



# **iC2-Micro Frequency Converters**

### 1 Introduction

This operating guide provides necessary information for qualified personnel to install and commission the AC drive. Read and follow the instructions to use the drive safely and professionally.



Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with local and currently valid legislation.

## 2 Safety

Pay particular attention to the safety instructions and general warnings to avoid the risk of death, serious injury, and equipment or property damage.

## A WARNING A

#### HIGH VOLTAGE

AC drives contain high voltage when connected to AC mains input, DC supply, or load sharing

### LININTENDED START

The motor may start from control panel, I/O inputs, fieldbus, or MyDrive® Insight at any time, when the drive is connected to the AC mains, DC supply, or load sharing.

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off

- Stop the motor, disconnect AC mains and permanent magnet type motors, and remove DC-link supplies, including battery backups, UPS, and DC-link connections to other drives

Wait for the capacitors to discharge fully and measure it before performing any service or repair work.

The minimum waiting time is 4 minutes for MA01c, MA02c, MA01a, MA02a, and MA03a drives, and 15 minutes for MA04a and MA05a drives.

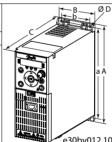
#### LEAKAGE CURRENT

Leakage currents of the drive exceed 3.5 mA. Make sure that the minimum size of the ground conductor complies with the local safety regulations for high touch current equipment.

## 3 Installation

#### 3.1 Mechanical Dimensions

Enclosure size	Height [mm (in)]					Mounting holes [mm (in)]		
3120	Α	<b>A</b> <sup>(1)</sup>	a	В	b	С	D	_
MA01c	150 (5.9)	216 (8.5)	140.4 (5.5)	70 (2.8)	55 (2.2)	143 (5.6)	4.5 (0.18)	4
MA02c	176 (6.9)	232.2 (9.1)	150.5 (5.9)	75 (3.0)	59 (2.3)	157 (6.2)	4.5 (0.18)	
MA01a	150 (5.9)	202.5 (8.0)	140.4 (5.5)	70 (2.8)	55 (2.2)	158 (6.2)	4.5 (0.18)	Ŀ
MA02a	186 (7.3)	240 (9.4)	176.4 (6.9)	75 (3.0)	59 (2.3)	175 (6.9)	4.5 (0.18)	
MA03a	238.5 (9.4)	291 (11.5)	226 (8.9)	90 (3.5)	69 (2.7)	200 (7.9)	5.5 (0.22)	
MA04a	292 (11.5)	365.5 (14.4)	272.4 (10.7)	125 (4.9)	97 (3.8)	244.5 (9.6)	7.0 (0.28)	
MA05a	335 (13.2)	396.5 (15.6)	315 (12.4)	165 (6.5)	140 (5.5)	248 (9.8)	7.0 (0.28)	4



Note: (1) Including decoupling plate.

(2) The potentiometer on the local control panel extends 6.5 mm (0.26 in) from the drive.

## 3.2 Mounting Clearance

### **Table 1: Minimum Mounting Clearance**

Enclosure size	Minimum mounting clearance [maximum temperature 50 °C (122 °F)]
All enclosure sizes	Above and below: 100 mm (3.9 in).
MA01a–MA05a, MA02c	Sides: 0 mm (0 in).
MA01c (natural cooling)	Sides: 0 mm (0 in) for 40 °C (104 °F), 10 mm (0.39 in) and above for 50 °C (122 °F).

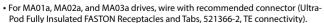
## 3.3 Connecting to Mains and Motor

- Mount the ground wires to the PE terminal.
- Connect motor to terminals U, V, and W.
- Mount mains supply to terminals L1/L, L2, and L3/N (3-phase) or L1/L and L3/N (single-phase) and tighten.
- For required maximum screwing torque, see the back of the terminal cover.

## 3.4 Load Sharing/Brake

#### Table 2: Connect Terminals

Table 21 Connect 1 Connects					
Load sharing	-UDC and +UDC/+BR				
Brake	-BR and +UDC/+BR				



- For other enclosure sizes, mount the wires to the related terminal and tighten. For required maximum screwing torque, see the back of the terminal cover.
- For more details, contact Danfoss or refer to the drive's design guide.

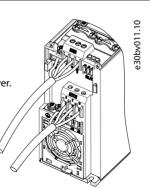


Illustration 1: Mounting of Ground Cable, Mains, and Motor Wires

## NOTICE

Voltage levels of up to 850 V DC may occur between terminals +UDC/+BR and -UDC. Not short-circuit protected.

#### 3.5 Control Terminals

- All control cable terminals are located underneath the terminal cover in front of the drive.
- See the back of the terminal cover for outlines of control terminals and switches

Remove the terminal cover with a screwdriver, see illustration 2

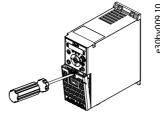


Illustration 2: Removing Terminal Cover

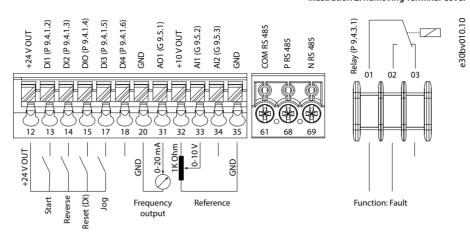


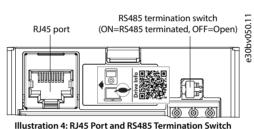
Illustration 3: Overview of Control Terminals in PNP-configuration with Factory Setting (Speed Control Mode)

## 3.6 RJ45 Port and RS485 Termination Switch

The drive has an RJ45 port which complies with Modbus 485 protocol.

The RJ45 port is used for connecting:

- External control panel (Control Panel 2.0 OP2).
- PC tool (MyDrive® Insight) via an adapter option.



# NOTICE

- The RJ45 port supports up to 3 m (9.8 ft) of shielded CAT5e cable which is NOT used to directly connect the drive to a PC Failure to follow this notice causes damage to the PC.
- If the drive is at the end of the fieldbus, set the RS485 termination switch to ON.
- Do not operate RS485 termination switch when the drive is powered on.

## 4 Programming

## 4.1 Control Panel

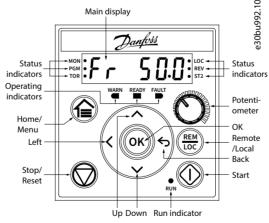


Illustration 5: Indicators and Operation Keys

## Table 3: Operation Keys and Potentiometer

Home/Menu	(1) Toggles between status display and main menu. (2) Long press to access the shortcut menu for quickly reading and editing parameters.
Up/Down	Switches status/parameter group/parameter numbers and tunes the parameter values.
Left	Moves the cursor 1 bit to the left.
Back	Navigates to the previous step in the menu structure or cancels the setting during tuning parameter values.
OK	Confirms the operation.
Remote/Local	Toggles between remote and local mode.
Start	Starts the drive in local mode.
Stop/Reset	Stops the drive in local mode, or resets the drive to clear a fault.
Potenti- ometer	Changes the reference value when the reference value is selected as potentiometer.

**Table 4: Status and Operating Indicator Lights** 

#### Name **Function** MON On Shows the drive status. The drive is in reverse direction. On REV The drive is in forward direction. PGM The drive is in programming status. Off On The drive is in torque mode. Refer to Table 6 Multiple Setups Indicator Lights. On ST2 TOR Off The drive is in speed mode. WARN Steadily lit when a warning occurs. Steadily lit when the drive is ready. The drive is in local mode LOC The drive is in remote mode. Flashes when a fault occurs

4.2 Operation with Control Panel

Table 5: Run Indicator Lights

RUN

Function

In the motor-stopping process; or

Flash the drive received a RUN command,

On The drive is in normal operation

Off The drive has stopped.

After the drive is powered up, press the Home/Menu key to toggle between status display and main menu. Use the Up/Down keys to select items, and press the OK key to confirm selection.

ST2

Active setup(1)

Programming setup<sup>(2)</sup> Setup 1

**Table 6: Multiple Setups Indicator Lights** 

(1) Select active setup in parameter P6.6.1 Active Setup.

Off

Setup 1

(2) Select programming setup in parameter P6.6.2 Programming Setup.

On

Setup 2

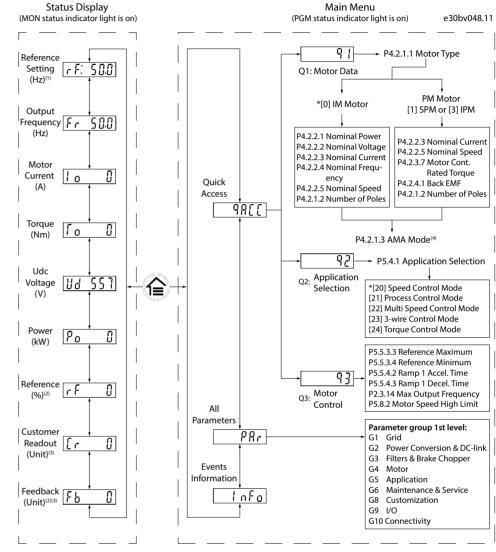
Flash Guickly

Setup 2

Setup 1

Setup 1

Setup 2 | Setup 2



Note: (1) Local mode only. (2) Remote mode only. (3) The status is only shown when the corresponding function is enabled. (4) For AMA execution, refer to chapter Automatic Motor Adaptation (AMA). If parameter P5.4.3 Motor Control Principle is set as [0] U/f, no need to execute AMA.

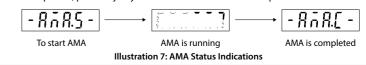
## Illustration 6: Operation with Control Pane

## 4.3 Automatic Motor Adaptation (AMA)

- Via running AMA in VVC+ mode, the drive builds a mathematical model of the motor to optimize compatibility between drive and motor, and thus enhances the motor control performance.
- Some motors may be unable to run the complete version of the test. In that case, select [2] Enable Reduced AMA in parameter P4.2.1.3 AMA Mode.
- AMA completes within 5 minutes. For best results, run the following procedure on a cold motor.

### Procedure:

- 1. Set motor data according to the motor nameplate.
- 2. If needed, set motor cable length in parameter P4.2.1.4 Motor Cable Length.
- 3. Set [1] Enable Complete AMA or [2] Enable Reduced AMA for parameter P4.2.1.3 AMA Mode, the main display shows To start AMA, see illustration 7.
- 4. Press the Start key, the test runs automatically and the main display indicates when it is completed.
- 5. When AMA is completed, press any key to exit and return to normal operation mode.



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## **5 Troubleshooting**

Number	Description	Warning	Fault	Trip lock	Cause
				iock	Signal on terminal 33 or 34 is less than 50% of the value set in <i>par</i>
2	Live Zero Error	х	х	-	ameter P9.5.2.3 T33 Low Voltage, parameter P9.5.2.5 T33 Low Curren parameter P9.5.3.3 T34 Low Voltage, and parameter P9.5.3.5 T34 Lov Current.
3	No Motor	Х	Х	-	No motor has been connected to the output of the drive.
4	Mains Phase Loss(1)	Х	Х	Х	Missing phase on the supply side, or the voltage imbalance is too high. Check the supply voltage.
7	DC Over Voltage <sup>(1)</sup>	Х	Х	-	DC-link voltage exceeds the limit.
8	DC Under Voltage <sup>(1)</sup>	Х	Х	-	DC-link voltage drops below the voltage warning low limit.
9	Inverter Overloaded	Х	Х	-	More than 100% load for too long.
10	Motor ETR Overtemperature	Х	Х	-	Motor is too hot due to more than 100% load for too long.
11	Motor Thermistor Overtemperature	Х	Х	-	Thermistor or thermistor connection is disconnected, or the moto is too hot.
12	Torque Limit	х	Х	-	Torque exceeds the value set in either parameter P5.10.1 Motor Torque Limit or parameter P5.10.2 Regenerative Torque Limit.
13	Over Current	x	х	Х	Inverter peak current limit is exceeded. If this fault occurs on power-up, check whether power cables are mistakenly connected to the motor terminals.
14	Earth fault	Х	Х	Х	Discharge from output phases to ground.
16	Short Circuit	-	Х	Х	Short circuit in motor or on motor terminals.
17	Control Word Timeout	Х	Х	-	No communication to the drive.
18	Start Failed	_	Х	-	May be caused by a blocked motor.
25	Brake Resistor Short	-	х	Х	Brake resistor is short-circuited, thus the brake function is disconnected.
26	Brake Overload	Х	Х	-	The power transmitted to the brake resistor over the last 120 s exceeds the limit. Possible corrections: Decrease brake energy via lower speed or longer ramp time.
27	Brake IGBT/Brake chopper Short Circuited	-	х	Х	Brake transistor is short-circuited, thus brake function is disconnected.
28	Brake Check	-	Х	Х	Brake resistor is not connected/working.
30	U phase loss	-	Х	Х	Motor phase U is missing. Check the phase.
31	V phase loss		Х	Х	Motor phase V is missing. Check the phase.
32	W phase loss	-	Х	Х	Motor phase W is missing. Check the phase.
36	Mains Failure	х	х	-	This warning/fault is only active if the supply voltage to the drive i less than the value set in parameter P2.3.7 Power Loss Controller Limit, and parameter P2.3.6 Power Loss Action is NOT set to [0] No Function.
38	Internal Fault	-	Х	Х	Contact the local supplier.
40	Overload T15	Х	-	-	Check the load connected to terminal 15 or remove short-circuit connection.
46	Gate drive Voltage Fault	-	X	X	-
47 50	24 V Supply Low AMA calibration failed	X	X	X	24 V DC may be overloaded.  A calibration error has occurred.
51	AMA check U <sub>nom</sub> and I <sub>nom</sub>	_	X		Wrong setting for motor voltage and/or motor current.
52	AMA low I	_	X	_	Motor current is too low. Check the settings.
53	AMA big motor	_	X	_	The power size of the motor is too large for the AMA to operate.
54	AMA small motor	_	X	_	The power size of the motor is too small for the AMA to operate.
55	AMA parameter range	-	Х	-	The parameter values of the motor are outside of the acceptable range. AMA does not run.
56	AMA interrupt	-	Х	-	The AMA is interrupted.
57	AMA timeout	-	Х	-	-
58	AMA internal		Х	-	Contact the local supplier.
59	Current Limit	Х	Х	-	The drive is overloaded.
60	External Interlock	-	Х	-	External interlock has been activated.
61	Feedback Error	X	X		Actual motor current has not exceeded release brake current
63	Mechanical Brake Low		X		within start delay time window.  The cutout temperature of the power card has exceeded the upper
69 80	Power Card Temp  Drive Initialized	X	X	X _	limit.  All parameter settings are initialized to default settings.
					Occurs in IT mains when the drive coasts, and the DC voltage is
87	Auto DC brake	Х	-	-	higher than 830 V for 400 V units and 425 V for 200 V units. The motor consumes energy on the DC link. This function can be enabled/disabled in <i>parameter P2.3.13 Auto DC Braking</i> .
95	Lost load detected	X	Х	-	-
99	Locked Rotor	-	Х	-	Rotor is blocked.
126	Motor Rotating	-	Х	-	PM motor is rotating when AMA is performed.
127	Back EMF too High	Х	-	-	The back EMF of PM motor is too high before starting.
Err. 89	Parameter read only	-	-	-	Parameters cannot be changed.
Err. 95	Not while running	-	-	-	Parameters can only be changed when the motor is stopped.
	A wrong password				Occurs when using a wrong password for changing a password-
Err. 96	was entered	_	- 1	_	protected parameter.

## **6 Specifications**

Table 8: Mains Supply 1x100-120 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A4	04A8		
Typical shaft output [kW (hp)]	0.37 (0.5)	1.1 (1.5)		
Enclosure size	MA01c	MA02c		
Output current				
Continuous (3x200–240 V) [A]	2.4	4.8		
Intermittent (3x200–240 V) [A]	3.6	7.2		
Maximum cable size (Mains, motor) [mm²/AWG]	4/	10		
Maximum input current				
Continuous (1x100–120 V) [A]	11.6	25.6		
Intermittent (1x100–120 V) [A]	17.4 38.4			
EMC filter type	C4			

## Table 9: Mains Supply 1x200-240 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A2	04A2	06A8	09A6	
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)	
Enclosure size	MA01c	MA01c	MA02c	MA02a	
Output current					
Continuous (3x200–240 V) [A] 2.2		4.2	6.8	9.6	
Intermittent (3x200–240 V) [A]	3.3	6.3	10.2	14.4	
Maximum cable size (Mains, motor) [mm <sup>2</sup> /AWG]	4/10				
Maximum input current					
Continuous (1x200-240 V) [A]	6.1	11.6	18.7	26.4	
Intermittent (1x200–240 V) [A]	8.3	15.6	26.4	37	
EMC filter type	C1/C4				

## Table 10: Mains Supply 3x200-240 V AC (Normal overload 150% for 1 minute)

Frequency converter	02A4	04A2	07A8	11A0	15A2		
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)	3.7 (5.0)		
Enclosure size	MA01a	MA01a	MA02a	MA03a	MA03a		
Output current							
Continuous (3x200-240 V) [A]	2.4	4.2	7.8	11	15.2		
Intermittent (3x200-240 V) [A]	3.6	6.3	11.7	16.5	22.8		
Maximum cable size (Mains, motor) [mm²/AWG]	4/10						
Maximum input current							
Continuous (3x200-240 V) [A]	3.8	6.7	12.5	17.7	24.3		
Intermittent (3x200–240 V) [A]	5.7	8.3	8.3 18.8		35.3		
EMC filter type		C4					

## Table 11: Mains Supply 3x380–480 V AC (Normal overload 150% for 1 minute)

Frequency converter	01A2	02A2	03A7	05A3	07A2	09A0	
Typical shaft output [kW (hp)]	0.37 (0.5)	0.75 (1.0)	1.5 (2.0)	2.2 (3.0)	3.0 (4.0)	4.0 (5.5)	
Enclosure size	MA01a	MA01a	MA01a	MA02a	MA02a	MA02a	
Output current							
Continuous (3x380-440 V) [A]	1.2	2.2	3.7	5.3	7.2	9.0	
Intermittent (3x380-440 V) [A]	1.8	3.3	5.6	8.0	10.8	13.7	
Continuous (3x440–480 V) [A]	1.1	2.1	3.4	4.8	6.3	8.2	
Intermittent (3x440-480 V) [A]	1.7	3.2	5.1	7.2	9.5	12.3	
Maximum cable size (Mains, motor) [mm²/AWG]	4/10						
Maximum input current							
Continuous (3x380–440 V) [A]	1.9	3.5	5.9	8.5	11.5	14.4	
Intermittent (3x380-440 V) [A]	2.6	4.7	8.7	12.6	16.8	20.2	
Continuous (3x440–480 V) [A]	1.7	3.0	5.1	7.3	9.9	12.4	
Intermittent (3x440–480 V) [A] 2.3		4.0	7.5	10.8	14.4	17.5	
EMC filter type			C2	/C4			

## Table 12: Mains Supply 3x380-480 V AC (Normal overload 150% for 1 minute)

Frequency converter	12A0	15A5	23A0	31A0	37A0	43A0
Typical shaft output [kW (hp)]	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)
Enclosure size	MA03a	MA03a	MA04a	MA04a	MA05a	MA05a
Output current						
Continuous (3x380-440 V) [A]	12	15.5	23	31	37	43
Intermittent (3x380-440 V) [A]	18	23.5	34.5	46.5	55.5	64.5
Continuous (3x440-480 V) [A]	11	14	21	27	34	40
Intermittent (3x440-480 V) [A]	16.5	21.3	31.5	40.5	51	60
Maximum cable size (Mains, motor) [mm?/AWG]	4/10			16	5/6	

Maximum input current						
Continuous (3x380-440 V) [A]	19.2	24.8	33	42	34.7	41.2
Intermittent (3x380-440 V) [A]	27.4	36.3	47.5	60	49	57.6
Continuous (3x440–480 V) [A]	16.6	21.4	29	36	31.5	37.5
Intermittent (3x440-480 V) [A]	23.6	30.1	41	52	44	53
EMC filter type	C2/C4					

## **7 Ambient Conditions**

Protection rating		IP20/Open Type (IP21/Type 1 conversion kit as an option).			
Temperature durir	ng operation	-20 °C to 55 °C (-4 °F to 131 °F), -10 °C to 50 °C (14 °F to 131 °F) without derating			
Temperature durir	ng storage/transport	-25 °C to 65/70 °C (-13 °F to 149/158 °F).			
Relative humidity		5–95%, non-condensing during operation.			
Altitude		0–1000 m (3280 ft) without derating.			
Aititude		1000–4000 m (3280–13123 ft) with derating of 1%/100 m (328 ft).			
	Storage	IEC 60721-3-1, Class 1C2 (aggressive gases), Class 1S11 (dust/sand).			
Contamination level	Transportation	IEC 60721-3-2, Class 2C2 (aggressive gases), Class 2S5 (dust/sand).			
levei	Operation	IEC 60721-3-3, Class C3 (aggressive gases), Class 3S6 (dust/sand).			
Mandania	Storage	IEC 60721-3-1, Class 1M11.			
Mechanical conditions	Transportation	IEC 60721-3-2, Class 2M4.			
	Operation	IEC 60721-3-3, Class 3M11.			

## 8 EMC Compatibility and Motor Cable Length

- Drive with built-in EMC filter fulfills radiated emission C2 limits.
- Drive with non built-in EMC filter fulfills conducted/radiated emission C4 requirements.
- The drive is designed to operate with optimum performance within the maximum motor cable lengths defined in Table 14 Maximum Motor Cable Length.

Table 13: EMC Compatibility Motor Cable Length

Table 14: Maximum Motor Cable Length

Drive with built- in EMC filter	Maximum motor cable l	ength (shielded), @4kHz		Shielded	50 m (164 ft)	
	C1 (Conducted)	C2 (Conducted)	Maximum motor			
1x200-240 V	5 m (16.4 ft)		cable length	Unshielded	75 m (246 ft)	
3x400-480 V	-	15 m (49.2 ft)		Onsinelaea		

	Non cabinet					Cabinet				
iC2-Micro	UL fuse				CE fuse	UL circuit breaker	CE circuit breaker			
kW (hp)	RK1	1 T	J	сс	gG	ABB MS165 Maximum trip level	Eaton Maximum trip level	Test cabinet size [Height x Width x		
Standard fault current SCCR	5 kA	5 kA			5 kA	5 kA	5 kA	Depth] [mm (in)]	volume [l	
High fault current SCCR	-		100 kA		-	65 kA	-			
1x100-120 V AC										
0.37 (0.5)		25 A			25 A	25 A	PKZM4-25	500 x 400 x 260	52	
1.1 (1.5)	35 A				50 A	42 A	PKZM4-50	(19.7 x 15.7 x 10.2)	52	
1x200-240 V AC										
0.37-0.75 (0.5-1.0)		25	Α		25 A	25 A	PKZM4-25	500 400 260		
1.5 (2.0)	35 A 40 A			35 A	32 A	PKZM4-32	-(19.7 X 15.7 X 10.2)	52		
2.2 (3.0)				50 A	42 A	PKZM4-50				
3x200-240 V AC										
0.37-0.75 (0.5-1.0)	15 A 30 A			16 A	16 A	PKZM0-16	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52		
1.5 (2.0)				32 A	32 A	PKZM4-32				
2.2-3.7 (3.0-5.0)	40 A				40 A	42 A			PKZM4-40	
3x380-480 V AC										
0.37-1.5 (0.5-2.0)	15 A			16 A	16 A	PKZM0-16				
2.2-4.0 (3.0-5.5)		30 A		40 A	32 A	PKZM4-32	500 x 400 x 260 (19.7 x 15.7 x 10.2)	52		
5.5-7.5 (7.5-10)		40	Α		40 A	42 A	PKZM4-40	(19.7 X 13.7 X 10.2)		
11–15 (15–20)						800 x 400 x 300	. 96			
18.5-22 (25-30)		60	A		80 A	80 A	NZMN1-A80	(31.5 x 15.7 x 11.8)	96	

## **10 Technical Documentation**

Scan the QR code to access more technical documents for the drive. Or, after scanning the QR code, click Global English on the website to select your local region's website, search iC2 to find the documents with your own languages.



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