Brushless Control Revision History

Rev 22.22 – 18/07/2016

Issues fixed

1. **New STO**: more robust solution against irradiate noise
2. **Old STO**: with 22.21 revision, output logic o17 doesn't work correctly (fluctuating) when the STO is activated
3. **Anybus**: solved the HMS issue of acyclic data exchange with the Ethernet IP

Rev 22.21 – 08/02/2016

New functionality

1. **Sensorless:** improved transition between low speed and real sensorless control.
2. **New STO** available (C58=1) with the appropriate hardware in the power cards.

Less important modification

1. Managed absolute linear encoder Endat LC183
2. Managed Biss AD581222
3. Hiperface: more robust startup also with slow encoders
4. Easy to use:
    a. Unique command C40 for enable complete autotuning test (C41+C42)
    b. At the end of Start-up time measurement the speed regulator is automatically set with stable bandwidth
    c. Connection C26 for invert power phases
5. Power Fault alarm A3 only with drive in run state
6. Actual position shifted available now with less than 16bits per revolution

Rev 22.13 - 02/02/2015

Issues fixed

4. **Endat 1313/Endat 1325**: the new safety control introduced with 22.12 version could give spurious alarm especially with low max speed P65 (less than 100rpm). Now The difference admitted between analog and digital channels it was been increased to 20% and the error is more filtered (5ms).
5. **DC Bus ripple alarm**: from 22.11 version could be spurious alarm A13.2 when the STO was restored in only signaling mode(C73 = 1).
6. **Anybus**: now the internal communication between the DSP and CompactCom module is more robust against interference.

7. **Emergency braking**: now the linear ramps are automatically enabled at occurrence when C34=3 in the main supply failure.

New functionality

3. **Braking** enabled by default with drive stopped (C91=1)**.**
4. **EtherCAT**: with P162 > 1 now it's possible to set the alias ID.
5. **New thermal drive model**: updated the IGBT data and slightly modified the model to take better account of the power conduction losses with the modulation index.

Rev 22.12 - 02/10/2014

Issues fixed

1. **Endat 1313/Endat 1325**: with 22.11 version were not compensated the offsets and the gains of the analog channels during C41 test and manual sensor tuning.
2. **Stationary Magnet recognition**: with previous versions, if the run command was switched off during the search, then the drive could always stay in the same search.

New functionality

1. **Endat 1313/Endat 1325**: for safety reason it was been introduced a new control to check if digital and analog sensor channels give coherent signals. With difference great than 10% of maximum speed alarm A9.5 is activated.
2. **New STO** available (C58=1) with the appropriate hardware in the power cards.
3. More robust manage of cyclic Logiclab task during drive boot-up.

Rev 22.11- 15/04/2014

Issues fixed

1. **Sensorless**: with 22.0x versions could be some problems with starting on the fly. Now this issued is solved
2. **Connection test C41**: with previous versions, after a failed test (A14 or A15 alarm) could be other failures only because one variable wasn't reset.
3. **PWM frequency**: with previous versions the minim working PWM frequency was 1145Hz. Now it's possible to go down to 1000Hz and using double update reach 500Hz.
4. **CANOpen**: with previous versions could be some problems with Node Guarding RTR message if had never been sent an Emergency message from the drive.
5. **Encoder and Hall sensors**: with previous versions there could be, in very rare cases, alarm A2.3 at startup for unstable sectors reading.

6. **High Radiator temperature output o15**: with previous versions wasn't managed. Now it works with hysteresis of 2 degrees.

New functionality

1. Control for **Synchronous Reluctance Motors** with or without magnets, sensorless version only with magnets. In dynamic applications with speed sensor, it's possible to use inner formulas to obtain the best working point, up to 5 times nominal speed. In Energy applications it's possible to find in real time the best working point like torque per ampere (MTPA function).
2. **Hiperface** sensor managed (only for OPDE) with connections C87 and C88 for set the single and multiturn bits resolution (to be enabled by C00=7).
3. **Double Update** (only for OPDE) function available to obtain control routines with double frequency compared with PWM frequency.
4. New **LogicLab cyclic task** with process image. This task is executed cyclically with a selectable period (usually some ms) and it can be interrupted by Fast and motor control tasks.
5. **Sincos absolute position accuracy** increased from ± 1 pulse to less than 1/8 pulse using second slot.
6. Now available LogicLab embedded functions for **expand I/O via second CAN line** (only for OPDE).
7. Now available IGBT thermal model with max junction and radiator temperature control (only for OPDE).
8. DC Bus ripple measured to find unbalanced main supply and/or rectified bridge problems. A.13.2 alarm. This function can be disabled by C31=1. With MiniOPDE single phase (230V) the function is automatically disabled.
9. The Encoder Index Channel is latched on rising edge during forward movements and on falling edge during reverse rotation.
10. MiniOPDE: with C94=0 the management of the fan depends on the radiator temperature. With C94=1 (default) the fan is enabled for 60 sec. *also* every time the Drive Brake goes on. With C94=2 the fan is always enabled.
11. MiniOPDE: high resolution Analog converter (VF). By using feedback board 4S0021 and enabling C09=0 and E23=YES (or I.23). The PLD version minimum required v1.04.
12. MiniOPDE: o.26 Brake Fault output (is TRUE if Brake Fault)

Less important modification

7. Starting from this version the analog inputs offsets are stored into permanent drive memory.
8. With the new firmware revision, during storing data in permanent memory (C63=1) there is an immediate control on the data written, if there isn't coherence, alarm A1.2 appears.
9. Restore **Factory Parameters** now available (C62=2).
10. Available **Rotating current vector** to test drive power circuit
11. Anybus CompactCOM approved for: DeviceNet, Ethernet/IP, Modbus TCP, Profinet.
12. New option for connection MAIN_LOST_SEL C34 = 4 : if the main supply is lost, immediately the drive goes in alarm A10.1.

13. Asymmetric torque limits available via fieldbus.
14. Available Torque Motor thermal protection for low speed situation
15. MiniOPDE: d.51, d.52, d.54 show communication alarm between Control and Power boards. d.54 shows the Power Board Firmware version.

Rev 22.03- 17/04/2013

Issues fixed

1. **MiniOPDE :** with previous version if C89=1 the drive could remain always in Stop also if there was a Run command
2. **Absolute SinCos:** with previous versions from 21.90, there was a limit on maximum Sincos frequency of 150KHz, beyond this limit, the speed was not decoded properly. Now this issue has been resolved.
3. **Absolute and Incremental Sincos:** starting from rev 22.00 was lost one pulse every 32768 per turn into inner position loop. Now this issue has been resolved.
4. **Multi turn Actual position absolute or incremental**: removed the possibility to choose with connection C54 if the actual position [16.16] is absolute or incremental. Now it's always absolute (like versions before 22.00)

Rev 22.01- 07/02/2013

Issues fixed

1. **Latch Alarm Reset :** with previous versions could be produced some Emergency Message (Can Open and EtherCAT) during initial reset period (600ms after regulation switch on)
2. **Voltage limit parameters:** minimum value admitted is now 0, so it's possible to work also with a very low DC Bus in input.

Rev 22.00 - 22/01/2013

Issues fixed

1. **PWM current routines lost** : with previous versions, working in a certain PWM frequency range, could lead to loss of some current control routine (about 11KHz ÷12.5KHz). Usually this issue produces only negligible effects, except for applications that require high electrical frequency in output(>400Hz).
2. **DPWM Modulator:** due to Texas Instruments bug, DPWM modulator could not work well, with a minimum current distortion. Now the issue was solved.
3. **Profibus DP and Anybus:** due a bug, with previous versions was possible to map up to only 9 words in input and output. Now it's possible to map up to 10 words in input and output.
4. **STO and not real alarms:** with previous versions when STO was enabled could appears some alarms like sensor presence (A9.1). Now this issue is solved.
5. **A8.3 Application alarms:** with previous versions, at drive switch on, in very rare cases, could appear a not real application alarm A8.3. Now this issue is solved.

6. **Application download:** with previous versions, in very rare case, after an application download the drive stayed in Boot state and OPDExplorer run Firmware Downloader. Now this issued is solved
7. **New Profibus Management:** with new version, if control word is mapped on Rx (Idx=0x201F Fieldbus Digital Inputs) this word is cleared at startup to avoid unexpected starts.
8. **Speed reached output o16:** with previous versions this output didn't work correctly, once activated, didn't changed more its state
9. **Incremental Position loop**: with previous versions the memory clear at stop (EN_POS_MEM_CLR P240) didn't work correctly closing the loop on second sensor (EN_POS_REG_SENS2 C90). Moreover using second sensor Sin/Cos to close the position loop, some pulses could be lost.

New functionality

1. **Current reading** : now second sensor signals and currents are read exactly in the center of pulse command, taking into account dead time and hardware delay on regulation board. This give more noise immunity to the signals
2. **Increased inner resolution**: in speed control and overlapped space loop now one turn is represented with a bit number depending on sensor used, without lose resolution. The pulses speed and position reference could be expressed with 16 or 32 bit per turn. At application level is now available the multi turn position in 32 bit, with the possibility to choose the number of fractional and integer bit.
3. **New current overload management**: now it's possible to select a new current overload management that reading radiator temperature allows a better current overload. It' also possible to change on line PWM frequency at low speed.
4. **Endat**: now available also this high resolution digital sensor (ECN125 with 25bits and 29bits)
5. **Biss C-mode**: now available.
6. **Endat 1325 and 1313**: new revision more robust against noise on the signals.
7. **SinCos Encoder**: with the previous versions max pulse per revolution was 16384, now this limit is 60000ppr.
8. **Stationary Magnet recognition** : especially for sensorless control now it's available a magnet recognition (motor phasing) without move the motor, for anisotropy motors (IPM).
9. **Resolver**: now it's possible to work with any pole number combination, but in this case it's necessary to phase the motor the first run.
10. **Notch Filter**: now it's available a notch filter on current reference to remove mechanical natural frequency
11. **MTPA (Maximum Torque per Ampere)**: with this new optional function is possible to find out the best working point about current produced. This algorithm works well with IPM (internal permanent magnet) motors especially for Energy application.
12. **Encoder Output**: now it's possible to select the resolution also referring to second sensor (C52=5). Moreover it's changed the First Zero Top managing, now also with incremental sensor, there aren't correction pulses in A and B channels.

Less important modification

16. **Maximum drive PWM frequency** : now the fast tast max duration is calculated on line knowing PWM period, speed and current routines duration. In OPDExplorer are available 5 internal data that shows the duration of speed, current, application routine, free time available and maximum drive PWM frequency.
17. **Multi turn Actual position absolute or incremental**: now it's possible to select with connection C54 if the actual position [16.16] is absolute or incremental Motor sensor Zero Top available in Tab_osc[12] in percent of mechanical turn.
18. **Mini-OPDE**: with previous versions the work hours are multiply by 2. So the real value is a half the showed value.
19. **LogicLab Data Block**: now available also internal values "Tab_int_opdexp"
20. **Canopen**: Now NMT command "reset node" works correctly. Now available also the actual position with up to 32 bit of resolution on one turn and second sensor position up to 32 bit. One Emergency message per alarm with alarm sub code available
21. **S-Ramps**: increased time constant resolution (now 10ms) and quantization time.
22. **Stop with mimimum speed**: with previous versions this function didn't work using software command C21.
23. **Motor and second sensor actual position**: now available in OPDExplorer the actual position with resolution equals to sensor resolution.
24. **Motor overheating output o14**: now with KTY84 thermal probe, the logical output function o14 goes at active level if the motor temperature is greater than threshold set with parameter P96 in percent of maximum temperature admitted P91. Without KTY84 is like the previous firmware revisions, the logical output function o14 is related to motor I^2t thermal protection.

Rev 21.92 - 16/01/2012

Issues fixed

1. **Sensor 1 and 2 offset and gain**: with 11.90 and 11.91 revisions these parameters became reserved not more TDE. This was made to help the user if autotuning test wrong. With 11.92 revision these parameters back to TDE parameters to preserve it for spare units.
2. **Frequency Encoder Output Alarm:** with 11.90 and 11.91 revisions, the system admitted max speed setting greater than limit of 500KHz in output, without alarm A15.1. Now this issue is solved.

New functionality

1. **Sensor phasing** : now setting C41=3 it's possible to phase manually the sensor looking in the internal value d27 the actual angle.

Rev 21.91 - 07/10/2011

Issues fixed

3. **Impulse brake command on regulation switch-on** : with previous versions, after regulation switch-on, appeared an impulse brake command of 25-40ms. This issue can creates some problems to the drive only if:
    a. a brake resistor is connected to the drive
    b. main supply is given before regulation switch-on or at the same time,
    c. the drive nominal current is < 70A or DC supply input over

    Workaround with previous versions is following the right sequence: switch on the regulation before give main supply

Rev 21.9 - 21/09/2011

Issues fixed

1. **Endat 1313**: with previous versions was not possible to use this sensor.
2. **PWM synchronization** : with previous versions, PWM drive to drive synchronization caused problems in the motor control in flux weakening area.
3. **Torque control with speed limit**: now it's possible to work also with one speed limit close to 0. The only condition about speed limit positive and negative is that they cannot be equal.
4. **Safe Torque Off**: with previous versions, enabling C73=1 (EN_STO_ONLY_SIG), minimum and maximum DC voltage limits were disabled with drive in run.
5. **Thermal protection**: with previous versions thermal probe signals from motor and drive were not filtered. With the new revision there is a 100ms filter on these signals.
6. **Autotuning test C41**: with previous versions could be some problems in this test with resolver or endat 2.0 sensors , if the motor had more than 6 poles.
7. **Can Open**: with previous versions the Emergency Message was not produced with alarm A06
8. **Preserved parameters by firmware change**: power soft start parameters and dead time are now preserved by firmware change.
9. **DC Main Supply voltage with STO**: with previous versions, using STO function and with DC Bus supply voltage could be some problems about power soft start. Now there is a connection C53 to set main supply AC or DC.
10. **Encoder and Hall sensors**: with previous versions, after encoder missing, was not possible to reset A9.1 alarm. Now is possible reset and re-start.

New functionality

1. **Speed Regulator Autosetting**: this feature now is available, known the starting time P169. With connection U02 ("SPD_REG_SETTING") is possible to choose, stable, dynamic, max or manual speed loop bandwidth. In manual mode is possible to choose the bandwidth with parameter P20 (SPD_LOOP_BW).

2. **Motor Autotuning** : reintroduced the measure of cubic term of dead time compensation (P153) during autotuning test C42=1. Parameters P152 and P153 removed.
3. **Sensor offset and gain compensation:** now during connection test C41, there is an automatic offset and gain compensation on sensor analog channels (Resolver and Sin/Cos encoder). It's possible to do the test without this compensation with C41=2. It's possible to execute manually the compensation with command U04 ("EN_SENSOR_TUNE"). During connection test the maximum current is now limited to the motor nominal value. Unlike previous versions, regardless of the number of motor poles, during the test a complete electric turn is come.
4. **Absolute Sin/Cos Management:** with connection C81=1 is possible to enable the new management: also the electrical angle is obtained from incremental channels, the absolute channels are used only at drive start-up to load incremental counter with absolute value. In this case is necessary Zero TOP for compensate spurious pulses counted.
    a. Now during connection test C41 is measured a 127 points array with real absolute incremental position according to position from absolute channels. The parameter P94 is the average angle between Zero Top and zero of absolute channels.
    b. With the usual command C63 is also saved this array. If a drive has enabled C81 function but the array isn't available, parameter P94 is used.
    c. If during autotuning test C41 Zero Top isn't detected, alarm A9.3 appears.
5. **Motor Thermal Probe management**: extended measurement range up to 2MΩ. Over 500KΩ thermal probe is considered not connected and alarm A5.4 appears. New connection C70 that multiplies x 10 the threshold P95 value. Changed the format of representation of the internal size d41, now in KOhm
6. **Speed limits**: now with standard application (0.23) is possible to change positive and negative speed limits with analog signals. The actual speed limits are showed in d57,d58, o40 and o67 .
7. **EtherCAT**: now is available the CanOpen over EterhCAT fieldbus, with Distributed clock management.
8. **Sensor slot swap**: with connection C19 (EN_SLOT_SWAP) it's possible to swap motor sensor and second sensor on slot 1 and 2.
9. **Frequency Output**: now up to 17 bits on the motor turn and maximum frequency 500KHz
10. **Incremental position loop**: now is possible to close the incremental position loop on second sensor (C90=1) with the gearbox compensation
11. **Torque control**: if the maximum speed limit in torque control is disabled (default), the speed regulator integral memory is forced to actual torque request, in order to execute a soft switch from torque to speed control. This means that in speed control the feed-forward torque reference has to be 0.
12. **Compatible with new multi-axes Real Time Graph:**
    d. Modbus rtu: enable broadcast management
    e. Nominal motor torque measured available in d30exp, nominal motor power available in d31 exp in Kwatt.
    f. Real Time Graph management: local or remote trigger control
13. **Stop in position (Standard application 0.23)**: if parameter P254 (DIS_STOP_POS) is set to 1 stop in position function is disabled when incremental position loop is enabled.

14. **Feed-forward Torque (Standard application 0.23)**: Added parameter P249 to enable the feedforward torque in speed control. In this way, with the default setting (P249=0), the feed-forward torque is disabled, to avoid unexpected behaviours.
15. **Dead band (Starndard application 0.23)**: added parameter P209 in order to set a dead band on the sum of analog inputs.

Less important modification

1. **Filtered speed** : now analog data 04 “filtered speed measured” is filtered with the same time constant and filter order like speed regulator filter. Internal value d21 “speed measured” is filtered with a first order filter with the same cut-off frequency of speed bandwidth.
2. **Incremental sensor alarm**: now if the user choose an incremental sensor (Encoder or SinCos Encoder) without enable IPP function (C78) for automatic start phase, alarm A9.4 appears.
3. **Utility commands**: some previous parameters (Quick start-up, Sensor tune, Speed test) are been replaced with utility commands changeable with keypad or OPDExplorer. In this way this commands are not stored in permanent memory.
4. **PLD version**: now is available in the internal value d47
5. **New output functions**: now are available 3 new output logic functions, **o23** STO Not dangerous failure, meaning that aren’t present alarms A3 or A11, **o24** Torque Control Activated and **o25** DC bus exceeds threshold (P79)
6. **Start time measure**: now speed regulator gains are temporary changed in order to reach the torque limit set.
7. **Extended parameters range**: minimum nominal speed is now 30rpm, maximum nominal voltage is 1000V, minimum DC Bus voltage 160V.
8. Parameter P126 changes from TDE reserved to reserved.
9. Power Board Firmware version (MiniOPDE) at Address 0xD0A0