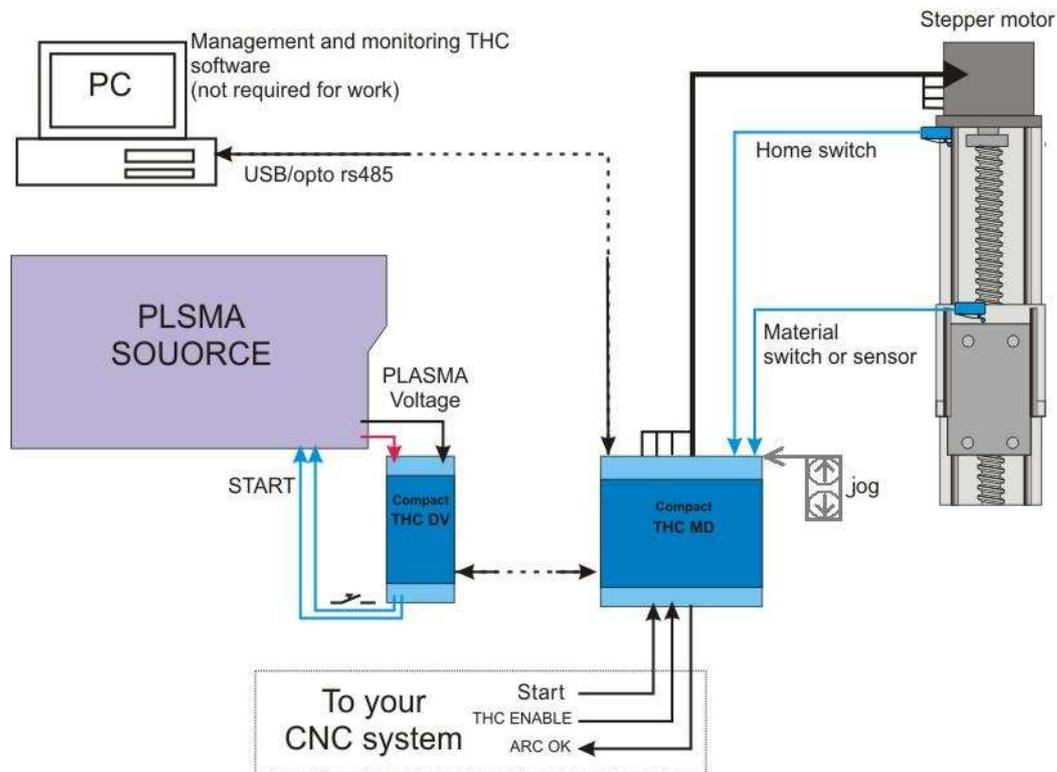


User's guide



Plasma Z Axis Controller

Model : Compact THC MD+DV (with Motor Driver and Voltage Divider)



This device is an independent controller of “Z” axis in the CNC plasma cutter. It is made up of the measuring module and main module which controls movement of a plasma torch in the Z axis. Controller is integrated with a stepper motor driver which greatly facilitates installation and start – the stepper motor of the Z axis is connected directly to this appliance.

The controller can cooperate with any type of plasma source and any kind of torch.

Functions which are realized by the controller after receiving the START signal:

1. Material detection / determination of the initial distance between torch and material.
2. Pilot arc conducting / main arc
3. “Breakdown” the material of the certain height
4. Measurement and control of the plasma arc voltage
5. Remaining a certain height of torch above the material
6. Retracting the torch to the safe travel height

Function of material detection can be achieved in two ways:

- With using the floating head, where the arc initiation takes place in a well-defined distance to the material,
- Without using the floating head – activation of the plasma source takes place beyond the material during the lowering of torch – detection of the main arc is equal to the detection of the material under the torch.

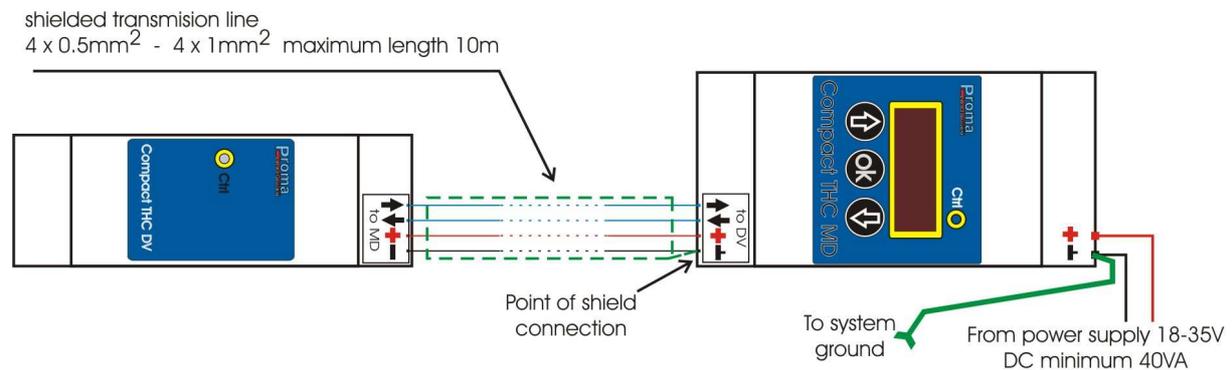
The function of piercing on the certain height is realized to prevent torch damages (splashing) during cutting a thick material.

Thanks to the integration of stepper motor control functions, quick reaction to small changes in the position of material is achieved. This allows for good quality cutting and, lower wear of torch elements.

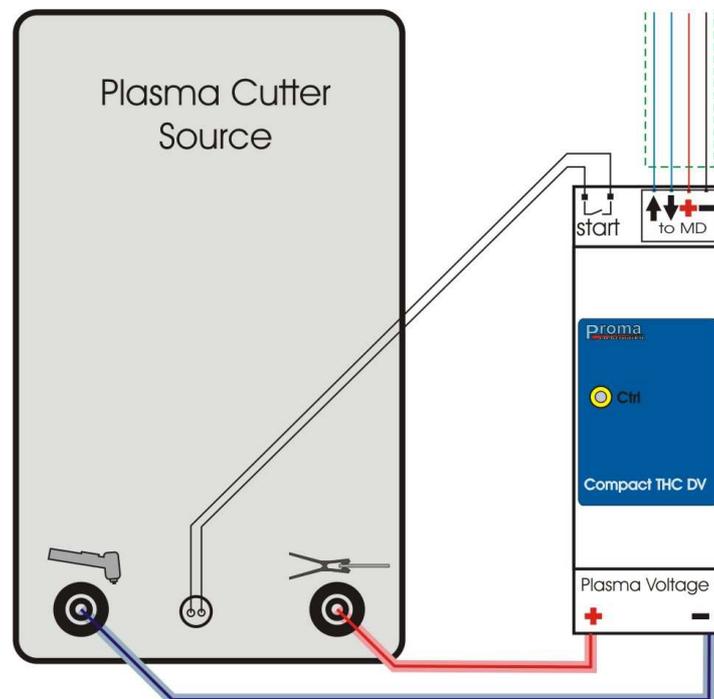
Parameters are loaded by the menu which is operated from the front panel or the ZAXIS computer application.

ATTENTION: All connections should be done with the power off!!!

To the system supply, you need to use the 18-35V DC power supply with a minimal power of 40VA, output voltage stabilization is not required.

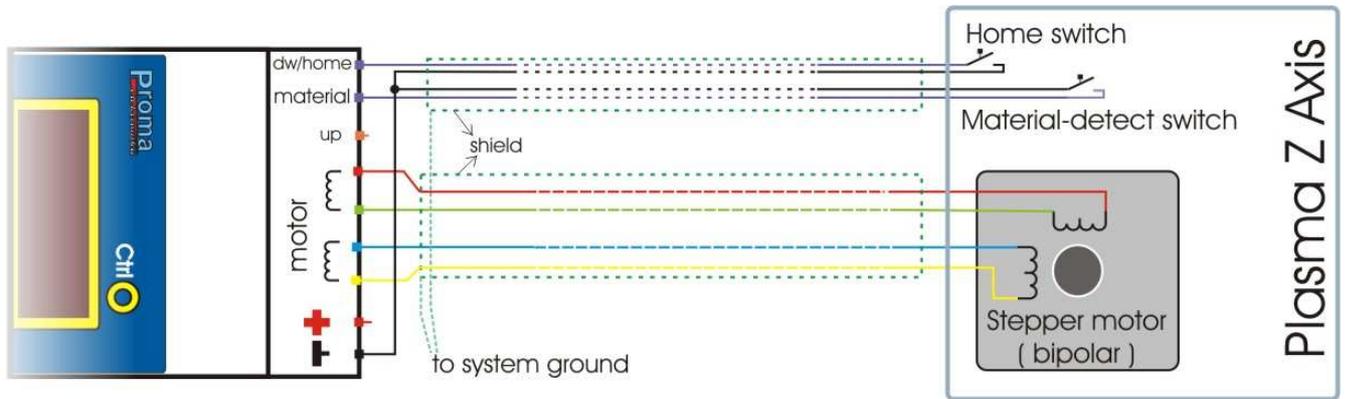


Scheme of plasma source connection



Attention: Voltage which is generated by the plasma source is dangerous for health and life. For safety reasons, the connection should only be carried out an authorized person. The connection of plasma source with the DV module should be carried out with short leads, as to prevent a fire or safety hazard and should be of adequate insulation of the conductive elements.

Scheme of the axis connection:

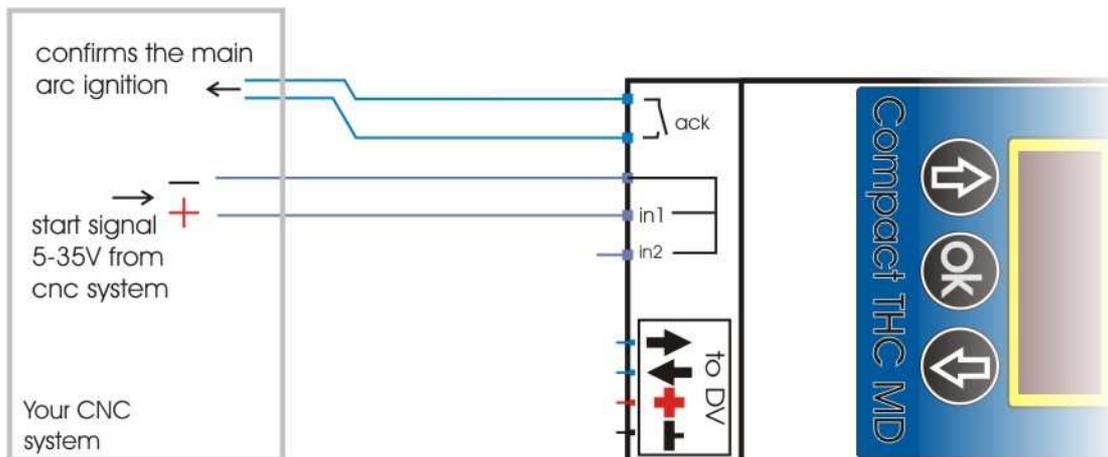


The HOME limit switch is connected to the HOME input on the controller. The switch is placed at the limit of the axis travel.

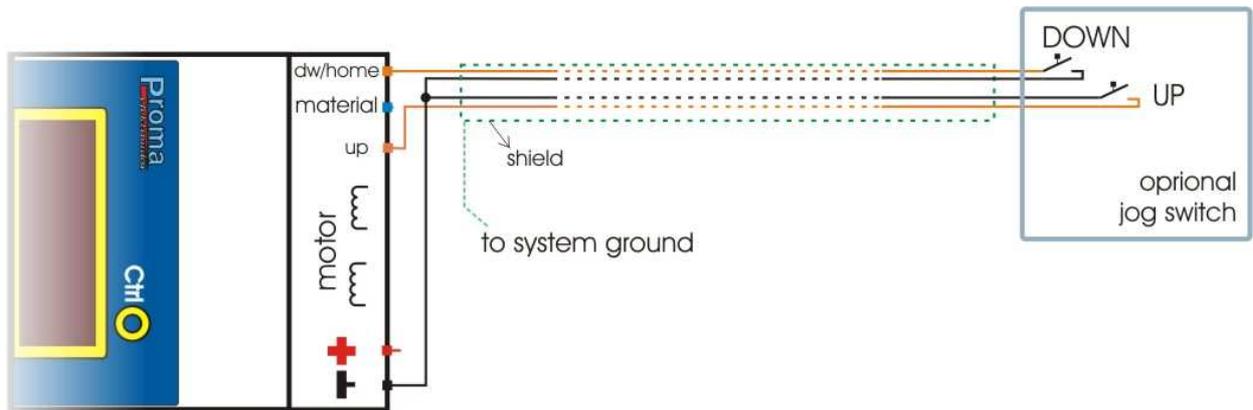
The MATERIAL detect switch connects to the MATERIAL input to the controller.

Attention – Poor connection of motor windings can permanently damage the controller. Before connecting, make sure which conductors are pairs of winding ends.

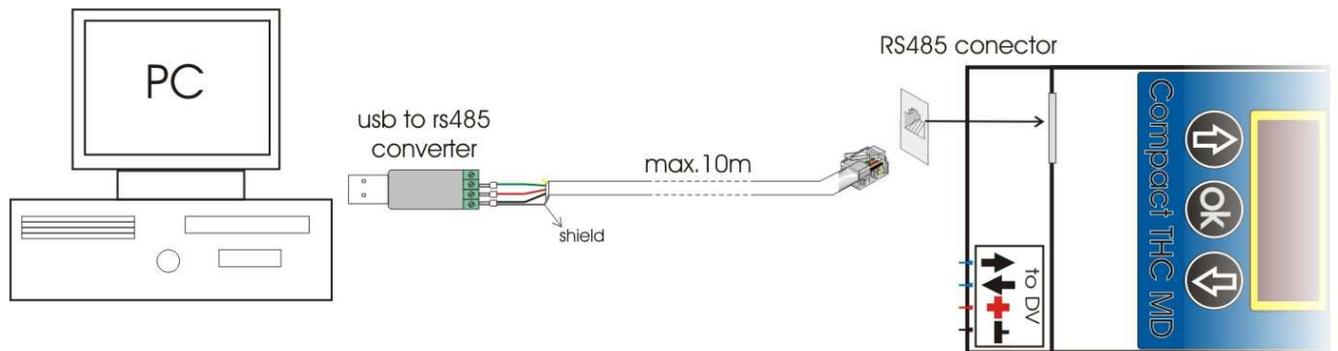
Sample connection of the input and output signal / which confirms the main arc ignition:



Optional connection of the manual control buttons (Jog):



Optional connection with a computer via the USB/RS485 interface:



Programming:

Parameters were divided into two groups: Service parameters and Operating parameters.

After changing any of service parameter, a reset of the MD module is forced.

To the convenient management of parameters on the producer's website you can find a free ZAXIS application (description below). The appliance can be also operated and configured by the MD module front panel without connection with a computer.

Operating parameters			
Parameter No.	Parameter name	Default value	Unit of measure
PA: U	Arc voltage to match cutting voltage (Cut height)	120	V
PA: t0	Delay time for ark to pierce the metal	0,5	s
PA: h1	Piercing height	2,0	mm
PA: 2	Safe travel height	50,0	mm
PA: 3	Initial height of the material detection**	30,0	mm
PA: 4	ARC Measuring sensitivity	3	-
PA: 5	Max speed of motion during cutting	5	mm/s

Service parameters			
Parameter No.	Parameter name	Default value	Unit of measure
PA: 20	Current of motor	1,5	A
PA: 2d	Direction (1 / -1)	1	-
PA: 21	Screw stroke	2	mm
PA: 22	Z axis working rate**	80,0	mm
PA: 23	Maximum speed	20	mm/s
PA: 24	Safe speed	3	mm/s
PA: 25	Ramp (coast down time)	5	-
PA: 26	Hand feed speed (JOG)	10	mm/s
PA: 27	Material detection speed / homing speed	10	mm/s
PA: 28	Correction of material detection	2	mm
PA: 29	Height of travel between cuts	1	mm
PA: 2U	Off-load voltage in plasma source this is the voltage that if the ark is over open metal.	200	V
PA: 2t	Delay of plasma start respond	150	ms
PA: 2A	Work mode FL=floating head, „n-FL”= no floating	FL	-

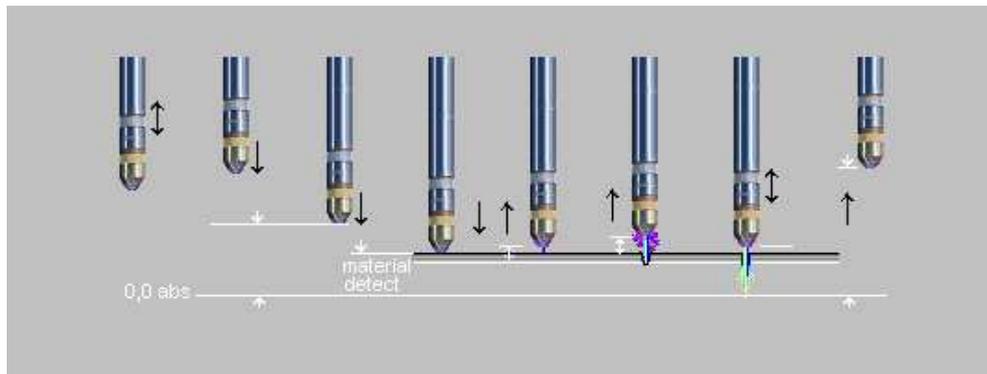
** absolute value (in respect of Z=000,0 machine point)

Description of the work algorithm:

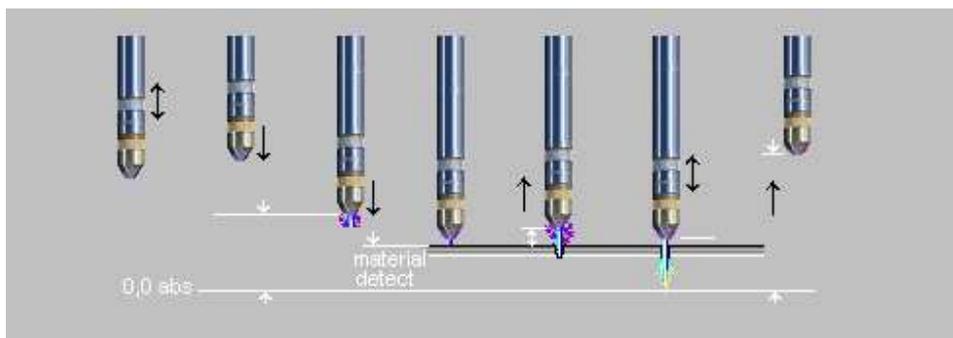
After a powering on of supply, homing of axis with a speed specified in PA:27 parameter upward is activated until the HOME limit switch starts working – it is assigned to the maximum value axis – PA: 22 parameter. The homing can be stopped by pressing any button on the front panel. The controller after this process is in standby mode, waiting for start signal, hand feeds (JOG) are possible. If the START signal is detected, the controller will do a sequence of functions:

- 1) With a maximum speed (PA:23) the position of axis will be reducing to the initial level of material detection (PA:3 parameter).
- 2) Feed speed will be reduced to the material detection speed (PA:27), for “rigid axis” operating mode, plasma source will be added
- 3) The position of axis will be reducing to the moment of material detection:
 - For “rigid axis” operating mode: the moment of main / cutting arc detection
 - For “floating head” operating mode: the moment of MATERIAL limit switch actuationCorrection of material detection is introduced (PA:28)
- 4) If the “floating head” mode was chosen, torch will be located on the transfer altitude (PA:29), where the plasma source will be installed.
- 5) After detection of the main arc, confirming output to the CNC system is actuated, torch will be located on the breakdown altitude (PA:h1) for the time specified in parameter (PA:t0)
- 6) After the breakdown of material, torch will be maintained in a fixed distance from the material, based on the measurement of voltage specified in parameter (PA:U), maximum speed of altitude correction and dynamics are specified in parameters (PA:4), (PA:5).
- 7) When the start signal is removed, the plasma source is turned off and the torch is raised with a maximum speed on the transition altitude, system goes into standby mode(point 1)

Control sequence in the “floating head” FL mode



Control sequence in the “no floating head” n-FL mode



Start the system step by step (without connection with computer):

- 1) First, you should only connect MD module with DV module and connect supply voltage in MD module. When you turn it on, the display should show a message: “Ref”, what indicates on the start of reference travel function, you need to stop this function by clicking OK. LED diode of the DV module should blink. After the proper communication of modules, display of MD module should show a present position, which can be changed using up/down buttons.
- 2) You need to determine key parameters of controller’s work, short pressing of OK button causes an entrance to the menu of working parameters 0+, longer holding causes an entry to the menu of service parameters 20+. In the group of service parameters, you need to entered: motor phase current (PA:20); propeller stroke / shift on one rotation of motor (PA:21); maximum working rate of Z axis (PA:22); Off-load voltage in plasma source: U_o (PA:2U) and type of axis (PA:2A), where “FL” designates a floating head, and “n-FL” “rigid” axis (no floating). To save data in memory and exit menu, you need to find the END position and confirm it with OK. After leaving the service menu, system is reset – reference travel / homing function is reactivated.
- 3) After setting these parameters, you need to turn off the power and connect the motor, HOME limit switch (and MATERIAL if the floating head option was chosen), connect the START signal and CONFIRMATION OF ARC IGNITION in accordance with the predefined scheme. For safety reasons, Z axis should be set in mid-range. Then you can turn the power on and carefully observe a homing process – axis ought to move upwards to activate the HOME switch. The homing process will be automatically finished. If the axis moves in the opposite direction after turning off the power, you should stop this process by pressing any key and change the PA:2d parameter.
- 4) After automatic homing the display should show a maximal position, “manual” relocation of axis of the entire operating range ought to be possible by using the up/down buttons with a speed specified in parameter (PA:26). When you observe indicated positions, you should remember values which will be suitable for the transition altitude and also start value of material detection which ought to be entered into menu of parameters (PA:2; PA:3). If the motor has problems with starting, safe speed should be reduced (PA:24) or/and extend the ramp (PA:25) – however, it causes an extension in time and distance of acceleration and deceleration which helps to slow down the system.
- 5) The next step is an introduction of correction value for material detection:
 - For “rigid axis”, it is a distance from the material, in which the ignition of main / cutting arc takes place, for cut-off machine without pilot arc function (contact ignition) you need to enter the value of 0,0mm;
 - For “floating head”, it is a distance covered by the axis since the contact with material to the activation of the MATERIAL limit switch. To accurately determine this value, we can give a value of voltage for the START input with inactive plasma source, what will cause activation of material detection function and the torch should be positioned above the material on the transfer altitude (PA:29), different distant from the torch to the material indicates an incorrect parameter setting (PA:28).

- The last step is to connect the plasma source in accordance with the predefined scheme. Other parameters are initially located, they should be individually adapted to needs during operation.

PA parameter: U ought to be entered according to data of plasma torch producer or experimentally during cutting – observing the distance from the torch to the material. Increasing the value of specified voltage increases the distance between the material and the torch during cutting. Value which is located too low results in touching the torch to the material.

For more convenient management of parameters, you can use the ZAXIS computer applications, which supervises a controller's work. This application can be downloaded for free from the producer's website: <http://proma-elektronika.pl>