

## Supporting Drives: FC102/202

### Name: Scaling of analogue input/output

#### 1.1 Introduction

##### 1.1.1 Introduction / Abstract

In some cases it is necessary that the value of an analogue input is also available as analogue output. This application note shows the procedures taking the feedback connected to a current input as an example and transfer it directly to the analogue output. Further more it is also meant to be a general guideline for scaling analogue signals.

##### 1.1.2 Application description

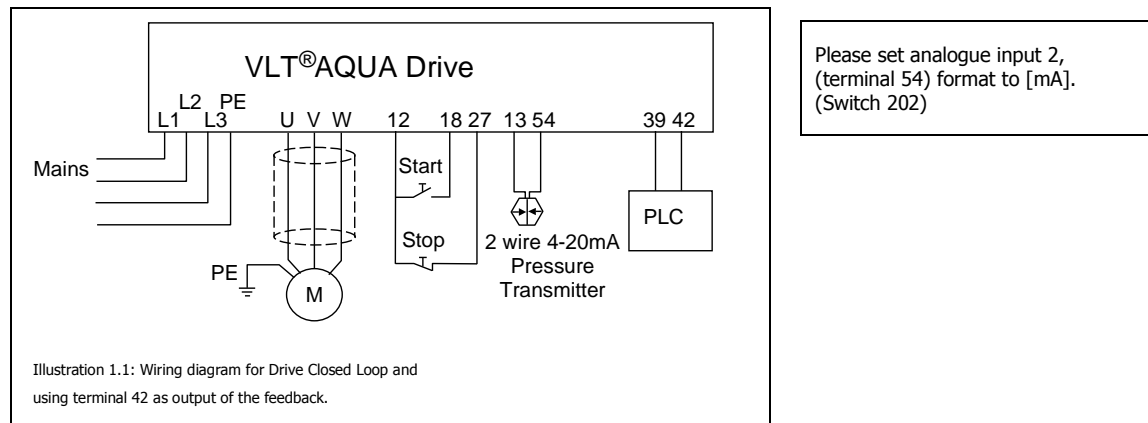
The system used as an example is a pump application, where the signal of a pressure transducer as feedback of the process is fed to the analogue input 54 and transferred to analogue output at terminal 42.

This application note describes the application example including installation diagram, the relevant parameters and settings and further information about scaling. "1:1 copy" and "downscaling" are described as two different possibilities of scaling.

##### 1.1.3 Example

In the example below the application considered is a pump including a 4-20 mA pressure transducer with a pressure range of -1-12 bar (for example AKS33) controlled in closed loop. The pressure transmitter is connected to the second analogue input terminal 54 in order to make commissioning with the Quick Menu possible and easy. Using analogue input 54 for feedback is recommended for all closed loop applications, since most needed settings then will be default and available in the Quick Menu:

##### 1.1.4 Electrical wiring



## 1.2 Parameter settings

### 1.2.1 General settings

General settings:	Parameter	Typical settings
Change display language	0-01	
Set motor speed unit (RPM/Hz)	0-02	Hz

### 1.2.2 Motor data

Motor data:	Parameter	Typical settings
Motor rated power (kW/HP)	1-20 /1-21	
Motor rated voltage	1-22	
Motor current	1-24	
Motor rated speed	1-25	
Enable Automatic Motor Adaption (AMA)	1-29	

### 1.2.3 Display settings

The display can be set up to show 5 different variables. The variables can be changed in par. 0-2\* but by default it will show set-point, current, frequency and feedback.

### 1.2.4 Drive Closed Loop

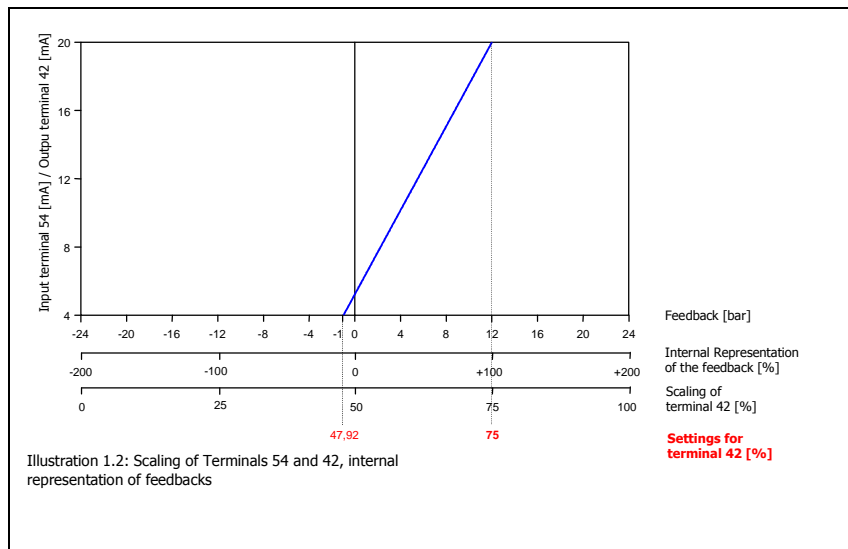
Note: Parameter 1-00 Configuration Mode is set to Closed Loop

Analog In/Out:	Parameter	Settings for the example
Feedback 1 Source	20-00	Analog input 54
Feedback 1 Conversion	20-01	Linear
Feedback 1 Source Unit	20-02	bar
Reference/Feedback Unit	20-12	bar
Feedback Function	20-20	Maximum
Setpoint 1	20-21	5.000

### 1.2.5 Analog In/Out

#### Example 1: Providing a 1:1 copy of the input at terminal 54 also at terminal 42

The illustration below shows how the analog input 54 is configured in this example for the feedback range and how the analog output 42 is scaled to provide a 1:1 copy of the input.



Analog In/Out:	Parameter	Settings for the example
Terminal 54 Low Current	6-22	4.00 mA
Terminal 54 High Current	6-23	20.00 mA
Terminal 54 Low Ref./Feedb. Value	6-24	-1.000
Terminal 54 High Ref./Feedb. Value	6-25	12.000
Terminal 54 Filter Time Constant	6-26	0.001 s
Terminal 54 Live Zero	6-27	Enabled
Terminal 42 Output	6-50	Feedback 4-20mA
Terminal 42 Output Min Scale	6-51	47.92 %
Terminal 42 Output Max Scale	6-52	75.00 %

As shown in illustration 1.2 the feedback is internally represented by a range of  $\pm 200\%$  and for the needed 1:1 copy this range has to be scaled to a 100% range. So the values for the parameters 6-51 and 6-52 are calculated as follows:

$$\text{Parameter 6-51} = \frac{(2 \cdot \text{Parameter 6-25} + \text{Parameter 6-24}) \cdot 100\%}{4 \cdot \text{Parameter 6-25}} = \frac{(2 \cdot 12 \text{ bar} - 1 \text{ bar}) \cdot 100\%}{48 \text{ bar}} = 47.92 \%$$

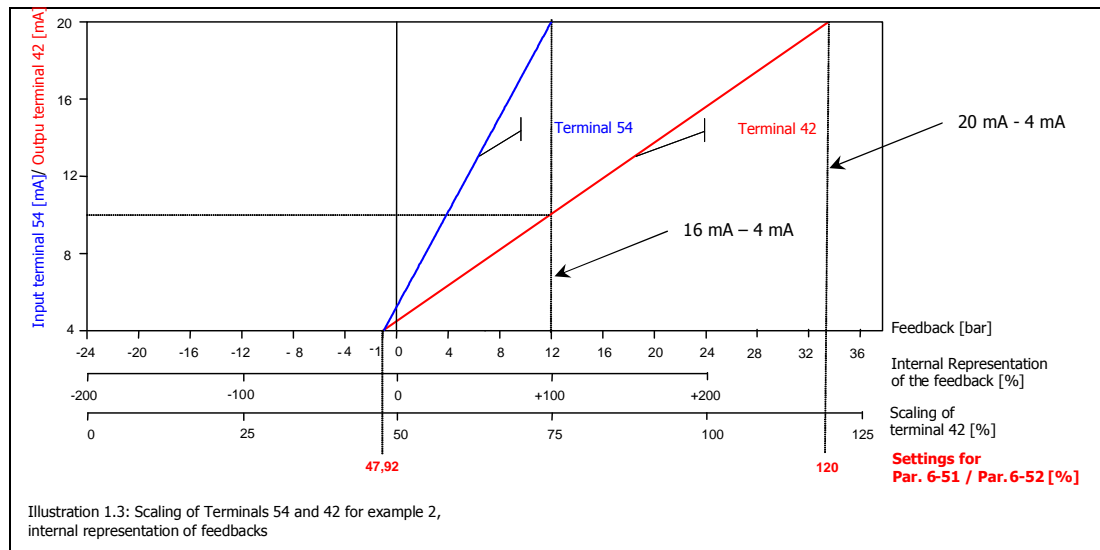
and

$$\text{Parameter 6-52} = \frac{(2 \cdot \text{Parameter 6-25} + \text{Parameter 6-25}) \cdot 100\%}{4 \cdot \text{Parameter 6-25}} = \frac{(2 \cdot 12 \text{ bar} + 12 \text{ bar}) \cdot 100\%}{48 \text{ bar}} = 75 \%$$

### Example 2: Different scaling of input at terminal 54 and output at terminal 42

It is also possible to scale the output signal down to another value.

The illustration below shows the signals at terminals 54 and 42 and how the analog output 42 has to be scaled to get a maximum value of 10 mA.



Analog In/Out:	Parameter	Settings for example 2
Terminal 54 Low Current	6-22	4.00 mA
Terminal 54 High Current	6-23	20.00 mA
Terminal 54 Low Ref./Feedb. Value	6-24	-1.000
Terminal 54 High Ref./Feedb. Value	6-25	12.000
Terminal 54 Filter Time Constant	6-26	0.001 s
Terminal 54 Live Zero	6-27	Enabled
Terminal 42 Output	6-50	Feedback 4-20mA
Terminal 42 Output Min Scale	6-51	47.92 %
Terminal 42 Output Max Scale	6-52	120.00 %

As shown in illustration 1.3 the scaling of the maximum output current at terminal 42 is now 120%. This value (X) can be calculated by using the intercept theorem. At first the point of intersection with the feedback axis is calculated:

$$\frac{20 \text{ mA} - 4 \text{ mA}}{10 - 4 \text{ mA}} = \frac{X - 47,92 \%}{75 \% - 47,92 \%}$$

or

$$X = \frac{16 \text{ mA}}{6 \text{ mA}} \cdot (75\% - 47,92\%) + 47,92\% = 120 \%$$