables b5-19 [PID Setpoint Value].	1
b5-19	Sets the PID setpoint.	X.Xbar
b5-20	Sets the units to set and show b5-19 [PID Setpoint Value].	3
b5-38	Sets the scaling for PID User Unit Display when the drive operates at the maximum output frequency.	1000
b5-39	Sets the number of digits to set and show the PID setpoint.	1

3.1.3 Analog Input

Parameter	Description	Value
H3-01	Sets the input signal level for MFAI terminal A1. 0 : 0 to 10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference) 2 : 4 to 20 mA 3 : 0 to 20 mA	2
H3-02	Sets a function for MFAI terminal A1.	30 (DWEZ AI1)
H3-03	Sets the gain of the analog signal input to MFAI terminal A1. Maximum Input value for example 10V or 24mA = X.X% Example: 4-20 mA 0 – 16 bar, set H3-03 to 160%, then 24mA are shown as 160.	160.0%
H3-09	Sets the input signal level for MFAI terminal A2. 0 : 0 to 10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference) 2 : 4 to 20 mA 3 : 0 to 20 mA	2
H3-10	Sets a function for MFAI terminal A2.	B (PID Feedback)
H3-11	Sets the gain of the analog signal input to MFAI terminal A2. Maximum Input value for example 10V or 24mA = X.X% Example: 4-20 mA 0 – 16 bar, set H3-03 to 160%, then 24mA are shown as 160.	160.0%

3.2 Triplex/Duplex Parameters Drive No. 2&3

3.2.1 Communication

Parameter	Description	Value
b1-02	Sets the input method for the Run command. 2 : Memobus/Modbus Communications	2
H5-01	Sets the communication slave address for drives.	1 (Slave 1) 2 (Slave 2)
H5-09	Sets the detection time for CE [Modbus Communication Error] issues when communication stops.	0,9 s

3.2.2 PID Control

Parameter	Description	Value
b1-01	Sets the input method for the frequency reference. 0 : Keypad	0
b5-01	Sets the type of PID control. 1 : Standard	1
b5-02	Sets the proportional gain (P) that is applied to PID input. Can be changed to tune the PID Control.	1.00
b5-03	Sets the integral time (I) that is applied to PID input. Can be changed to tune the PID Control.	1.0s
b5-18	Sets the function that enables and disables b5-19 [PID Setpoint Value].	1
b5-19	Sets the PID setpoint.	X.Xbar
b5-20	Sets the units to set and show b5-19 [PID Setpoint Value].	3
b5-38	Sets the scaling for PID User Unit Display when the drive operates at the maximum output frequency.	1000
b5-39	Sets the number of digits to set and show the PID setpoint.	1

3.2.3 Analog Input

Parameter	Description	Value
H3-01	Sets the input signal level for MFAI terminal A1. 0 : 0 to 10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference) 2 : 4 to 20 mA 3 : 0 to 20 mA	2
H3-02	Sets a function for MFAI terminal A1.	B (PID Feedback)
H3-03	Sets the gain of the analog signal input to MFAI terminal A1. Maximum Input value for example 10V or 24mA = X.X% Example: 4-20 mA 0 – 16 bar, set H3-03 to 160%, then 24mA are shown as 160.	160.0%

3.3 Lag Triplex/ Lag Duplex Parameters

3.3.1 PID Control

Parameter	Description	Value
b1-01	Sets the input method for the frequency reference. 0 : Keypad	0
b5-01	Sets the type of PID control. 1 : Standard	1
b5-02	Sets the proportional gain (P) that is applied to PID input. Can be changed to tune the PID Control.	1.00
b5-03	Sets the integral time (I) that is applied to PID input. Can be changed to tune the PID Control.	1.0s
b5-18	Sets the function that enables and disables b5-19 [PID Setpoint Value].	1
b5-19	Sets the PID setpoint.	X.X bar
b5-20	Sets the units to set and show b5-19 [PID Setpoint Value].	3
b5-38	Sets the scaling for PID User Unit Display when the drive operates at the maximum output frequency.	1000
b5-39	Sets the number of digits to set and show the PID setpoint.	1

3.3.2 Analog Input

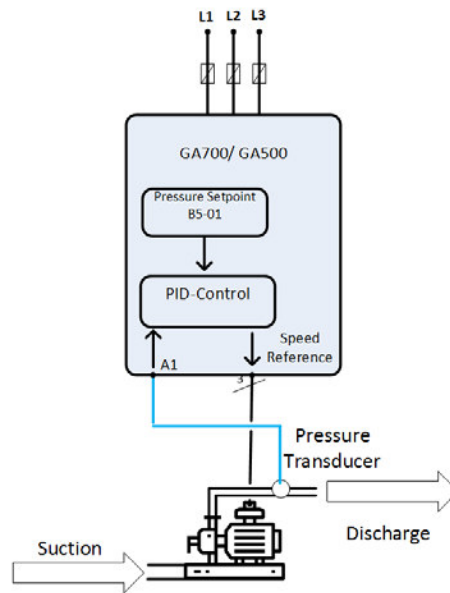| Parameter	Description	Value
H3-01	Sets the input signal level for MFAI terminal A1. 0 : 0 to 10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference) 2 : 4 to 20 mA 3 : 0 to 20 mA	2
H3-02	Sets a function for MFAI terminal A1.	B (PID Feedback)
H3-03	Sets the gain of the analog signal input to MFAI terminal A1. Maximum Input value for example 10V or 24mA = X.X% Example: 4-20 mA 0 – 16 bar, set H3-03 to 160%, then 24mA are shown as 160.	160.0%

3.4 Simple PID Controller Setup

Figure 10: Overview PID-Controller setup

Table 3: PID-Controller parameters

Example of application	Needs	Applied Function	Function Selection and Parameter Setting
Water supply pump	I want to maintain a constant water pressure.	Simply input the signal from the pressure transducer to A1. Example: 4-20 mA 0 – 16 bar	MFAI A2 Select H3-10 = B (PID Feedback) MFAI A2 GAIN H3-11 = 160 -> 24mA=160%
		Use PID control to perform constant control of water pressure.	PID Mode Setting b5-01 = 1 Enable PID Setpoint b5-18 = 1 Set PID Setpoint (%) b5-19 = X.Xbar PID Setpoint unit b5-20 = 3 (bar) PID Setpoint scaling b5-38 = 1000 →160%=16bar PID User Unit Digit b5-39 = 1 (X.X) PID control parameter b5-02 to 89

	I want to prevent the minimum rotation speed from being exceeded because too low a rotation speed causes reverse flow of water.	Use the Lower Frequency Limit. Continue the operation even when the frequency is lost.	Frequency Reference Lower Limit
			                               d2-02 = □%
			Frequency Reference Loss Detection Selection
			                               L4-05 = 0 or 1
			Frequency Reference at Loss of Ref
			                               L4-06 = □Hz

4 Connection of Sensors

4.1 GA700

Use analog input terminals A1 to A3 to input a voltage or a current signal. Set the signal type as shown in the table below:
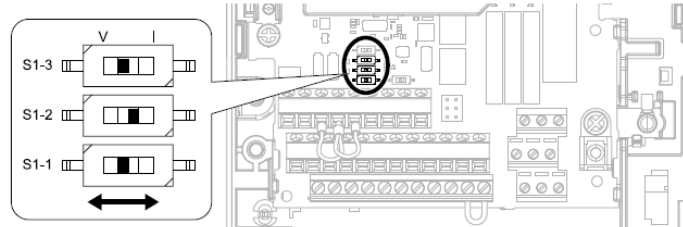

Figure 11: GA700 dip switches for analog signal type

Table 4: GA700 MFAI terminals A1 to A3 signal settings

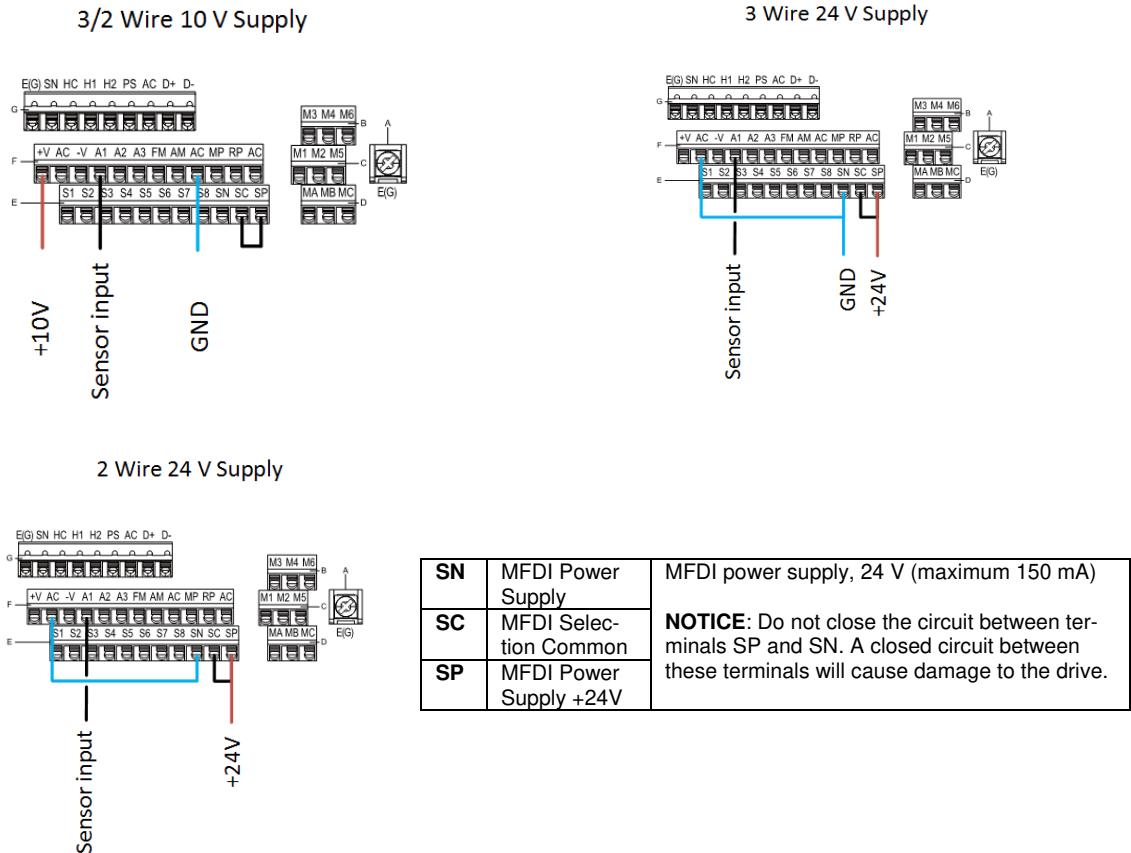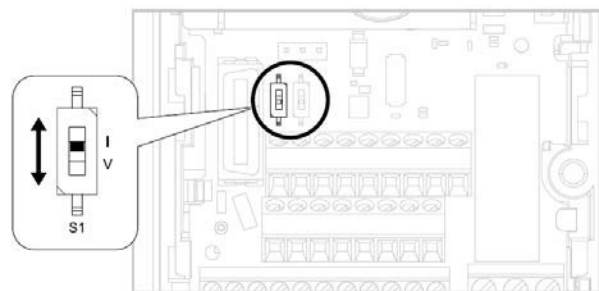| Terminal	Input Signal	DIP Switch Settings		Parameters	
		Switch	**Setting**	**No.**	**Signal Level**
A1	Voltage input	S1-1	V (Default)	H3-01	0: 0 V to 10 V/0% to 100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to 100%
	Current input		I		2: 4 mA to 20 mA/0% to 100% 3: 0 mA to 20 mA/0% to 100% (input impedance: 250 Ω)
A2	Voltage input	S1-2	V	H3-09	0: 0 V to 10 V/0% to 100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to 100%
	Current input		I (Default)		2: 4 mA to 20 mA/0% to 100% 3: 0 mA to 20 mA/0% to 100% (input impedance: 250 Ω)
A2	Voltage input	S1-3	V (Default)	H3-05	0: 0 V to 10 V/0% to 100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to 100%
	Current input		I		2: 4 mA to 20 mA/0% to 100% 3: 0 mA to 20 mA/0% to 100% (input impedance: 250 Ω)

3/2 Wire 10 V Supply

3 Wire 24 V Supply

2 Wire 24 V Supply

SN	MFDI Power Supply	MFDI power supply, 24 V (maximum 150 mA)
SC	MFDI Selection Common	**NOTICE**: Do not close the circuit between terminals SP and SN. A closed circuit between these terminals will cause damage to the drive.
SP	MFDI Power Supply +24V	

Figure 12: GA700 sensor connection examples

4.2 GA500

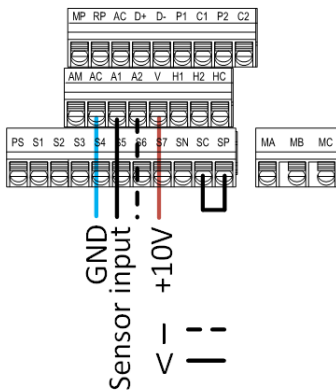Use analog input terminal A1 to input a voltage signal or analog input terminal A2 to input a voltage or a current signal.
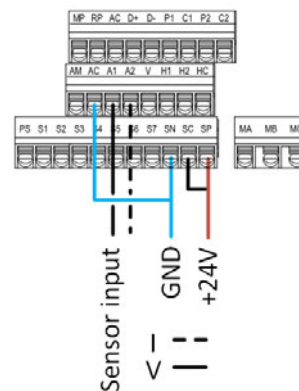

Figure 13 GA500 dip switch for analog signal type

Table 5: GA500 MFAI terminals A1 to A2 signal settings

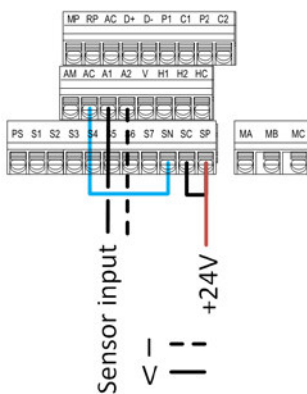| Terminal	Input Signal	DIP Switch Settings		Parameters	
		Switch	Setting	No.	Signal Level
A1	Voltage input	-	V	H3-01	0: 0 V to 10 V/0% to 100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to 100%
A2	Voltage input	S1	V	H3-09	0: 0 V to 10 V/0% to 100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to 100%
	Current input		I (Default)		2: 4 mA to 20 mA/0% to 100% 3: 0 mA to 20 mA/0% to 100% (input impedance: 250 Ω)

SN	MFDI Power Supply	MFDI power supply, 24 V (maximum 150 mA)
SC	MFDI Selection Common	**NOTICE**: Do not close the circuit between terminals SP and SN. A closed circuit between these terminals will cause damage to the drive.
SP	MFDI Power Supply +24V	

Figure 14: GA500 sensor connection examples