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# Substitution Guideline

MC NEMA 1 → i510/i550 protec NEMA 1

As easy as that.



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### 1 Use of document

This document is a guideline for the replacement of MC NEMA 1 / IP31 inverter with i510/i550 protec NEMA 1 / IP31 inverter and can be used by Application Engineers, Sales and Project Management.

It shows the following:

- Suitability of i510/i550 protec IP31 instead of MC NEMA 1 / IP31 inverter
- Replacement engineering help



**NOTICE!** For detailed engineering, the technical documents have to be considered!



**NOTICE!** Comparison is based on i500 state as of HMI 2018.

### 2 Why should I change?

**The i550 protec is the new inverter series in the 0.5 to 15 hp (0.37 to 11 kW) power range. Its distinguishing features: a slim design, scalable functionality and exceptional user-friendliness.**

Going decentral is recommended most of all for large machines to save installation costs or where cabinet space is limited.

The i550 protec is designed for motor applications where dynamic speed and torque control is demanded, making the units ideal for many applications like conveyors, packaging equipment plus fan and pump systems.

Based on the established hardware and software of the i500 cabinet inverters — this means same drive functionality and user interaction.

#### Highlights

- Ingress protection of IP66 (NEMA 4X) with protection against high pressure water jets from any direction and dust tightness allows for use in harsh environment applications
- First decentral drive in the market with IO-Link Device Interface
- Sensorless synchronous motor control
- Intuitive user interface for fast setup and an easy navigation parameter structure
- EPM module for simple series commissioning and device replacement
- USB Micro diagnostic interface on board
- Optionally equipped with keypad or WLAN diagnostic module

## Replacement unit



### 3 Replacement unit

The following list shows an overview of the available product range:

MC NEMA1																
		1x120V			1x230V			3x230V			3x480V			3x600V		
hp	kW	MC model	i510	i550	MC model	i510	i550	MC model	i510	i550	MC model	i510	i550	MC model	i510	i550
0.33	0.25	Mx103SB	Y*	Y*												
0.50	0.37	Mx105SB	Y	Y	Mx205SB	Y	Y	Mx205B	Y	Y						
1.0	0.75	Mx110SB	Y	Y	Mx210SB	Y	Y	Mx210B	Y	Y	Mx410B	Y	Y	Mx510B	N	Y
1.5	1.1	Mx115SB	N	Y	Mx215SB	Y	Y	Mx215B	Y	Y						
2.0	1.5				Mx220SB	Y	Y	Mx220B	Y	Y	Mx420B	Y	Y	Mx520B	N	Y
3.0	2.2				Mx230SB	Y	Y	Mx230B	Y	Y	Mx430B	Y	Y	Mx530B	N	Y
5.0	4.0							Mx250B	Y	Y	Mx450B	Y	Y	Mx551B	N	Y
7.5	5.5							Mx275B	N	Y	Mx475B	Y	Y	Mx575B	N	Y
10.0	7.5							Mx2100B	N	Y	Mx4100B	Y	Y	Mx5100B	N	Y
15.0	11.0							Mx2150B	N	Y	Mx4150B	Y	Y	Mx5150B	N	Y
20.0	15.0							Mx2200B	N	Y	Mx4200B	N	Y	Mx5200B	N	Y
25.0	18.5							Mx2250B	N	Y	Mx4250B	N	Y	Mx5250B	N	Y
30.0	22.0							Mx2300B	N	N	Mx4300B	N	Y	Mx5300B	N	Y
40.0	30.0							Mx2400B	N	N	Mx4400B	N	S	Mx5400B	N	N
50.0	37.0										Mx4500B	N	S	Mx5500B	N	N
60.0	45.0							Mx2600B	N	N	Mx4600B	N	S	Mx5600B	N	N
75.0	55.0										Mx4750B	N	S			
100.0	75.0										Mx41000B	N	S			
125.0	90.0										Mx41250B	N	N			
150.0	110.0										Mx41500B	N	N			

Notes:

x=1 (MC1000) or 3 (MC3000)

\*Note substitution uses higher power rating

S - Substitute with i550 protec IP54 rated drive

### MC to i5x0 protec cross substitution part numbers

NEMA 1			
Input Line Voltage		120V or 240V (1Ø)	
hp	kW	MC Series	i5x0 protec (120V ONLY)
1.5	1.1	M1115SB	I55AP211A00301K03S
1.5	1.1	M3115SB	



## 4 Mechanical installation

### 4.1 General fit

Mechanical	MC NEMA 1	i510 NEMA 1	i550 NEMA 1
Enclosure protection class	NEMA 4,4X,12	IP55, IP54 (equivalent to NEMA 4X and NEMA 12)	
Built-in heatsink	Yes	Yes	
Cold plate	No	C-type possible	
Push trough	No	C-type possible	
Zero-clearance side-by-side mounting	No	Yes	

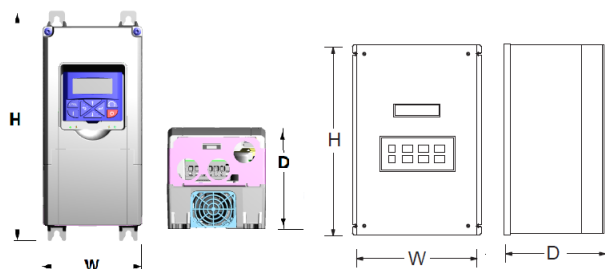
#### Notes:

1. Size: The i510/i550 protec is similar in size to the MC. See dimensional comparison on next page:

## Mechanical installation



			i550 IP31 protec			i510 IP31 protec			MC IP31 Dimensions		
V	kW	Internal EMC Filter	H	W	D	H	W	D	H	W	D
120 V 1-p	0.37	no	190	140	117	200	100	110	190.5	155.4	92.2
120 V 1-p	0.75	no	205	140	140	200	100	110	190.5	155.4	107.2
120 V 1-p	1.1	no	205	140	140				190.5	155.4	107.2
230 V 1-p	0.37	yes							190.5	119.4	92.2
230 V 1-p	0.55	yes									
230 V 1-p	0.75	yes							190.5	119.4	110.0
230 V 1-p	1.1	yes							190.5	155.4	107.2
230 V 1-p	1.5	yes							190.5	155.4	130.0
230 V 1-p	2.2	yes							190.5	155.4	130.0
230V 1/3-p	0.37	no	190	140	117	200	100	110	190.5	119.4	92.2
230V 1/3-p	0.55	no									
230V 1/3-p	0.75	no	190	140	117	200	100	110	190.5	119.4	110.0
230V 1/3-p	1.1	no	205	140	140	200	100	110	190.5	119.4	110.0
230V 1/3-p	1.5	no	205	140	140	200	100	110	190.5	155.4	130.0
230V 1/3-p	2.2	no	205	140	140	200	100	110	190.5	155.4	130.0
230V 3-p	3	no	250	180	170	230	100	110			
230V 3-p	4	no	250	180	170	230	100	110	200.2	199.6	150.9
230V 3-p	5.5	no	250	180	170				238.3	199.6	173.7
230V 3-p	7.5	no	290	180	170				285.8	199.6	173.7
230V 3-p	11	no	290	180	170				329.9	199.6	173.7
230V 3-p	15	no	405	220	184				329.9	260.6	196.6
230V 3-p	18.5	no	405	220	184				400.1	260.6	212.1
400/480 V 3-p	0.75	yes (i510 no)	190	140	117	200	100	110	190.5	119.4	92.2
400/480 V 3-p	1.1	yes (i510 no)	205	140	140	200	100	110			
400/480 V 3-p	1.5	yes (i510 no)	205	140	140	200	100	110	190.5	155.4	107.2
400/480 V 3-p	2.2	yes (i510 no)	205	140	140	200	100	110	190.5	155.4	130.0
400/480 V 3-p	3	yes (i510 no)	250	180	170	230	100	110			
400/480 V 3-p	4	yes (i510 no)	250	180	170	230	100	110	190.5	155.4	130.0
400/480 V 3-p	5.5	yes (i510 no)	250	180	170	230	100	110	238.3	199.6	158.8
400/480 V 3-p	7.5	yes (i510 no)	290	180	170	280	130	160	238.3	199.6	173.7
400/480 V 3-p	11	yes (i510 no)	290	180	170	280	130	160	285.8	199.6	173.7
400/480 V 3-p	15	yes	405	220	184				323.9	199.6	173.7
400/480 V 3-p	18.5	yes	405	220	184				323.9	260.6	196.6
400/480 V 3-p	22	yes	405	220	184				323.9	260.6	196.6
400/480 V 3-p	30	yes							400.1	260.6	212.1
400/480 V 3-p	37.5	yes							501.7	260.6	217.2
400/480 V 3-p	45	yes							501.7	260.6	217.2
400/480 V 3-p	55	yes							736.6	422.7	301.0
400/480 V 3-p	75	yes							736.6	620.3	301.0
400/480 V 3-p	90	yes							736.6	620.3	301.0
400/480 V 3-p	110	yes							736.6	931.2	301.0





### 4.2 Engineering

1. Mounting:  
MC has different mounting hole locations than i510/i550 protec. New mounting holes will need to be drilled.
2. Zero clearance:  
i510/i550 protec can be mounted side-by-side with zero clearance without derating. This was not possible with MC.

## 5 Main electrical installation

### 5.1 General fit

Electrical	MC	i510	i550
Supported network	TT, TN	TT, TN (IT only as C-type)	
Integrated dynamic brake transistor	Option	-	Yes
DC Interconnection 400/480V-3ph:	-	-	Yes

### 5.2 Engineering

1. Unlike i500 cabinet drives, i500 protec drives have integrated mains chokes on power sizes where required.
2. Connector position:  
Both the MC and i510/i550 protec have all connections at the bottom of the inverter; however Mains and Motor connections are reversed. On MC-Mains is on the Right. On i510/i550 protec - Mains is on the left.  
This is to be more intuitive for customers where we have seen a tendency for customers to miss-wire.



## 6 Control

### 6.1 General fit

Device I/O	MC	i510 protec	i550 protec
		Basic I/O	Standard I/O
Digital inputs	4 + 1 Start + 1 Stop	5	
Digital outputs	2 (NPN, sinking)	1	
Relay output	1 (NO/NC)	1 (NO/NC)	
Analog inputs	1 (V or I)		2 (Bipolar V/I)
Analog outputs	2 (V) Not configurable	1 (V/I)	
Frequency output	-	Yes	
Logic	NPN	PNP or NPN	
Encoder feedback	-	-	DI3 / DI4 up to 100kHz
Frequency input (Pulse train input)	-	-	DI3 / DI4
Internal 24V supply; 100mA	-	Yes	
Input for external (keep alive)	-	Yes	
Available with fieldbus	Modbus-RTU only	CanOpen/Modbus Variant	Yes

Device I/O	MC	i510 protec	i550 protec
Safe Torque Off STO	-	-	Optional
Integrated brake transistor	option	-	Yes (all sizes)
Brake with external chopper	-	-	(Not needed)
Dedicated PTC input	-	-	Yes

Control connectors	MC	i510 protec	i550 protec
AIO, DIO terminals	Fixed, Screw	Fixed, Spring	
Relay terminals	Fixed, Screw	Fixed, Spring	
STO terminals	-	-	Pluggable, Spring
PTC input	-	-	Fixed, Spring

### 6.2 Engineering notes

#### 1. Stop Terminal:

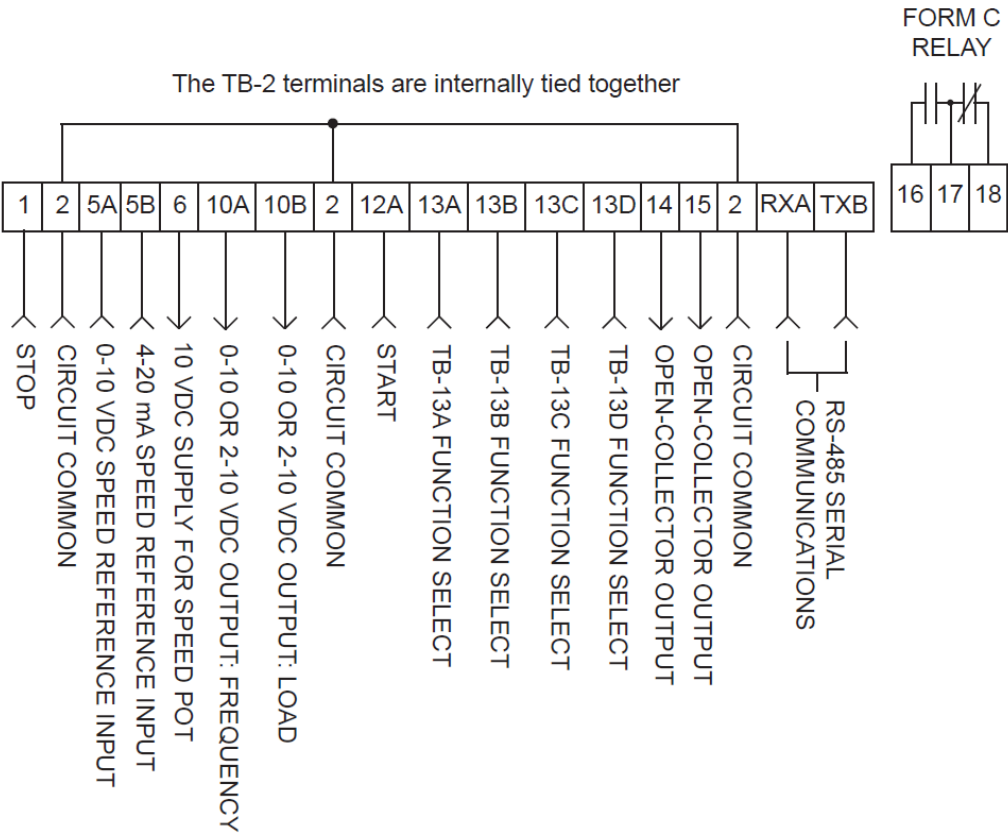
The Stop function (terminal # 1) and the Start function (terminal #12A) are dedicated digital inputs on MC. On i510/i550 every IO-function can be freely assigned in Parameter 400 (P400). The function Stop is assigned in P400:02. The Run function has several options for configuring (See P400:02 and P400:06-09).



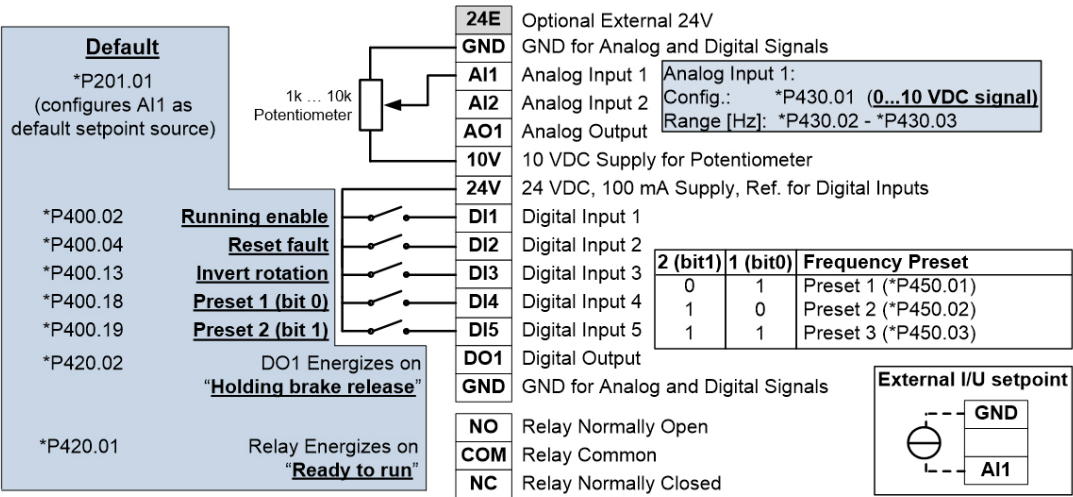


2. Control terminals Standard I/O:

MC:



i500:





## I/O Point Comparison:

MC	Function	i500	Note:
1	DI - Dedicated Stop	DI1	P400.1: TRUE [1], P400.2: Digital Input 1 [11]
2	Circuit Common (Analog and Digital Common)	GND	Analog and Digital Common
5A	Analog input (Setpoint) 0...10 VDC	AI1	P430:1 (0...10 VDC; 4...20 mA Configurable)
5B	Analog input (Setpoint) 4...20 mA		
6	10VDC supply for speed pot	10V	10VDC supply for speed pot
10A	Analog Output: Frequency (0-10VDC or 2-10VDC)	AO1	Analog output Configurable P440:1, P440:2
10B	Analog Output: Load (0-10VDC or 2-10VDC)	-	AO2 only available on i550 Applciation I/O
13A	DI – P47 (default not configured)	DI2	P400:004 (default config. – Reset Fault)
13B	DI – P48 (default not configured)	DI3	P400:013 (default config. – Invert rotation)
13C	DI – P49 (default not configured)	DI4	P400:018 (default config. – Preset Setpoint bit 0)
13D	DI – P50 (default not configured)	DI5	P400:019 (default config. – Preset Setpoint bit 1)
14	DO (Sinking) P52 (default not configured)	DO1	PNP +24 VDC, , P420.2 (default – Release Brake)
15	DO (Sinking) P53 (default not configured)	-	DO2 only available on i550 Applciation I/O
TXA	Modbus TXB	CH/TB	Modbus Variant Required
TXB	Modbus TXA	CL/TA	Modbus Variant Required
-	-	24V	+24 VDC, 100 mA
16	Relay NO P54 (default not configured)	NO	Form C relay (NO, NO, COM) P420.1: Fault [56]
17	Relay COM	NC	
18	Relay NC NO P54 (default not configured)	COM	

## Important notes:

- The Digital Outputs on MC (terminals 14 and 15) are Open Collector / Sinking type output. The i550 Digital Outputs are PNP / Sourcing +24 VDC.
- i550 uses 24V as reference for DI when active high or GND as reference when active low.



## 7 Communication

### 7.1 General fit

Communication (option)	MC	i510 protec	i550 protec
CANopen	-	Yes	
PROFIBUS	-	-	Yes
ETHERNET Powerlink	-	-	Yes
Modbus	Standard	Yes	
EtherCat	-	-	Yes
ProfiNet	-	-	Yes
Ethernet IP	-	-	Yes
Connector Type	Fixed, Screw	Fixed, Spring	Yes
Combination Fieldbus & Keypad possible?	Yes	Yes	Fixed, Spring (Modbus/CANopen, Profibus) Dual RJ-45 (all EtherNET busses)
Fieldbus combination with I/O possible?	Yes	Basic I/O	Yes

### 7.2 Engineering

- Control words and register addresses:  
The fieldbus control words and the register addresses have changed. Refer to the communication manual for detailed information.
- Modbus:  
i510 protec: CANopen and Modbus combined in one type code (Selection by DIP switch).  
i550 protec: Modbus and CANopen are dedicated type codes.



## 8 Functionality

### 8.1 General fit

Motor	MC	i510	i550
Asynchronous induction motor control	Yes	Yes	
Synchronous motor control	-	Yes	
Max Output frequency	590 Hz (**NOTE HISTORICALLY COULD BE UNLOCKED UP TO 650Hz**)	599 Hz (>599Hz --> C-Type)	

Motor control	MC	i510	i550
VFCplus: V/f linear	Yes	Yes	
VFCplus: V/f squared	Yes	Yes	
VFCplus: V/f linear closed loop with encoder	-	-	Yes
VFCplus: V/f squared closed loop with encoder	-	-	Yes
VFCplus: V/f user definable V/f characteristic	-	Yes	
VFCplus Eco (Energy saving feature)	-	Yes	
Voltadd control (Additive voltage impression)	-	Yes	
SLVC: Sensorless vector control ASM	-	Yes – Speed & Torque	
SLPSM: Sensorless vector control PSM	-	Yes	
SC: Servo Control for synchr. motors (SM)	-	-	
SC: Servo Control for asynchr. motors (ASM)	-	-	Yes

Functions	MC	i510	i550
Process controller (PID)	Yes	Yes	
Motor potentiometer	Yes	Yes	
Fixed setpoints for speed / accel / decel	4 / 1 / 1	15 / 2 / 2	
Slip compensation	Yes	Yes	
Skip frequency	2 frequency ranges	3 frequency ranges	
Motor brake (holding brake) control	-	Yes	
Speed control with torque limitation	-	Yes	
Flying start	Yes	Yes	
Parameter change over	-	4x32 parameter	
Sequencer	-	Yes (flat, but also nested sequences possible)	
Automatic Start	Yes	Yes	
DC brake	Yes (0 Hz, auto only)	Yes (programmable Hz trigger auto and manual trigger)	
AC motor brake	-	Yes	
Controlled deceleration during undervoltage	-	Yes	
Frequency (Pulse-Train) setpoint	-	-	Yes
Support of user units	Hz Multiplier, PID Units	Hz Multiplier, PID Units	
Switch Off Positioning	-	Yes	



## 9 Operation / Commissioning

### 9.1 General fit

Operation	MC	i510	i550
Program without mains power?	-	Yes (USB, memory module, +24 VDC [i550])	
Keypad	Integrated	Optional	
Descriptive text on keypad	Yes	Yes	
PC tool	TechLink	EasyStarter, Smart Keypad	
Interface	LCD Text Keypad	LCD Text Keypad, USB-Module, WLAN-Module <b>*(i550 protec has USB integrated)</b>	
Removable memory module	No	Yes	

### 9.2 Engineering

1. New parameter numbers:  
The parameters for the i500 have been arranged for better usability. Due to this, the parameter numbers are not equal and can't be copied 1:1.
2. Common parameters:  
Parameter numbers have changed. The following list shows the most common used parameters:

MC NEMA 1 / IP31		i550		
Param. #	Param. Name	Param. #	Param. Name	Param. Group
P30	CONTROL	P200:00	Control Selection	Group 2: Basic Settings
P29	MANUAL	P201:01	Frequency Setpoint Source	
P10	MIN FRQ	P210:00	Minimum motor frequency	
P11	MAX FRQ	P211:00	Maximum motor frequency	
P8	ACCEL	P220:00	Acceleration time 1	
P9	DECEL	P221:00	Deceleration time 1	
P0	LINE VOLTS	P208:01	Rated Mains Voltage	Group 3: Motor Control
P18	BASE	P303.02	V/f Base Frequency	
P19	FX BOOST	P316.01	Fixed voltage boost	Group 4: Function & I/O Settings
P47	TB13A	P400.02	Run / Stop	
P48	TB13B	P400.04	Reset Fault	
P49	TB13C	P400.13	Invert Rotation Direction	
P1	SPEED #1	P450.01	Preset frequency setpoint 1	
P2	SPEED #2	P450.02	Preset frequency setpoint 2	
P3	SPEED #3	P450.03	Preset frequency setpoint 3	
P54	RELAY	P420.01	Relay function	
P42	TB14 OUT	P420.02	DO1 function	
		<b>Favorites</b>		

- Please note that the most commonly used MC parameters can be found in the preconfigured Favorites Menu (Group 0) of i500.
- In addition – the Favorites Menu contents in i500 can be customized by the OEM / machine builder.
- Please note in MC changes to parameters were automatically saved. In i500 the user must execute a SAVE command to have changes be written to the EPM. A SAVE command can be executed either via the SAVE icon in EasyStarter or by pressing and holding the drive's enter key on the keypad for three seconds. This is also true for keypad speed setpoint.

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