



160 Series C Custom Firmware

S02 Option – FRN 7.06 C004

Introduction

The S02 option extends the kW/HP ratings of the standard 160 drive. In addition, the following function changes have been made. Refer to the appropriate page for details.

- High Speed Stall Prevention – [page 1](#)
- Accel/Decel Selection – [page 2](#)
- Smartspin Balance Detection (revised) – [page 3](#)
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- Five Point V/Hz Curve – [page 4](#)
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Important: FRN 7.06 C004 contains additional functionality and parameter changes over earlier firmware versions. These changes are indicated by shading in the tables. In addition, a summary of parameter changes is provided on [page 6](#)



ATTENTION: Use of this Custom Software without full understanding of the “Firmware Changes” (see below) could result in unpredictable motor operation and/or hazardous machine conditions.

Firmware Changes

High Speed Stall Prevention

The S02 option provides two current limits, compared to one in the standard drive. Each current limit has definite conditions. The High Speed Current Limit is used to keep the motor from stalling, while accelerating toward frequencies above P35 - [Base Frequency]. For frequencies between base frequency and 150% of base frequency, the current limit is linearly decreased from P43 - [Low Speed Current Limit] to P47 - [High Speed Current Limit]. See [Table A](#).

Table A
High Speed Stall Prevention Parameters

Parameter Number	Parameter Name	Min./Max./Default	Description
P43	Low Speed Current Limit	1/180/150 %	This limit is only in effect from zero to P35 [Base Frequency].
P47	High Speed Current Limit	1/180/150 %	This limit is only in effect above 150% of P35 [Base Frequency].

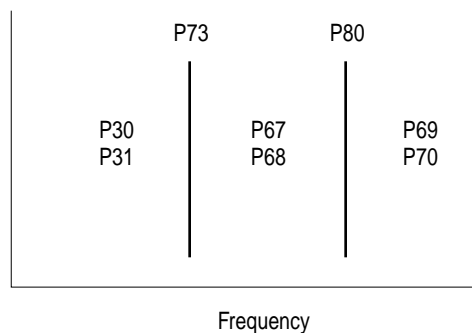
Accel/Decel Selection

In addition to the two standard accel/decel times, a third set of programmable accel/decel times has been added. None of these times will be associated with the Preset Frequency parameters in the standard drive. Instead, two other parameters will set the frequency points where the different accel/decel times will be in affect (refer to the [Table B](#)).

Table B
Accel/Decel Parameters

Parameter Number	Parameter Name	Min./Max./Default	Description
P30	Low Accel	0.0/600.0/10.0 Sec	Accel used when frequency is below first crossover point (P79).
P31	Low Decel	0.1/600.0/10.0 Sec	Decel used when frequency is below first crossover point (P79).
P67	Mid Accel	0.0/600.0/20.0 Sec	Accel used when frequency is between first & second crossover points (P79 & P80).
P68	Mid Decel	0.1/600.0/20.0 Sec	Decel used when frequency is between first & second crossover points (P79 & P80).
P69	High Accel	0.0/600.0/30.0 Sec	Accel used when frequency is above second crossover point (P80).
P70	High Decel	0.1/600.0/30.0 Sec	Decel used when frequency is above second crossover point (P80).
P73	Low to Mid Crossover	0/240/30 Hz	First frequency crossover point used to determine which accel/ decel rate will be used.
P80	Mid to High Crossover	0/240/60 Hz	Second frequency crossover point used to determine which accel/ decel rate will be used.

If P80 - [Mid to High Crossover] is less than P73 - [Low to Mid Crossover], then P80 will be ignored and P67 - [Mid Accel] & P68 - [Mid Decel] will be used for all frequencies above P73. If P73 is equal to zero, P30 - [Low Accel] & P31 - [Low Decel] will not be used. See the following diagram.



Smartspin Balance Detection

Smartspin balance detection uses the current phase angle information to determine if the load is within a programmable amount of variation. The algorithm requires four parameters which allow for individual machine set-up. In addition, a display parameter (P20 - [Smartspin Angle]) will be used to aid in the set-up of this feature.

Important: New control logic has been added to all 2 wire control schemes to support Smartspin. When the Balance Detection Complete bit of [Smartspin Status] is set, asserting both the Run Forward and Run Reverse inputs will initiate Smartspin (the Smartspin Active bit of [Smartspin Status] will be set).

At all other times, setting both Run Forward and Run Reverse simultaneously will result in the drive stopping. During Smartspin, [Smartspin Result] is used as the frequency reference.

Once the Smartspin Active bit of [Smartspin Status] is set, removing either Run Forward or Run Reverse will terminate Smartspin and cause the drive to stop.

Table C
Smartspin Balance Detect Parameters

Param. Number	Parameter Name	Min./Max./Default	Description
P38	Smartspin Level	0/255/0 Numeric Value	Sets the threshold of angle variation in the load. Below this limit the balance detect output becomes active.
P49	PWM Frequency	2.0/6.0/4.0	PWM frequency.
P62	Smartspin Status	0/255/0	Status word: Bit 0 – Balance Detection In Progress Bit 1 – Balance Detection Complete Bit 2 – Smartspin Active Bits 3 through 7 – Not Used
P63	Smartspin Time	0/255/0 Sec	Number of seconds before the output relay will indicate the results of the balance test.
P64	Smartspin Frequency	0/240/0 Hz	The target frequency at which the drive will perform the balance test. IMPORTANT: Once balance detection has started, [Smartspin Frequency] is used as the frequency reference. This minimizes drift problems associated with using an analog frequency reference. There is a 3 Hz hysteresis band around this frequency which will have to be exceeded in order to terminate balance detection.
P65	Smartspin Result	0/240/0 Hz	Frequency result determined by Smartspin.
P66	Smartspin Scale	0/999/221 Numeric Value	Scale factor used to configure Smartspin.
P41	Smartspin Volts	0/230/0 Volts	The voltage used when the commanded frequency equals [Smartspin Frequency], and the output frequency reaches the commanded frequency. IMPORTANT: If [Smartspin Volts] = zero, the output voltage will be determined by the selected volts/hz curve.
P20	Smartspin Angle	0/255/0 Numeric Value	Difference measured by the drive, and used to compare with P38 - [Smartspin Level].

Shading indicates recent firmware changes

Braking

The P34 - [Stop Mode Select] setting 3, “DC Injection Braking (w/Auto Shutoff)” function uses a new parameter for current limit during braking. This allows maximum braking performance.

Table D
Braking Parameters

Parameter Number	Parameter Name	Min./Max./Default	Description
P48	DC Injection Current Limit	1/180/150 %	This limit is only in effect during DC injection braking.

Five Point V/Hz Curve

V/Hz curves are programmed in the standard drive with P38 - [Boost Select]. This function has been replaced by a five point V/Hz curve. The curve can be adjusted using the parameters described in [Table E](#). The ramp will start at the programmed start frequency, but will ramp down to zero when stopping or reversing (if the start frequency is non-zero). The voltage will follow a straight line drawn from the start point to zero frequency and zero voltage.

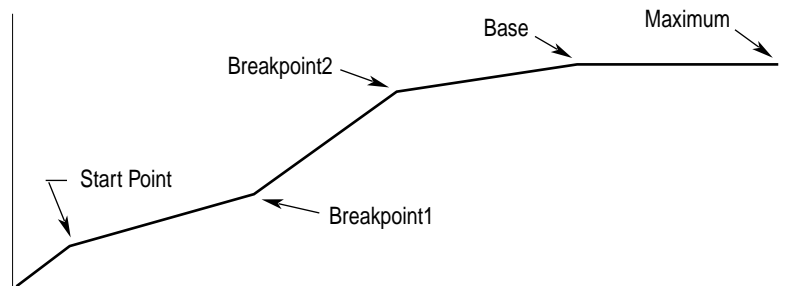


Table E
Five Point V/Hz Parameters

Parameter Number	Parameter Name	Min./Max./Default	Description
P81	Start Frequency	0/120/0 Hz	Determines the starting frequency for the drive to ramp up from.
P82	Start Volts	0/230/0 Volts	Sets the voltage for the start frequency.
P83	Breakpoint1 Frequency	0/240/10 Hz	Determines the frequency point used after the Start Frequency.
P84	Breakpoint1 Volts	0/115/42 Volts for 230V Rated Units 0/230/84 Volts for 460V Rated Units	Sets the voltage for the Breakpoint1 Frequency.
P85	Breakpoint2 Frequency	0/240/15 Hz	Determines the frequency point used after the Breakpoint1 Frequency.
P86	Breakpoint2 Volts	0/230/57 Volts for 230V Rated Units 0/460/115 Volts for 460V Rated Units	Sets the voltage for the Breakpoint2 Frequency.
P35	Base Frequency	10/240/60 Hz	Determines the frequency point used after the Breakpoint2 Frequency.
P36	Base Voltage	20/230/230 Volts for 230V Units 20/460/460 Volts for 460V Units	Sets the voltage for the Base Frequency.
P33	Maximum Frequency	0/240/60 Hz	This will determine the frequency point used after the Base Frequency.
P37	Maximum Voltage	20/255/230 Volts for 230V Units 20/510/460 Volts for 460V Units	This will set the voltage for the Max. Frequency.

In the event that the frequencies or voltages are programmed incorrectly, the following will occur:

If a breakpoint or start point frequency is programmed less than the previous frequency, the V/Hz trajectory will follow its normal course to the next breakpoint (up until the out of sequence breakpoint frequency). At that point it will jump to the voltage set for that breakpoint frequency and continue on a line to the next breakpoint frequency. If P33 - [Maximum Frequency] is set less than any other frequency, it will not affect the V/Hz curve. However, it will end at the maximum frequency regardless of other set points. If a setpoint voltage is set less than the previous one, the V/Hz profile will simply connect these two points. Thus, the voltage at one breakpoint can be less than that of a previous breakpoint.

Program Lock Password

The S02 option provides a program lock feature with a three digit integer (standard lock feature uses a single digit). All program group parameters will be locked unless the correct integer is entered in P57 - [Program Lock]. This parameter value will re-initialize to “000” or re-lock whenever power is cycled. The program unlock will also be required when using communication modules after the power is cycled.

Relay Output Contacts

Parameters P47 - [Output Configure] and P48 - [Output Threshold] are not used with the S02 option. Instead, the relay will function to indicate a balanced condition after the balance test has been completed and to indicate the braking mode until shut-off. A switching of the relay contacts from the de-energized state will indicate a balanced condition at the balance frequency or the braking mode.

Summary of Parameter Changes

The following parameter changes have been made to the standard 160 Analog Signal Follower Drive.

Parameter Number	Standard Analog Drive Parameter Name	What Changed?
20	New parameter	Smartspin Angle, see “Smartspin Balance Detection” on page 3
30	Accel Time 1	Changed to Low Accel, see “Accel/Decel Selection” on page 2
31	Decel Time 1	Changed to Low Decel, see “Accel/Decel Selection” on page 2
38	Boost Select	Changed to Smartspin Level, see “Smartspin Balance Detection” on page 3
41	Motor Overload Select	Changed to Balance Volts, see “Smartspin Balance Detection” on page 3
43	Current Limit	Changed to Low Speed Current Limit, see “High Speed Stall Prevention” on page 1
46	Input Mode	Min./Max./Default changed to 0/8/0
47	Output Configure	Changed to High Speed Current Limit, see “High Speed Stall Prevention” on page 1
48	Output Threshold	Changed to DC Injection Current Limit, see “Braking” on page 4
49	PWM Frequency	Min./Max./Default changed to 2.0/6.0/4.0
57	Program Lock	Min./Max./Default changed to 000/999/000 - see “Program Lock Password” on page 6
62	New parameter	Smartspin Status, see “Smartspin Balance Detection” on page 3
63	New parameter	Smartspin Time, see “Smartspin Balance Detection” on page 3
64	New parameter	Smartspin Freq, see “Smartspin Balance Detection” on page 3
65	New parameter	Smartspin Result, see “Smartspin Balance Detection” on page 3
66	New parameter	Smartspin Scale, see “Smartspin Balance Detection” on page 3
67	New parameter	Mid Accel - see “Accel/Decel Selection” on page 2
68	New parameter	Mid Decel - see “Accel/Decel Selection” on page 2
69	Accel Time 2	Changed to High Accel, see “Accel/Decel Selection” on page 2
70	Decel Time 2	Changed to High Decel, see “Accel/Decel Selection” on page 2
73	Reverse Disable	Changed to Low to Mid Crossover, see “Accel/Decel Selection” on page 2
80	Stall Fault Time	Changed to Mid to High Crossover, see “Accel/Decel Selection” on page 2
81	PI Proportional Gain	Changed to Start Frequency, see “Five Point V/Hz Curve” on page 4
82	PI Integral Gain	Changed to Start Volts, see “Five Point V/Hz Curve” on page 4
83	PI Process Reference	Changed to Breakpoint1 Frequency, see “Five Point V/Hz Curve” on page 4
84	PI Dead Band	Changed to Breakpoint1 Volts, see “Five Point V/Hz Curve” on page 4
85	New Parameter	Breakpoint2 Frequency, see “Five Point V/Hz Curve” on page 4
86	New Parameter	Breakpoint2 Volts, see “Five Point V/Hz Curve” on page 4
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Notes

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