OPEN DRIVE

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Application n°011

Washing machine

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This OPEN DRIVE application is been developed for an asynchronous sensor-less motor used in industrial washing machines. The particular functions are the possibility to automatically switch-off the power when the motor is stopped and the measure of unbalanced load.
In this application it's very useful to use the standard function of change frequency regulator gains depending on working frequency, in order to obtain high gains at low speed in the washing cycles and low gains at high speed to avoid vibrations.

1. APPLICATION CONFIGURATION

1.1. Application parameters

PAR	DESCRIPTION	RANGE	Default value	NORM. base	Internal rappr.
P180	Frequency reference threshold for automatic run disable	0.0 ÷ 100.0	1.0	% fmax	16383
P181	Test time for automatic run disable	0.0 ÷ 6.0	1.0	seconds	10
P182	II°order filter time constant for measure average current value	0.0 ÷ 3200.0	3200.0	milliseconds	10
P183	II°order filter time constant to cut high armonics on current	0.0 ÷ 3200.0	40.0	milliseconds	10
P184	Test time for logic output o21 "admitted ripple"	0 ÷ 3600	10	seconds	1
P185	Maximum current ripple admitted	0.0 ÷ 100.0	10.0	% Inom az	4095

1.2. Application internal values

INT	INTERNAL VARIABLE	NORM. base	Internal rappr.
d50	Current ripple	% Inom az	4095

1.3. Application analog and monitor outputs

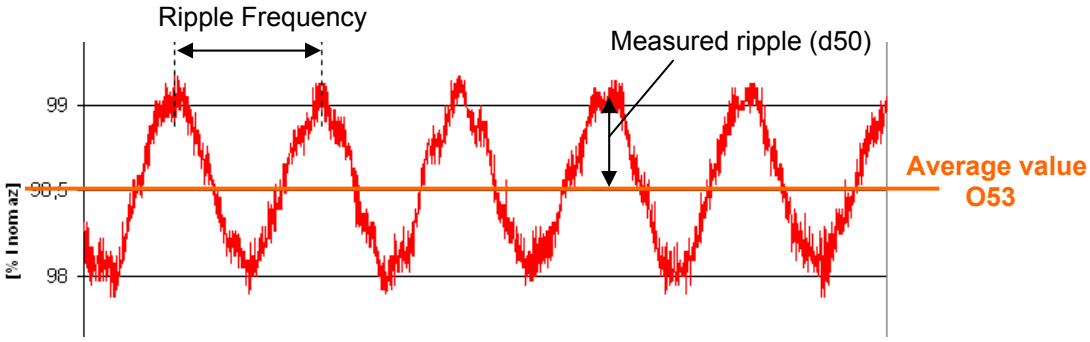
OUT	INTERNAL VARIABLE	NORM. base	Internal rappr.
O53	Average current amplitude (with filter P182)	% Inom az	4095
O54	Current with high frequency filter (P183)	% Inom az	4095
O55	Current ripple absolute value	% Inom az	4095
O56	Timer counter logic output o21	Tpwm	1
O57	Timer counter logic output o21	seconds	1

2. RUN COMMAND AUTODISABLE

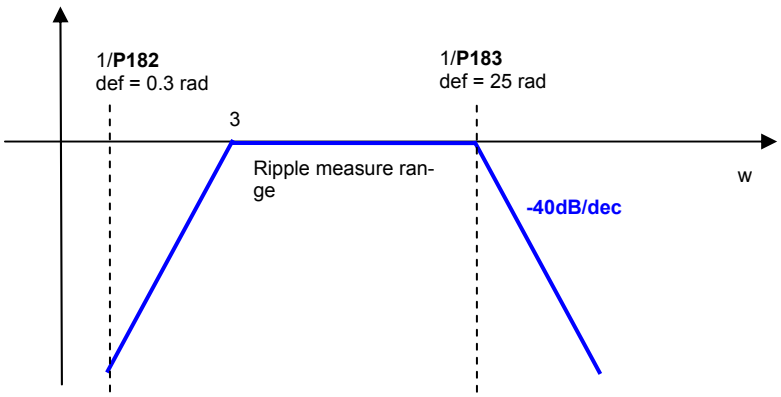
For a sensorless control is very difficult to work for a long time with speed reference equals to zero, for this reason it has been developed the function “Run command autodisable”.
If the absolute value of total frequency reference (**d33**) is lower than the threshold set in parameter **P180** (in percent of maximum frequency) for a time greater than parameter **P181**(seconds), the run command is automatically disabled.
When the frequency reference reachs the threshold P180 automatically the run command is actived again.

3. UNBALANCED LOAD MEASURE

Usually the washing machine load is unbalanced and it is very important to verify the current oscillation before increasing too much the speed. For this reason it has been implemented the measure of unbalanced load with logic output (o21) and internal value (d50) outputs.



In order to measure correctly the current ripple it’s very important to set the digital passband filter.
The parameters involved are **P182** and **P183** that express the time constants like the following figure:



The ripple frequency depends on the rotational washing machine speed, therefore it is necessary to center the measure range with the working frequency band.
With the default configuration the measure range goes from 3 to 25 rad, that correspond to 25÷200rpm.

These monitor values are available:

- O53 is the average current amplitude (with filter P182)
- O54 is the current with high frequency filter (P183)
- O55 is the current ripple absolute value

The measured ripple is compared with the threshold set in parameter **P185** in percent of nominal drive current: only if the ripple is lower for a time expressed in parameter **P184,** the logic output o21 “Ripple admitted” is forced to active value. In the internal value **d50** is possible to read the current ripple amplitude.