Digital Interface Protocol for HQC Plasma Systems

CANopen

Contents

Introduction

This reference manual targets system integrators. It provides complete information on how to implement a proper interfacing for HQC Plasma Systems by using the *CANopen* protocol.

This manual refers to power sources art.**948.40**, **949.40**, **960.40**, **968.40**, and **969.40** with firmware release **07** or higher.

Related documents

All instruction manuals and cutting charts are available from CEBORA website http://welding.cebora.it

CANopen interface

Overview

The CANopen interface between a plasma power source (*slave*) equipped with an automatic gas console (art.466) and a CNC/robot (*master*) can be implemented in two different ways:

- **basic mode**: the CNC handles I/O control signals using PDO messages and the external panel (art.460) is required for the parameters configuration;
- **advanced mode**: the CNC handles both I/O control signals using PDO messages and the parameters configuration by using SDO messages.

Implementing the *basic mode* the system acts almost as a standard plasma cutting system with analog interface plus:

- higher number of control signals including the voltage measure in real-time;
- automatic setup of the optimal process parameters;
- automatic switch for cutting and marking operation;
- automatic documentation of the consumable parts in the user panel.

Implementing the *advanced mode* a fully integrated control software inside the CNC could be done, removing the requirement of an additional external human interface connected to the power source.

Hardware configuration

The power source must be connected to the CNC/robot by using the specific shielded cable (CAN-L, CAN-H and CAN-GND). Depending on the fieldbus network (type of the network, topology, number of nodes, baud-rate, etc.) the terminating resistors must be properly connected at the ends of the cables. In a basic network with two nodes only (the CNC and the power source) both the ends must be terminated.

The terminating resistance can be inserted or removed by moving the proper dip-switch in the main control board. By default the terminating resistance is set, so you may need to open the machine only if you add a third node to the network.

CANopen network configuration

The plasma power source acts as a CANopen slave implementing the device profile for generic I/O modules (DS 401). The network management protocol (NMT) is implemented with *heartbeat* messages: the heartbeat interval and the consumer time is set by default at 500ms. The *node guarding* protocol in not supported.

The following network parameters must be configured or verified:

- **mode**: slave
- **baud-rate**: 125kbps, 250kbps, 500kbps, 1Mbps – (default = 125kbps)
- **power source node-id** *(slave)*: from 1 to 126 – (default = 2)
- **robot node-id** *(master)*: from 1 to 126 – (default = 1)

Network parameters must be configured by software using the manual gas console panel (art.470 or art.480) or the user panel (art.460) – see the *Settings* section in the related manual cod.3.300.045.

According to the structure of the CANopen object dictionary, the following subset of objects has been defined.

Communication Profile Area

Index	Sub	Name	Size	Type	Access	Unit	Note
0x1000	0	Device Type	4	int	RO	-	0x000F0191
0x1001	0	Error register	1	int	RO	-	
0x1008	0	Manufacturer device name	4	string	RO	-	e.g. “960” for art.960
0x1009	0	Manufacturer hardware ver.	4	string	RO	-	e.g. “458” for art.960
0x100A	0	Manufacturer software ver.	4	string	RO	-	e.g. “001”
0x1016	0	Consumer heartbeat	1	int	RO	-	1
	1	Consumer heartbeat time	4	int	RW	ms	Default 1000ms
0x1017	0	Producer heartbeat time	2	int	RW	ms	Default 500ms
0x1018	0	Identity Object	1	int	RO	-	3
	1	Vendor ID	4	int	RO	-	0x00455341
	2	Product Code	4	int	RO	-	0x00010002
	3	Revision Code	4	int	RO	-	0
0x1400	1	RxPDO1 Comm. Parameter	4	int	RO	-	0x200 + node-ID
0x1401	1	RxPDO2 Comm. Parameter	4	int	RO	-	0x300 + node-ID
0x1800	1	TxPDO1 Comm. Parameter	4	int	RO	-	0x180 + node-ID
0x1801	1	TxPDO2 Comm. Parameter	4	int	RO	-	0x280 + node-ID
0x1802	1	TxPDO3 Comm. Parameter	4	int	RO	-	0x380 + node-ID

Manufacturer Specific Area

The index range from `0x2000` to `0x5FFF` is available only for the *advanced mode*: see Parameters Description.

Device Profile Area

Index	Sub	Name	Size	Type	Access	Unit	Note
`0x6000`	0	Read Input	1	int	RO	-	4
`0x6200`	0	Write Output	1	int	RO	-	8
`0x6401`	0	Read analogue input 16-bit	1	int	RO	-	8
`0x6411`	0	Write analogue output 16-bit	1	int	RO	-	4

Signals handshaking

The following figure shows the correct signals handshaking between the power source and the CNC. For the description of each signals see the following paragraphs.

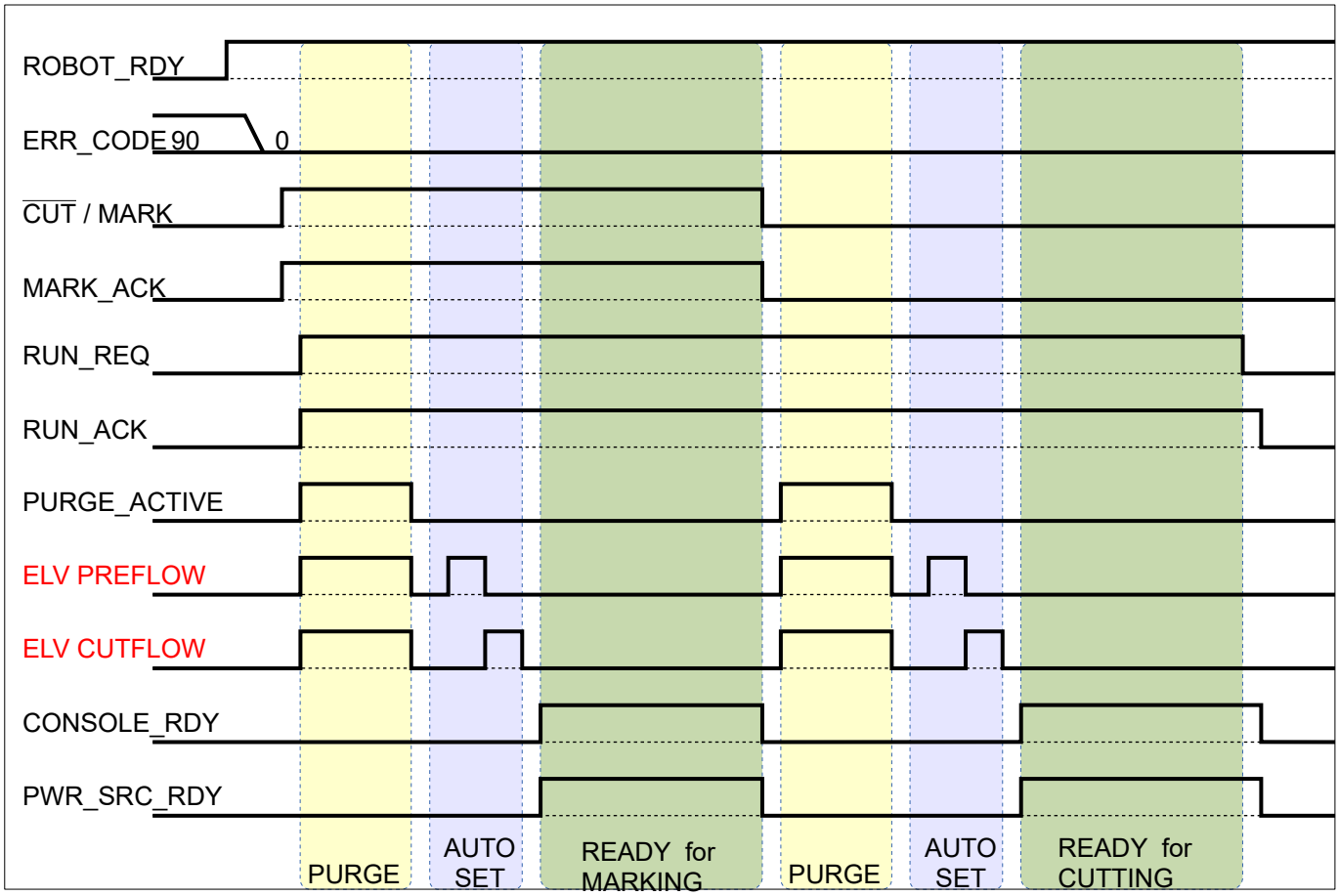

Figure 1: General interfacing protocol.

Some notes:

- the *Robot Ready* and *Run (Request)* signals should not be toggled simultaneously;
- the *Run (Request)* and *Mark (Request)* signals should not be toggled simultaneously;
- the *Mark (Request)* and *Run (Request)* should be toggled when the Robot Ready is stable active;
- the *Mark (Request)* must be toggled when the *Run (Request)* is stable (active or inactive);
- during the purging and auto-set phases the *Mark (Request)* should not be toggled.

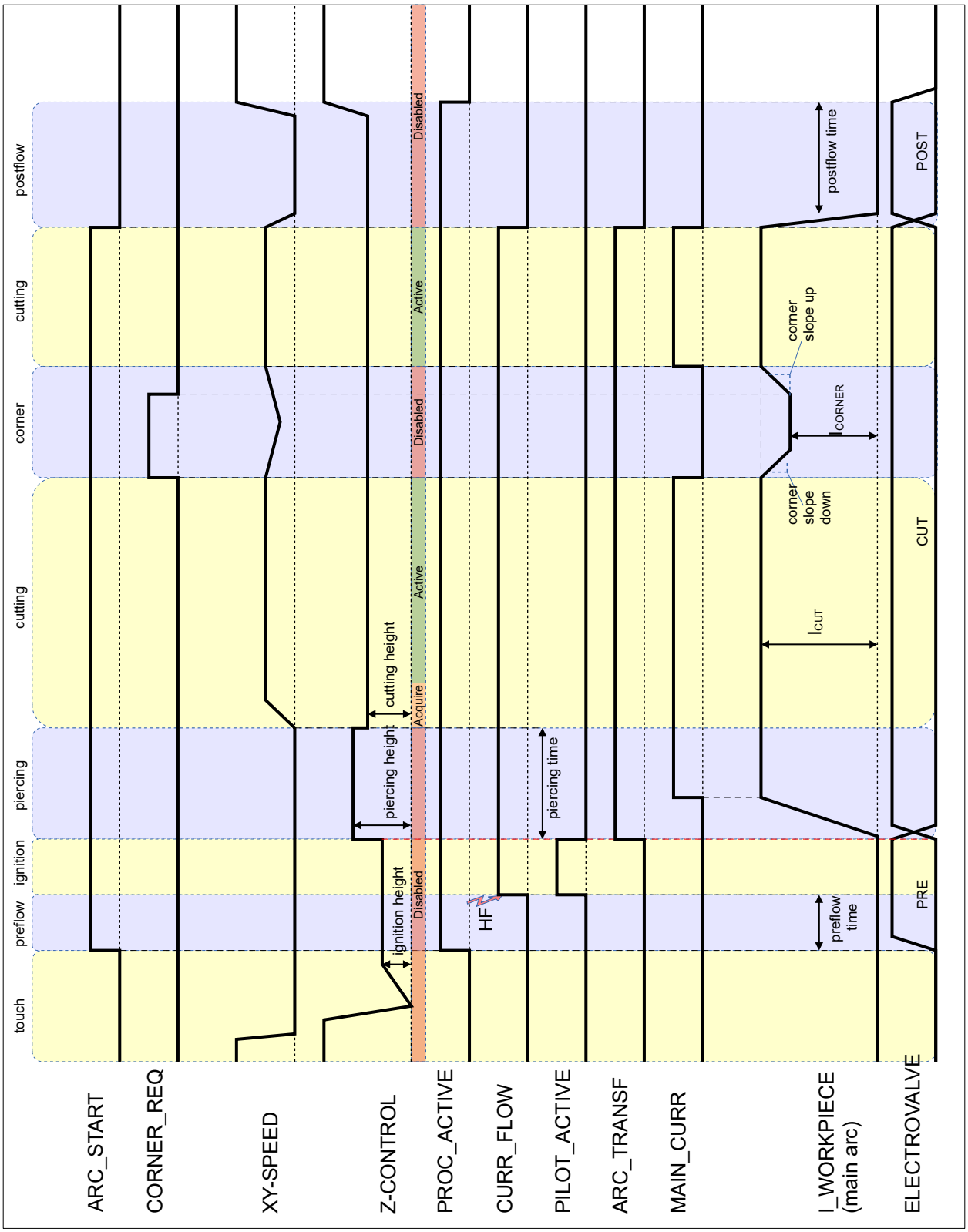

Figure 2: Process signals.

Signals description (PDO)

With the digital interface, a lot of control signals can be exchanged between the power source (slave) and the CNC (master). Some signals are mandatory, some are optional. These signals are implemented by using a set of standard PDO messages:

- **one digital input** (`0x200` + slave node-id) – from CNC to PS
- **one analog input** (`0x300` + slave node-id) – from CNC to PS
- **one digital output** (`0x180` + slave node-id) – from PS to CNC
- **two analog output** (`0x280` and `0x380` + slave node-id) – from PS to CNC

In the following tables are listed the bit numbering for each PDO. By comparison between the digital interface and the analog interface, two columns are shown on the right.

Conventions about the bit state:

Bit value	Description
0	Inactive state (reset state)
1	Active state (set state)
0 → 1	Inactive to active transition (set event)
1 → 0	Active to inactive transition (reset event)

Digital Inputs (0x200)

Digital inputs are implemented with a single PDO of 8 data bytes for a total of 64 inputs. The transmission of this message is usually event-driven and it is sampled by the power source every [10ms]. Some bits are mandatory because they are required for the cutting process control, others are optional.

Bit	Name	Analog Interface	Digital Interface
0	Start Arc	X	X
1	Robot Ready	X	X
2	Run Request	-	X
3	-	-	-
4	-	-	-
5	-	-	-
6	-	-	-
7	Protocol Mode	0	X
8	Preflow	X	X
9	-	-	-
10	Gas Test Auxiliary	-	X
11	Source Error Reset	-	X
12	Gas Test Plasma Preflow	-	X

13	Gas Test Plasma Cutflow	-	X
14	Gas Test Secondary Preflow	-	X
15	Gas Test Secondary Cutflow	-	X
23:16	Job Number (8-bit)	-	X
31:24	-	-	-
32	Analog Setpoint Disable 0	X	X
33	Analog Setpoint Disable 1	X	X
55:34	-	-	-
56	Corner Request	X	X
57	Spot Request	X	X
58	Mark Request	X	X
63:59	-	-	-

Start Arc – bit [0]

Turn on/off request of the plasma arc.

Start Arc	Description
1 → 0	Trigger the turn-off sequence of the plasma arc and starts the post-flow
0 → 1	Trigger an arc ignition. This command is accepted only if the *Power Source Ready* bit is asserted.

Robot Ready – bit [1]

Indication of the robot control status to the power source. Once the communication is established the CNC sets this bit enabling the power source to accept other control signals. If it is not set, the power source remain in an error state (error number 90) and all outputs signals are set to the inactive state. This bit directly controls even the state of the cooling pump, so it is not advisable to toggle it if not strictly needed.

Robot Ready	Description
0	The robot control is not ready or in alarm state. The cooling pump is stopped.
1	The robot control is ready for the signal handshaking. The cooling pump is running.

Run (Request) – bit [2]

Request for enabling the plasma cutting process. This bit must be toggle from inactive to active when the *Robot Ready* bit is set. If this request is accepted the *Run Acknowledge* bit is set and, and if needed, the power source execute a purging phase followed by an auto-set of the gasses. At the end of the procedure the *Power Source Ready* bit goes to active state.

Run (Request)	Description
0	The power source is requested for disabling the plasma process.
1	The power source is requested for enabling the plasma process.

Protocol Mode – bit [7]

Selection of the data representation for all 16-bit analog values, both measures and setpoints. If inactive (analog mode) each value must be rescaled from the minimum value to the maximum value in order to fully fit in a 16-bit unsigned variable. If active (digital mode) all values are handled as standard signed binary values and no rescaling is needed.

Protocol Mode	Description
0	Values are 16-bit *unsigned* rescaled with range `0x0000` (min) – `0xFFFF` (max).
1	Values are 16-bit *signed* binary with no rescaling.

Preflow – bit [8]

Trigger the preflow process phase (plasma and secondary preflow channel are both open) without igniting the pilot arc. This bit is sampled only when the *Power Source Ready* bit is active and the *Arc Start* bit is not set. Use this command for extending the preflow phase or for saving time (up to 0.5s) between successive ignitions of the arc.

Preflow	Description
0	User preflow not requested (automatic preflow).
1	User request for entering in the preflow phase.

Source Error Reset – bit [11]

Request for resetting an error condition in the power source. A typical gas low alarm *(ERR.78)* can be reset from the master. Others cannot be reset and the power source remains in alarm state until the error condition disappears or the system is rebooted.

Source Error Reset	Description
0, 1, 1 → 0	No operation.
0 → 1	Request for resetting the error condition in the power source.

Gas Test (Set) – bit [15:12]

Each of these bits triggers the activation of the corresponding gas channel. It is useful for testing the gas flow. These bits are sampled only when the *Run (Request)* is not active.

Gas Test	Description
0	No operation
1	Request for opening one of the gas channels (manual gas set)

Job Number – bit [23:16]

These bits are used for addressing a job from the power-souce memory. Jobs must be previously stored by the art.460 panel and the *Internal* flag must be deactivated.

Gas Test	Description
0	Normal mode – no job is selected from CNC
1 - 99	Valid job number

100 - 255	Invalid job number – value 99 is used

Analog Input Disable – bit [33:32]

These bits enable or disable the sampling of an external setpoint received in the analog input message. Each bit is related to a 16-bit bit field in the analog input message AI[1].

Analog Input Dis.	Description
0	The analog input *n* must be read.
1	The analog input *n* must be ignored.

Corner (Request) – bit [56]

This bit is used for the synchronization of the cutting current and the torch speed at a corner. It is sampled only in the standard cut process when the *Main Current* bit is active. An inactive to active transition begins a reduction of the cutting current with a fixed ratio (see object *Corner slope-down*) until the *Corner Current* value is reached. An active to inactive transition begins an increase of the cutting current with a fixed ratio (see object *Corner slope-up*) until the *Main Current* value is reached.

Corner	Description
0	Standard cut process.
0 → 1	Request for starting the corner phase.
1	Corner phase.
1 → 0	Request for ending the corner phase.

Spot (Request) – bit [57]

This bit selects the spot marking process. It is sampled only when the *Power Source Ready* bit is active but it is ignored when the *Mark (Request)* bit is active.

Spot	Description
0	Standard cut process request.
1	Spot marking request.

Mark (Request) – bit [58]

Process type selection between standard cutting (or spot marking) and marking. If this bit is toggled when the Power Source Ready bit is set, a purging phase followed by an auto-set of the gas regulators is performed. If the *Mark* bit is active, the *Spot* bit is ignored.

Mark	Description
0	Cut (or spot marking) process request.
1	Marking process request.

Analog Inputs (0x300)

The power source accepts a single PDO message of 8-data byte for handling setpoint adjustment runtime. The data are organized as 4 analog setpoint values named AI1[3:0] of 16-bit each. Inputs are sampled within [10ms] since the receive event. The format of 16-bit data fields depends on the *Protocol Mode* bit.

Bit	Name	Analog Interface	Digital Interface
15:0	Current Fine Regulation	X	X
31:16	Corner Current Regulation	X	X
47:32	-	-	X
63:48	-	-	X

Current Fine Regulation – AI1[0], bit [15:0]

This field (I_{CFR}) is used for adjusting runtime the actual cutting current within the range admitted by the selected consumable parts of the torch. It is expressed in [0.1 A] from -25.0A to +25.0A.

$$I_{ARC} = I_{SET} + I_{CFR}$$

This field is ignored if the *Analog Setpoint Disable 0* bit is set.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	-25.0A	0x0000	0xFF06
Default	0.0A	0x8000	0x0000
Maximum	25.0A	0xFFFF	0x00FA

Corner Current Regulation – AI1[1], bit [31:16]

This field (CCR) is used for setting the corner current value runtime from the CNC. It is expressed as percentage of the main current value from 100% (no current reduction) down to 50% (lowest accepted value). See also *Corner Req* and *Corner Ack* bits.

$$I_{CORNER} = I_{ARC} * CCR / 100$$

This field is ignored if the *Analog Setpoint Disable 1* bit is set. If disabled the regulation of the corner current can be done using the object 0x2A44 sub 3.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	20%	0x0000	0x0014
Maximum	100%	0xFFFF	0x0064

Digital Outputs (0x180)

Digital outputs reflects the status of the power source and the plasma process. They are implemented with a single PDO of 4 data bytes for a total of 32 outputs. Outputs are updated every [10ms] and the transmission of the message is triggered by a status change.

Bit	Name	Analog Interface	Digital Interface
0	Current Flow	-	X
1	Run Acknowledge	-	X
2	Process Active	X	X
3	Main Current	-	X
4	-	-	-
5	Power Source Ready	X	X
6	Communication Ready	-	1
7	Protocol Mode	-	X
15:8	Error Code (8-bit)	-	X
16	Plasma Preflow Active	-	X
17	Plasma Cutflow Active	-	X
18	Secondary Preflow Active	-	X
19	Secondary Cutflow Active	-	X
20	Purge Active	-	X
21	Console Ready	-	X
22	Arc Transfer	X	X
23	Pilot Arc	X	X
24	Corner Acknowledge	-	X
25	Spot Acknowledge	-	X
26	Mark Acknowledge	-	X
30:27	-	-	-
31	Hard Fault	-	X

Current Flow – bit [0]

Indicates if the power source is generating current. It is active when the pilot-arc or the main-arc are on.

Current Flow	Description
0	The power source is not generating current.
1	The power source is generating current.

Process Active – bit [2]

Indicates that the power source accepted a start command and the plasma process is running. This bit is active from the preflow phase to the end of the postflow phase.

Process Active	Description
0	The plasma process is not running.
1	The plasma process is running.

Main Current – bit [3]

Indicates that the output current of the plasma arc is equal to the main current setpoint. This bit goes inactive during a corner phase.

Main Current	Description
0	The output current is lower than the main current setpoint.
1	The output current has reached the main current setpoint.

Power Source Ready – bit [5]

This bit goes active after a *Run (Request)* command, indicating that the power source is not in alarm status and all gasses are prepared for the plasma arc ignition. If this bit does not go active within a timeout of about 1 minutes from the *Run (Request)* command, some errors are occurred, and the *Run (Request)* bit must be released. See also the *Purge Active* and *Console Ready* bits.

Power Source Ready	Description
0	The power source is in stand-by or in alarm state.
1	The power source is ready for the plasma process.

Communication Ready – bit [6]

Status of the signals communication. This bit goes to the active state after the boot-up sequence of the power source and becomes immediately inactive when a power-down event occurs. Signals handshaking is enabled only when this bit is active.

Comm. Ready	Description
0	The power source is not ready for the signal handshaking (boot-up sequence, ...).
1	The power source is ready for the signal handshaking.

(Power Source) Protocol Mode – bit [7]

This bit reflects the state of the *Protocol Mode* input bit, indicating that the power source has accepted or not the configuration requested by the master.

(P.S.) Prot. Mode	Description
0	Values are 16-bit unsigned rescaled with range `0x0000` (min) – `0xFFFF` (max).
1	Values are 16-bit signed binary with no rescaling.

Error Number – bit [15:8]

Error code number referring the error code table of the specific power source model. Some error conditions require a reboot of the system (*fatal errors*) others can be reset runtime (*warnings*) using the *Source Error Reset* bit. See also the *Hard Fault* bit.

Error Number	Description
0	The machine is operating.
1 – 99	The machine is in error state with all outputs inactive (see the error code table).

Flow Active – bit [19:16]

Each bit is active when the corresponding gas channel is active.

Flow Active	Description
0	The gas channel is closed.
1	The gas channel is open.

Purge Active – bit [20]

A gas purging is running. When this bit is active the power source is not enabled for the arc ignition.

Purge Active	Description
0	The gas console is not purging.
1	The gas console is purging.

Console Ready – bit [21]

This bit indicates that the automatic gas console is set and ready for starting the plasma process. This bit goes active after a *Run Request* command, usually followed by the purging and auto-set phases.

Console Ready	Description
0	Some gas are not ready for the plasma process.
1	All gasses are ready for starting the plasma process.

Arc Transfer – bit [22]

Status of the plasma arc. This bit goes active after the *Pilot Arc* bit.

Arc Transfer	Description
0	The arc is not transferred to the workpiece

1	The arc is on and transferred to the workpiece.

Pilot Arc – bit [23]

Status of the pilot arc. This bit goes active after an arc ignition indicating that the pilot arc is on and goes inactive when the arc is transferred on the workpiece.

Pilot Arc	Description
0	The pilot arc is off.
1	The pilot arc is on.

Corner Acknowledge – bit [24]

The power source is executing a corner. This signal goes active after a C*orner Request* during the main current phase.

Corner Ack.	Description
0	The power source is not executing the corner current.
1	The power source is executing the corner current.

Spot Acknowledge – bit [25]

This bit goes active when the *Spot Marking* process is selected. This bit goes active after the *Power Source Ready* bit is active.

Spot Ack.	Description
0	The spot marking process is not selected.
1	The spot marking process is selected.

Mark Acknowledge – bit [26]

This bit is the current process indication. When this bit is active, *Corner* and *Spot* commands are ignored.

Mark Ack.	Description
0	Cut (or spot marking) process selected.
1	Marking process selected.

Hard Fault – bit [31]

This bit goes active when a fatal error occurs and the plasma system must be shut down. See also *Error number*.

Hard Fault	Description
0	No fatal errors occurred.
1	A fatal error occurred.

Analog Outputs (0x280, 0x380)

The plasma power source produces two PDO messages AO1, AO2, each containing 4 analog measures of 16-bit values AO1[3:0], AO2[3:0]. The format of 16-bit data fields is dependent on the *Protocol Mode* bit.

The first one AO1 (**0x280**) is sent every [10ms] and is related to the state of the power source and the cooling system.

Bit	Name	Analog Interface	Digital Interface
15:0	Arc Voltage Measure	X	X
31:16	Arc Current Measure	X	X
47:32	Coolant Temperature Measure	-	X
63:48	Coolant Flow Measure	-	X

Arc Voltage Measure – AO1[0], bit [15:0]

The plasma arc voltage measured with [0.1 V] of resolution.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	0.0V	0x0000	0x0000
Maximum	250.0V	0xFFFF	0x09C4

Arc Current Measure – AO1[1], bit [31:16]

The plasma arc current measured with [1 A] of resolution.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	0A	0x0000	0x0000
Maximum (other models)	300A	0xFFFF	0x012C
Maximum (for art.960 only)	500A	0xFFFF	0x01FA

Coolant Temperature Measure – AO1[2], bit [47:32]

The temperature of the cooling liquid with [0.1°C] of resolution.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	-50.0°C	0x0000	0xFE0C
Maximum	100.0°C	0xFFFF	0x03E8

Coolant Flow Measure – AO1[3], bit [63:48]

The mass flow of the cooling liquid with [0.1 l/min] of resolution.

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	0.0 l/min	0x0000	0x0000
Maximum	10.0 l/min	0xFFFF	0x0064

The second one AO2 (**0x380**) is sent cyclically every [100ms] and it is related to the pressure of the gas in the gas console. These values matches the actual setpoints only when the corresponding valve is open.

Bit	Name	Analog Interface	Digital Interface
15:0	Pressure Measure Plasma Preflow	-	X
31:16	Pressure Measure Plasma Cutflow	-	X
47:32	Pressure Measure Secondary Preflow	-	X
63:48	Pressure Measure Secondary Cutflow	-	X

All pressure measures have the same range and resolution [0.1bar].

Description	Value	Protocol Mode = 0	Protocol Mode = 1
Minimum	0.0 bar	0x0000	0x0000
Maximum	10.0 bar	0xFFFF	0x0064

Plasma Preflow Pressure Measure – AO2[0], bit [15:0]

The pressure of the gas in the plasma preflow channel with [0.1bar] of resolution.

Plasma Cutflow Pressure Measure – AO2[1], bit [31:16]

The pressure of the gas in the plasma cutflow channel with [0.1bar] of resolution.

Secondary Preflow Pressure Measure – AO2[2], bit [47:32]

The pressure of the gas in the secondary preflow channel with [0.1bar] of resolution.

Secondary Cutlow Pressure Measure – AO2[3], bit [63:48]

The pressure of the gas in the secondary cutflow channel with [0.1bar] of resolution or the water flow [0.1l/min] when water secondary console (art.485) is used.

Parameters description (SDO)

It is possible to read and write almost any plasma process parameter of the power source by using the CANopen SDO protocol (*advanced mode*). In this case the CNC handles all the system setup and the external panel (art.460) must not be used. During the power up phase the power source tries to detect the presence of an external panel and if none is found, assumes that the parameters setup must be provided from the CNC interface. If you leave connected an external panel, some command conflicts may occur and the proper operation is not guaranteed.

The parameters are grouped in six ranges:

- from **0x2800** to **0x284F** – power source base configuration
- from **0x2A00** to **0x2A2F** – cutting table selection
- from **0x2A40** to **0x2A7F** – plasma process configuration
- from **0x2B00** to **0x2B0F** – consumable parts list
- from **0x2B20** to **0x2B3F** – suggested cutting process setup
- from **0x2B40** to **0x2B5F** – suggested marking process setup

After the low-level CANopen communication is established, the master have to identify the power source type using the **0x2800** (*Power source model*) object (optionally the *Firmware release* number) and poll the **0x2802** object (*Machine status*) until its value is equal or greater than 2. This means that the power source has booted correctly and loaded a valid configuration.

Optionally other information about the plasma cutting system can be read (or modified) in order to check the correct configuration: **0x2A00** (*Plasma valve console*), **0x2A01** (*Torch type*) and **0x2A02** (*Gas cable length*).

In order to select a cutting table, the master have to write the following mandatory objects:

1. **0x2A10** Material
2. **0x2A19** Gas type for plasma cutflow
3. **0x2A1B** Gas type for secondary cutflow
4. **0x2A11** Thickness
5. **0x2A20** sub **1** Main cutting current setpoint
6. **0x2A03** (optional) Consumable set

and if the marking process is used:

7. **0x2A22** sub **1** Marking current setpoint.

If an incorrect value is written to an object, the standard abort code is returned (see *SDO Abort Codes*).

After the cutting table is selected, the master may read the relevant list of consumable parts for the torch in use from **0x2B00** to **0x2B05**.

If the cutting process is selected (*Mark Ack* bit not active), the master may:

- read or change the gas setup from **0x2B20** to **0x2B24**;
- read the cutting current values at **0x2B28** and the suggested arc voltage setpoint at **0x2B29**;
- read the suggested configuration for the torch movements from **0x2B40** to **0x2B39**.

If the marking process is selected (*Mark Ack* bit active), the master may:

- read or change the gas setup from **0x2B40** to **0x2B44**;
- read the cutting current values at **0x2B48** and the suggested arc voltage setpoint at **0x2B49**;
- read the suggested configuration for the torch movements from **0x2B40** to **0x2B39**.

Additionally, the master may read and change some optional parameters like the corner configuration **0x2A44**.

Write the object **0x2A60** *Run Request* to request the power source to enter in the ready state. The control software on the master node should use the *Run Request* bit in the PDO message or the *Run Request* object of the dictionary.

Once the power source sets the *Power Source Ready* bit to the active state, any further writing of the objects in the dictionary is ignored. The only exceptions are the gas pressure setpoints for cutting (**0x2B20:0x2B23** sub **1**) and marking (**0x2B40:0x2B43** sub **1**) that can be changed at any time.

Parameter Dictionary

The parameters defined in the object dictionary, their index, sub-index, size and type of access are listed in the following table.

bool	The parameter can set to 0 or 1 only.
enum	Enumerated type: see the related conversion table.
int	Standard signed integer.
string	Array of ANSI characters.

RO	Read-only parameter.
RW	Read-write parameter.
WO	Write-only parameter.

Index	Sub	Name	Size	Type	Access	Unit	Note
0x2800	0	Model name	4	string	RO	-	e.g. ”960”
0x2801	0	Firmware release	4	string	RO	-	e.g. “001”
0x2802	0	Machine status	4	enum	RO	-	0=Init 1=Precharge 2=Ready 3=Operational 4=Warning 5=Error 6=Power-off
0x2803	0	Serial number	4	int	RO	-	
0x2804	-	(reserved)		-	-	-	
0x2805	0	Database revision	2	int	RO	-	MSB=major LSB=minor
0x2810	0	Number of entries	1	int	RO	-	5
	1	Apply CAN bus config	1	int	WO	-	1=apply
	2	CAN bus mode	1	enum	RW	-	2=CANopen (slave)
	3	CAN bus baud-rate	1	enum	RW	-	4=125k, 5=250k, 6=500k, 7=1M
	4	Power source node-id	1	int	RW	-	from 1 to 126 (def=2)
	5	Robot node-id	1	int	RW	-	from 1 to 126 (def=1)
0x2A00	0	Plasma valve cons. (PVC)	1	enum	RW	-	0=undefined 1=art.475 (deprecated) 2=art.469 3=art.462
0x2A01	0	Torch type	1	enum	RW	-	0=undefined 1=CP251G (deprecated)

							2=CP450G 3=CP455G
0x2A02	0	Gas cable length	1	int	RW	m	
0x2A03	0	Consumable set	1	int	RW	-	0=Standard 1=QPC 2=Speed 3=EXP
0x2A04	0	Water secondary console (WSC)	1	enum	RW	-	0=OFF 1=art.485
0x2A10	0	Material	1	enum	RW	-	0=undefined 1=Mild-steel 2=Aluminum 3=Stainless-steel
0x2A11	0	Thickness	2	int	RW	0.1mm	
0x2A18	0	Gas type (plasma pre)	1	enum	RO	-	0=undefined 1=Ar, 2=air, 3=O_2, 4=N_2, 5=H35, 6=F5, 7=H_2O(water)
0x2A19	0	Gas type (plasma cut)	1	enum	RW	-	
0x2A1A	0	Gas type (sec. pre)	1	enum	RO	-	
0x2A1B	0	Gas type (sec. cut)	1	enum	RW	-	
0x2A20	0	Number of entries	1	int	RO	-	4
	1	Current setpoint	2	int	RW	A	
	2	Minimum setpoint	2	int	RO	A	
	3	Maximum setpoint	2	int	RO	A	120A for art.948 180A for art.968 250A for art.949 300A for art.969 420A for art.960
	4	Default setpoint	2	int	RO	A	
0x2A22	0	Number of entries	1	int	RO	-	4
	1	Marking setpoint	2	int	RW	A	
	2	Minimum setpoint	2	int	RO	A	9A
	3	Maximum setpoint	2	int	RO	A	19A
	4	Default setpoint	2	int	RO	A	12A
0x2A40	0	Self restart	1	bool	RW	-	
0x2A44	0	Number of entries	1	int	RO	-	5
	1	Corner enable	1	bool	RW	-	Always 1 with art.466
	2	Corner curr. enable	1	bool	RO	-	0=disabled, 1=enabled
	3	Corner curr. ratio	2	int	RW	%	
	4	Corner slope down	2	int	RW	A/0.01s	
	5	Corner slope up	2	int	RW	A/0.01s	
0x2A48	0	Number of entries	1	int	RO	-	3

	1	Spot enable	1	bool	RW	-	
	2	Spot current	2	int	RW	A	
	3	Spot time	2	int	RW	0.01s	
0x2A50	0	Preflow timeout	2	int	RW	s	(not implemented)
0x2A51	0	Postflow timeout	2	int	RW	s	
0x2A60	0	Run request	1	bool	RW	-	
0x2A61	0	Gas test command (Set)	1	int	RW	-	0x01=plasma preflow 0x02=plasma cutflow 0x04=secondary preflow 0x08=secondary cutflow
0x2B00	0	Number of entries	1	int	RO	-	2
	1	Electrode art. number	4	string	RO	-	
	2	Electrode code	4	int	RO	-	
0x2B01	0	Number of entries	1	int	RO	-	2
	1	Swirl ring art. number	4	string	RO	-	
	2	Swirl ring code	4	int	RO	-	
0x2B02	0	Number of entries	1	int	RO	-	2
	1	Nozzle art. number	4	string	RO	-	
	2	Nozzle code	4	int	RO	-	
0x2B03	0	Number of entries	1	int	RO	-	2
	1	Nozzle holder art. number	4	string	RO	-	
	2	Nozzle holder code	4	int	RO	-	
0x2B04	0	Number of entries	1	int	RO	-	2
	1	Shield art. number	4	string	RO	-	
	2	Shield code	4	int	RO	-	
0x2B05	0	Number of entries	1	int	RO	-	2
	1	Shield holder art. number	4	string	RO	-	
	2	Shield holder code	4	int	RO	-	
0x2B06	0	Number of entries	1	int	RO	-	2
	1	Water tube art. number	4	string	RO	-	
	2	Water tube code	4	int	RO	-	
0x2B20	0	Number of entries	1	int	RO	-	4
	1	Gas pressure plasma pre.	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B21	0	Number of entries	1	int	RO	-	4

	1	Gas pressure plasma cut.	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B22	0	Number of entries	1	int	RO	-	4
	1	Gas pressure sec. preflow	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B23	0	Number of entries	1	int	RO	-	4
	1	Gas pressure sec. cutflow	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B24	0	Number of entries	1	int	RO	-	4
	1	Gas aux ratio	2	int	RW	%	Initialized at sub 4 value
	2	(reserved)	2	int	RW	%	
	3	(reserved)	2	int	RW	%	
	4	Suggested aux ratio	2	int	RO	%	
0x2B28	0	Number of entries	1	int	RO	-	4
	1	Nominal cutting current	2	int	RO	A	e.g. 80A
	2	Minimum cutting current	2	int	RO	A	e.g. 70A
	3	Maximum cutting current	2	int	RO	A	e.g. 90A
	4	Suggested cutting current	2	int	RO	A	e.g. 80A
0x2B29	0	Suggested cutting voltage	2	int	RO	V	
0x2B30	0	Suggested cutting speed	2	int	RO	mm/min	
0x2B31	0	Suggested cutting height	2	int	RO	0.1mm	
0x2B32	0	Suggested pierce height	2	int	RO	0.1mm	
0x2B33	0	Suggested pierce delay	2	int	RO	0.1s	
0x2B34	0	Optimal kerf	2	int	RO	0.1mm	
0x2B35	0	Suggested ignition height	2	int	RO	0.1mm	
0x2B36	0	Suggested path length at piercing height	2	int	RO	0.1mm	
0x2B37	0	Suggested path length at cutting height	2	int	RO	0.1mm	
0x2B38	0	Fixed height enable	1	bool	RO	-	0=disabled, 1=enabled
0x2B39	0	Edge start required	1	bool	RO	-	0=workpiece ignition

							1=edge ignition
0x2B40	0	Number of entries	1	int	RO	-	4
	1	Gas pressure plasma pre.	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B41	0	Number of entries	1	int	RO	-	4
	1	Gas pressure plasma cut.	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B42	0	Number of entries	1	int	RO	-	4
	1	Gas pressure sec. preflow	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B43	0	Number of entries	1	int	RO	-	4
	1	Gas pressure sec. cutflow	2	int	RW	0.1bar	Initialized at sub 4 value
	2	(reserved)	2	int	RW	0.1bar	
	3	(reserved)	2	int	RW	0.1bar	
	4	Suggested pressure	2	int	RO	0.1bar	
0x2B44	0	Number of entries	1	int	RO	-	4
	1	Gas aux ratio	2	int	RW	%	Initialized at sub 4 value
	2	(reserved)	2	int	RW	%	
	3	(reserved)	2	int	RW	%	
	4	Suggested aux ratio	2	int	RO	%	
0x2B48	0	Number of entries	1	int	RO	-	4
	1	Nominal marking current	2	int	RO	A	12A
	2	Minimum marking current	2	int	RO	A	5A
	3	Maximum marking current	2	int	RO	A	19A
	4	Suggested marking current	2	int	RO	A	
0x2B49	0	Suggested marking voltage	2	int	RO	V	
0x2B50	0	Suggested marking speed	2	int	RO	mm/min	
0x2B51	0	Suggested marking height	2	int	RO	0.1mm	
0x2B52	0	Suggested pierce height	2	int	RO	0.1mm	
0x2B53	0	Suggested pierce delay	2	int	RO	0.1s	

0x2B54	0	Optimal kerf	2	int	RO	0.1mm	n/a
0x2B55	0	Suggested ignition height	2	int	RO	0.1mm	
0x2B56	0	Suggested path length at piercing height	2	int	RO	0.1mm	
0x2B57	0	Suggested path length at cutting height	2	int	RO	0.1mm	
0x2B58	0	Fixed height enable	1	bool	RO	-	0=disabled, 1=enabled
0x2B59	0	Edge start required	1	bool	RO	-	0

SDO Abort Codes

Abort Code	Description
0x0503 0000h	Toggle bit not alternated.
0x0504 0000h	SDO protocol timed out.
0x0504 0001h	Client/server command specifier not valid or unknown.
0x0504 0002h	Invalid block size (block mode only).
0x0504 0003h	Invalid sequence number (block mode only).
0x0504 0004h	CRC error (block mode only).
0x0504 0005h	Out of memory.
0x0601 0000h	Unsupported access to an object.
0x0601 0001h	Attempt to read a write only object.
0x0601 0002h	Attempt to write a read only object.
0x0602 0000h	Object does not exist in the object dictionary.
0x0604 0041h	Object cannot be mapped to the PDO.
0x0604 0042h	The number and length of the objects to be mapped would exceed PDO length.
0x0604 0043h	General parameter incompatibility reason.
0x0604 0047h	General internal incompatibility in the device.
0x0606 0000h	Access failed due to a hardware error.
0x0607 0010h	Data type does not match, length of service parameter does not match.
0x0607 0012h	Data type does not match, length of service parameter too high.
0x0607 0013h	Data type does not match, length of service parameter too low.
0x0609 0011h	Sub-index does not exist.
0x0609 0030h	Value range of parameter exceeded (only for write access).
0x0609 0031h	Value of parameter written too high.
0x0609 0032h	Value of parameter written too low.
0x0609 0036h	Maximum value is less than minimum value.
0x0800 0000h	General error
0x0800 0020h	Data cannot be transferred or stored to the application.
0x0800 0021h	Data cannot be transferred or stored to the application because of local control.
0x0800 0022h	Data cannot be transferred or stored to the application because of the present device state.
0x0800 0023h	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of a file error).

Document revision history

Rev.	Date	Author	Description
0	14/02/2014	C.C.	Preliminary.
1	20/02/2014	C.C.	Communication and Device profile added. Some typos fixed.
2	27/05/2014	C.C.	Fix SDO index for Spot parameters.
3	09/07/2014	C.C.	Changed entry 0x2B06 in the object dictionary.
4	16/10/2014	C.C.	Analog Inputs and Analog Outputs updated.
5	16/02/2015	C.C.	Hard Fault bit description added. Improved SDO description.
6	30/03/2015	C.C.	Added art.948 and 949. Some grammatical corrections.
7	12/01/2016	C.C.	Profile table updated. Added entry 0x2A03. Old models removed.
8	23/02/2016	C.C.	Updated entry 0x2A03. General document refactoring.
9	19/12/2016	C.C.	Updated entry 0x2A03. General document style refactoring.
10	12/06/2017	C.C.	Added job description.
11	02/10/2017	C.C.	Added entry 0x2805.
12	26/07/2018	C.C.	Updates for WSC: updated entry 0x2A1B and added entry 0x2A04.
13	11/06/2019	C.C.	Minor updates
14	10/06/2020	C.C.	Updates for torch CP455 and models art.968, art.969