

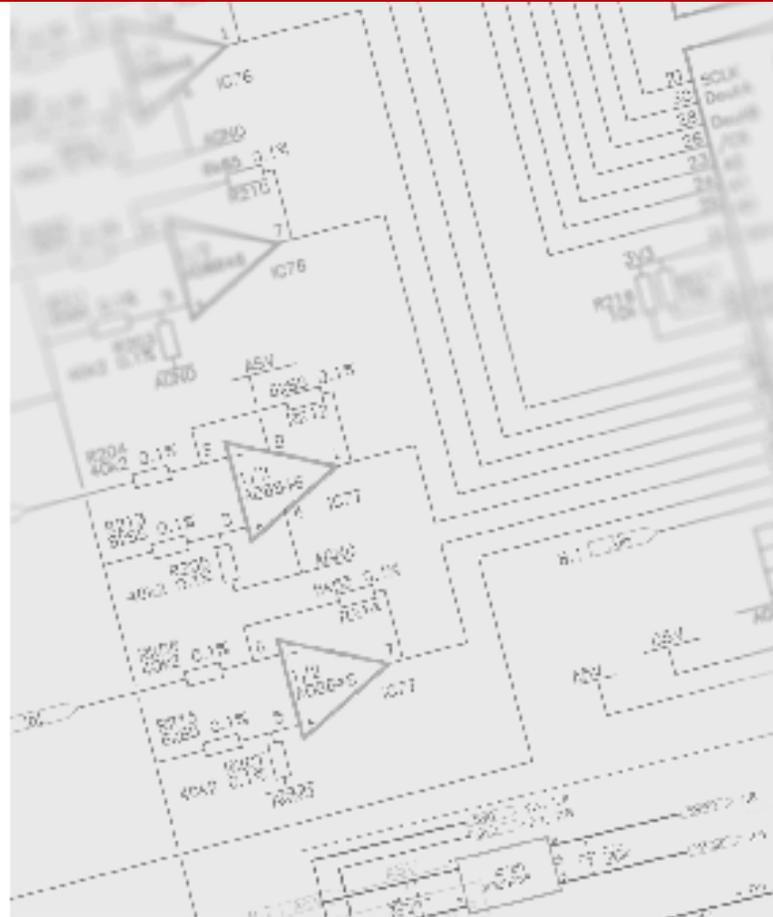
The logo for ENTRON, featuring the word "ENTRON" in a bold, black, sans-serif font with a trademark symbol. A thick red horizontal bar is positioned above the text.

User Manual

EN7000v2

Firmware Version

2.27





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Document Revisions

Date	Document Number	Approved By	Document Changes

Languages

This document is only published in the English language.

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1 BACKGROUND

1.1 Description of the User

This manual has been written to inform qualified custom equipment manufacturers, integrators, control engineers, weld engineers, and/or maintenance technicians how to safely install, setup, operate, and maintain the weld control.

DANGER!



Qualified Personnel Only

The information contained in this manual is intended for Qualified Personnel, as defined by the National Electrical Code (NEC). Always follow Electrical Safety in the Workplace per NFPA 70E or equivalent standard in your location.

This manual has been written for the EN7000v2 AC weld control product line with an EN7000v2 weld timer. The manual applies to the V2.27 version of firmware on the EN7000V2 timer.

This document should be carefully read before installing and operating the weld control. Failure to follow the instructions defined in this manual could create a safety hazard or impact the warranty on the product.

1.2 Conventions Used in This Manual

The following style conventions are used in this document:

Bold Italics type font is used for emphasis

- Bulleted lists generic lists and do not define a sequence or procedures
- 1) Numerical lists define a sequence or procedures

`Courier` text is used for system output, such as an error message or script URLs, complete paths, filenames, prompts, and syntax

1.3 Explanation of Symbols

This section defines the symbols used throughout this document.

DANGER!



DANGER!

Danger indicates a hazard with a high level of risk which, if not avoided, will result in immediate, serious personal injury or loss of life. Examples are: exposed high voltage; exposed fan blades.

WARNING!



WARNING!

The Warning symbol indicates a hazard with a potential hazard which **could result** in personal injury or loss of life. Examples are: not using proper personal protect; removal of guards.

CAUTION!



CAUTION!

The Caution symbol indicates a hazard which **could result** in non-life threatening personal injury or damage to equipment. CAUTION may also be used to alert against unsafe practices.



PACEMAKER

Individuals with cardiac devices should maintain a safe distance due to strong magnetic fields arising from resistance welding. The function of cardiac pacemakers and defibrillators may be disturbed, which may cause death or considerable health damages! These persons should avoid the welding system unless authorized by a licensed physician.

NOTICE



NOTICE

The Notice symbol is used for making recommendations on use or supplementary information. Non-compliance with these recommendations may result in damage to the control, welding machine or workpiece and voiding of the warranty.



HELPFUL TIP

The Helpful Hint symbol is used to provide additional information on a topic that may be helpful to the user.

1.4 Important Safety Instructions

Before installing, starting up, or operating the EN7000v2, carefully read all safety instructions to ensure safe use of the product.

SAVE THESE INSTRUCTIONS

The safety instructions are part of the product. Keep the instructions in a safe and easily accessible place near the product.

DANGER!



Never open the enclosure door when the breaker is in the ON position.

DANGER!



Never operate control with the door open.

DANGER!



Always disconnect power to the weld control before servicing or establishing electrical connections with the product.

DANGER!



Use product only as described in this manual.

DANGER!



Stop Operation if any problems occur. If the equipment is not working as it should, has been dropped, damaged, left outdoors, or has been in contact with water, contact ENTRON.

DANGER!



Only apply the specified power. Application of a voltage or current beyond the specified range can cause electric shock or fire.

DANGER!



Upon receipt of unit, inspect unit for damage from shipping. Before applying power to product, inspect electrical connections to verify the connections are secure.

WARNING!



Except for the internal water-cooling system, keep water and water containers away from product. Water ingress can cause a short circuit, electric shock, or fire.

DANGER!



Keep free of dust and debris.

Do not install the product in any of the following environments:

damp environments where humidity is 90% or higher;

DANGER!



dusty environments; environments where chemicals are handled;

environments near a high-frequency noise source;

hot environments where temperatures are above 40° C / 104° F;

cold environments where temperatures are below 0° C / 32° F;

environments where water will condense.

DANGER!



It is not recommended that holes be drilled into the cabinet. Metal debris inside the cabinet can cause a short circuit, electric shock, or fire. If holes must be drilled it is imperative that all components are protected from debris. Drilling holes in the cabinet may allow dust and other materials to enter the cabinet.

DANGER!



Individuals with cardiac devices should maintain a safe distance due to strong magnetic fields arising from resistance welding. The function of cardiac pacemakers and defibrillators may be disturbed, which may cause death or considerable health damages! These persons should avoid the welding system unless authorized by a licensed physician.

WARNING!



Always ensure cooling water is adequately flowing at the proper rate, temperature, and is of sufficient quality. For water quality requirements, refer to AWS J1.2M/J1.2.2016 Guide Installation and Maintenance of Resistance Welding Machines.

1.5 Technical Support

1.5.1 Internet

The latest version of the documentation and other helpful resources in the ENTRON Document Library page found in the Resource section of the ENTRON website: <https://www.entroncontrols.com>

1.5.2 Documentation Request

Documentation, user instructions and technical information can be requested by emailing ENTRON Controls at customerservice@entroncontrols.com or support@bfentron.co.uk

Please include your name and email

1.5.3 Service and Technical Support

For service and technical support, we request that customers fill out the Technical Support Form found on our website at link below:

NOTICE



TECHNICAL SUPPORT FORM LINK

<https://www.entroncontrols.com/resources/technical-support.html>

After the web form has been completed, your case will be assigned to one of our technical specialists who will contact you directly.

For all other questions, our customer service team is available to assist. The contact information for each our manufacturing and service sites is shown in the table below. Please contact the site for your specific region.

Manufacturing Site	Country	Phone	Email	Regions Supported
ENTRON UK	England	+44-1384-455401	support@bfentron.co.uk	Europe, Asia, Africa, Rest of World
ENTRON US	USA	+1-864-416-0190	tech.support@entroncontrols.com	USA, Canada
ENTRON MX	Mexico	+52-844-415-9081	soporte@entronmx.com	Mexico, Central America

2 INTRODUCTION

2.1 Weld Control

The EN7000v2 Weld Timer Control is primarily a single-phase 50/60 Hz AC control. It can be configured for Single Gun, Multi-Weld Cascade, Seam Weld, Roll Spot, Analog and 3 Phase DC.

Key Configurations of the EN7000v2 for AC & 3 Phase DC welding:

- 1) Available in two models, with or without **Touch Screen** on board programmer.
- 2) Phase Angle control and Constant Current can be combined in single or linked programs to reduce expulsion on pre-heat currents.
- 3) Available Analog Control for certain Seam or Heating applications.
- 4) Available Multi Electrode configuration for cascade machines. This allows shorter cycle times in multi-weld operations.
- 5) Available 3 Phase DC configuration (for use with Inside the Delta 3 phase DC Transformers). Allows equal primary loading with improved power factor for higher current applications.

2.2 Features

The EN7000v2 weld timer control is suitable for various resistance welding and heating applications. These include spot, spot repeat, projection, multi-welding, seam, roll spot including 0 to 10 volts Analog control. The EN7000v2 is available with a range of SCR's. From 300 Amp Air cooled SCRs to 5000 Amps Water-cooled heavy-duty SCRs. The EN7000v2 product range covers a high number of industrial resistance welding/heating applications that use pneumatic pedestal machines, Cascade machines and including large coil joining seam welders.

The primary features are:

- Store up to 256 weld schedules (Programs)
- Data log for up to 6,000 welds
- Real time clock
- 3 weld intervals: Pre-Heat + Main Heat + Post Heat
- Secondary or Primary constant current regulation
- Built in Ethernet/IP
- 2 Analog Inputs
- 1 Analog Output
- 16 Discrete Inputs & Outputs (24 V dc short circuit protected, monitored guided contact safety relay)
- Aux Valves (7)
- Forge Delay using any selected AUX output
- Multiple modes of programming. These include Touch Screen, WSP3 Hand Held Pendant, Net Flash™ Software, MODBUS, Ethernet/IP.
- 0 to 10 volt Analog control mode
- Force profiling
- Electrode management (stepper functions)

INTRODUCTION

Product Hardware Specifications

- Current and Force monitoring
- C-Monitor checks secondary circuit for shunting or wear conditions
- Communication via Ethernet/IP, RS232, RS485, MODBUS TCP/IP, or MODBUS RTU

An EN7000v2 weld control is also available in a Multi-Welder (Cascade) configuration. This configuration allows a user to control multiple weld transformers and multiple weld actuators with a single control. The features of the multi-weld configuration are:

- Control up to 8 weld transformers
- Control up to 8 weld valves (WAV)
- 7 auxiliary valves under program control
- Electrode manager (stepper function) for up to 8 electrodes

For more information on multi-welding refer to the section Multi-Welding Machine of this manual.

2.3 Product Hardware Specifications

The EN7000v2 weld timer control is available with various SCR options and build configurations. The specifications for the standard EN7000v2 product line are defined in this section.

2.3.1 Power Specifications

Description	Value	
Standard Voltage	Single or 3 Phase AC 240V – 575V (+10% / - 20%)	
Line Frequency	50 / 60 Hz	
Standard SCR Options	UK	US
	N/A	300A Air Cooled
	150M Water cooled	1200A Water cooled
	300M Water cooled	1800A Water cooled
	TC500 Water cooled	2200A Water cooled
	TC2000 Water cooled	3200A Water cooled
	TC3000 Water cooled	N/A

Table 1: EN7000v2 Power Specifications Table

2.3.2 Function and Monitoring Specifications

Description	Value
Phase Angle Firing	Percent Available phase heat control
Constant Current Regulation Primary	30 Amps – 4000 Amps (dependent upon CT selection)
Constant Current Regulation Secondary	2kA Amps – 600kA (with a TAM up to x10 module)

Primary Current Range	50A to 4000A
Timing Control	1 cycle at 50Hz / 60Hz.
Duty Cycle Limit	SCR capacity dependent.

Table 2: EN7000v2 Functions and Monitoring

2.3.3 EN7000v2 Weld Timer Specifications

Description	Value
Communications	Ethernet IP 100 BaseT Modbus TCP/IP 100 BaseT RS485 RS232 for WSP3 Pendant
Local Inputs	16 Inputs 24VDC
Local Outputs	16 Outputs 24VDC
Number of Weld Programs	256
Number of Steppers	8 Steppers with 10 Programmable Steps
Language	English

Table 3: EN7000v2 Weld Timer Specifications Table

2.3.4 Environmental Specifications

Description	Value
Operating Temperature	The cabinet internal ambient temperature must not rise above 104 degrees Fahrenheit or 40 degrees Centigrade under normal operation conditions
Humidity	The cooling water temperature must NOT be low enough to cause the formation of condensation inside the inverter.

Table 4: EN7000v2 Environmental Specifications

2.3.4.1 Cooling Water Specifications

Description	Inverter Size	Value
Maximum Water Temperature	All	must not exceed 77 degrees Fahrenheit or 25 degrees Centigrade
Water Quality	All	pH-7-8.5 Hardness max 12.5(UK) 10.5(US)

	<p>Chlorides 20mg/l max</p> <p>Nitrates 10mg/l max</p> <p>Sulphates 100mg/l max</p> <p>Insoluble substances 250mg/l max</p> <p>Deposits in cooling water may cause corrosion/abrasive wear</p> <p>Tap water may meet requirements.</p> <p>An algacide is recommended.</p>
--	---

Table 5: EN7000v2 Cooling Water Specifications

2.4 Main Component Overview

The EN7000v2 weld control is an assembled unit. The major components of the standard 150M/1200A EN7000v2 configuration are identified below and in **Figure 1: EN7000v2 150M 250A Control Layout**.

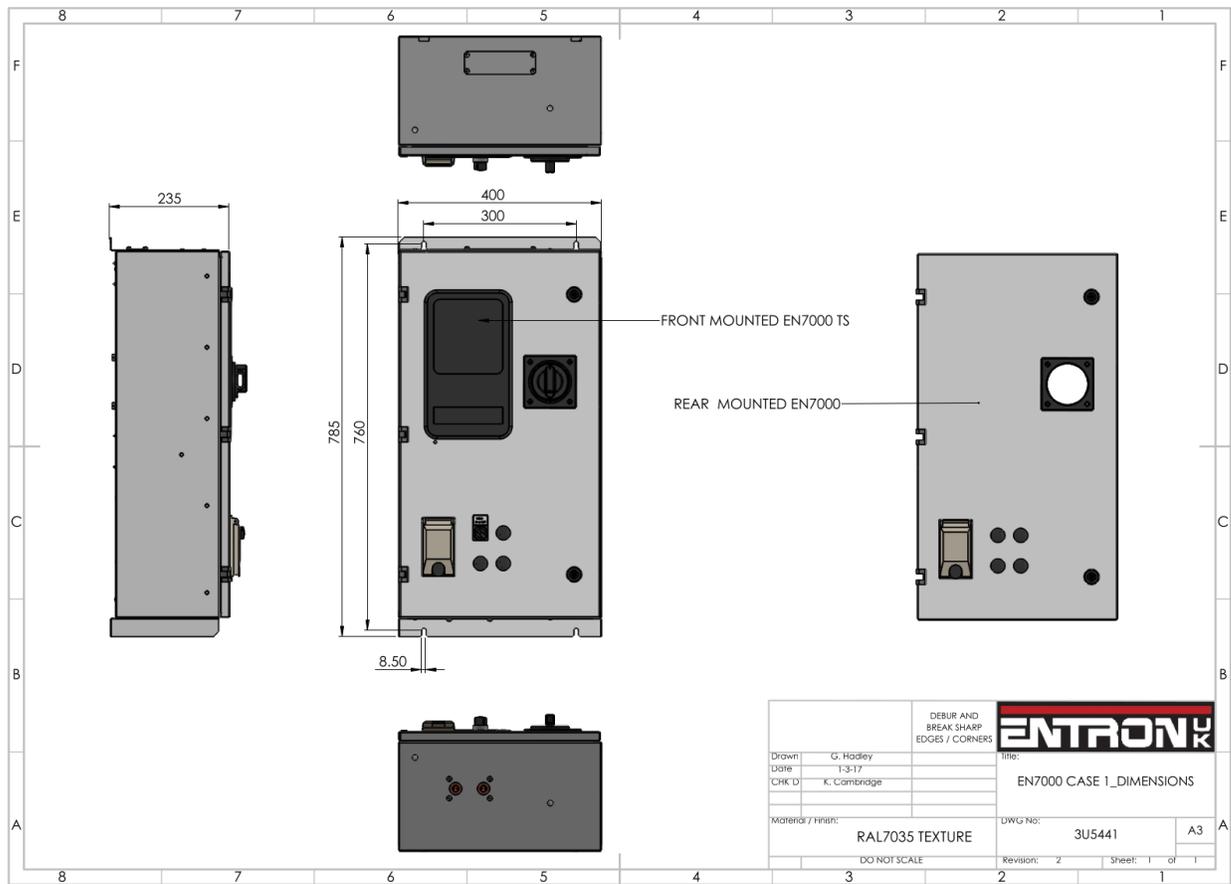


Figure 1: EN7000v2 150M 250A Control Layout

2.5 Wiring Diagrams

The EN7000v2 weld timer control is designed to operate with various size SCRs and up to 8 welding transformers. This section provides the electrical schematic for customer connections when interfacing the EN7000v2 and a generic Weld Control wiring diagram. The drawing is applicable for the following product configurations:

Part Number	Part Description	Wiring Drawing Number	Issue No.	No. of Pages
10-64-21-00-03-13-02-13	EN7000v2-125A-150M-1SW	3U3732	1	3
10-64-21-00-04-13-02-13	EN7000v2TS-125A-150M-1SW			
10-64-21-01-03-13-02-13	EN7000v2-125ET-150M-1SW			
10-64-21-01-04-13-02-13	EN7000v2TS-125ET-150M-1SW			
10-64-31-00-03-13-02-13	EN7000v2-160A-150M-1SW			
10-64-31-00-04-13-02-13	EN7000v2TS-160A-150M-1SW			
10-64-31-01-03-13-02-13	EN7000v2-160ET-150M-1SW			
10-64-31-01-04-13-02-13	EN7000v2TS-160ET-150M-1SW			
10-64-51-00-03-13-02-13	EN7000v2-250A-150M-1SW			
10-64-51-00-04-13-02-13	EN7000v2TS-250A-150M-1SW			
10-64-51-01-03-13-02-13	EN7000v2-250ET-150M-1SW			
10-64-51-01-04-13-02-13	EN7000v2TS-250ET-150M-1SW			
10-64-52-00-04-13-02-13	EN7000v2TS-250A-300M-1SW			
10-64-62-00-23-23-02-13	EN7000v2-400A-300M-1SW	3U3720	2	3
10-64-62-00-24-23-02-13	EN7000v2TS-400A-300M-1SW			
10-64-62-90-14-23-02-13	EN7000v2TS 3PH-300M-400A-1SW	3U3654	1	2
"10-64-0C-20-03-B1-00-10	EN7000/P-1200(2)D/EIP	421548	REV-B	2
10-64-0C-20-03-B1-05-10	EN7000/P-1200(2)D/EIP/OMS			
10-64-0C-20-04-B1-00-10	EN7000TS/P-1200(2)D/EIP			
10-64-0C-20-43-B1-00-10	EN7000/P-1200(2)D/220V/EIP			
10-64-0C-30-03-E1-00-10	EN7000/P-1200(3)L/EIP			
10-64-0C-30-04-E1-00-10	EN7000TS/P-1200(3)L/EIP			
10-64-0C-40-03-E1-00-10	EN7000/P-1200(4)L/EIP			
10-64-0C-70-03-Y1-00-10	EN7000/P-1200(7)U/EIP			
10-64-0C-80-03-Y1-00-10	EN7000/P-1200(8)U/EIP			
10-64-0D-40-04-E1-00-10	EN7000TS/P-1800(4)L/EIP			

INTRODUCTION

Wiring Diagrams

10-64-BC-20-04-B1-00-13	EN7000TS/P-1200(2)D/103/EIP			
10-64-CC-20-03-B1-00-13	EN7000/P-1200(2)D/203/EIP			
10-64-CC-20-04-B1-00-13	EN7000TS/P-1200(2)D/203/EIP			
10-64-CC-20-04-B1-05-13	EN7000TS/P-1200(2)D/203/EIP/OMS			
10-64-CC-20-04-E1-00-13	EN7000TS/P-1200(2)L/203/EIP			
10-64-CC-30-03-E1-00-13	EN7000/P-1200(3)L/203/EIP			
10-64-CC-30-04-E1-00-13	EN7000TS/P-1200(3)L/203/EIP			
10-64-CC-30-04-E1-05-13	EN7000TS/P-1200(3)L/203/EIP/OMS			
10-64-CC-40-03-E1-00-13	EN7000/P-1200(4)L/203/EIP			
10-64-CC-40-04-E1-00-13	EN7000TS/P-1200(4)L/203/EIP			
10-64-CC-60-04-Y1-00-13	EN7000TS/P-1200(6)U/203/EIP			
10-64-CC-80-04-Y1-00-13	EN7000TS/P-1200(8)U/203/EIP			
10-64-DC-20-03-B1-00-13	EN7000/P-1200(2)D/253/EIP			
10-64-DC-20-03-B1-05-13	EN7000/P-1200(2)D/253/EIP/OMS			
10-64-DC-20-04-B1-00-13	EN7000TS/P-1200(2)D/253/EIP			
10-64-DC-20-04-B1-05-13	EN7000TS/P-1200(2)D/253/EIP/OMS			
10-64-EC-20-04-B1-00-13	EN7000TS/P-1200(2)D/403/EIP			
10-64-EC-20-04-B1-05-13	EN7000TS/P-1200(2)D/403/EIP/OMS			
10-64-EC-30-04-E1-04-13	EN7000TS/P-1200(3)L/403/EIP/PLS			
10-64-EC-30-04-E1-05-13	EN7000TS/P-1200(3)L/403/EIP/OMS			
10-64-EC-80-04-Y1-00-13	EN7000TS/P-1200(8)U/403/EIP			
10-64-ED-20-04-B1-02-13	EN7000TS/P-1800(2)D/403/EIP/WNW"			
10-64-OC-00-04-A1-00-10	EN7000TS/P-1200C/EIP			
10-64-OC-00-03-A1-02-10	EN7000/P-1200C/EIP/WNW			
10-64-CC-00-04-A1-00-13	EN7000TS/P-1200C/203/EIP			
10-64-CC-00-64-A1-00-13	EN7000TS/P-1200C/203/575V/EIP			
10-64-DC-00-03-B1-00-13	EN7000/P-1200D/253/EIP			
10-64-CC-00-03-B1-00-13	EN7000/P-1200D/203/EIP	421547	REV-E	1
10-64-ED-00-04-B1-00-13	EN7000TS/P-1800D/403/EIP			
10-64-DC-00-04-B1-00-13	EN7000TS/P-1200D/253/EIP			
10-64-OC-00-04-B1-05-10	EN7000TS/P-1200D/EIP/OMS			
10-64-OC-00-04-B1-00-10	EN7000TS/P-1200D/EIP			
10-64-OD-00-04-A1-00-10	EN7000TS/P-1800C/EIP			

Table 6: Standard Product Wiring Diagram List by Part Number



DOCUMENTATION REQUEST

If your part number is not defined in **Error! Reference source not found.**, please email ENTRON at customerservice@entroncontrols.com to request the drawing for your product. Please include the following in your request: **your name, company name, part number, and product serial number.**

You can also visit www.entroncontrols.com/resources/entron-library.html for pdf versions of the wiring diagrams.

2.5.1 Customer Connections Diagram (3U3633)

The user connections for the EN7000v2 weld timer control for inputs and outputs are defined in Wiring Diagram **Figure 2: 3U3633**. This wiring diagram applies to all EN7000's.

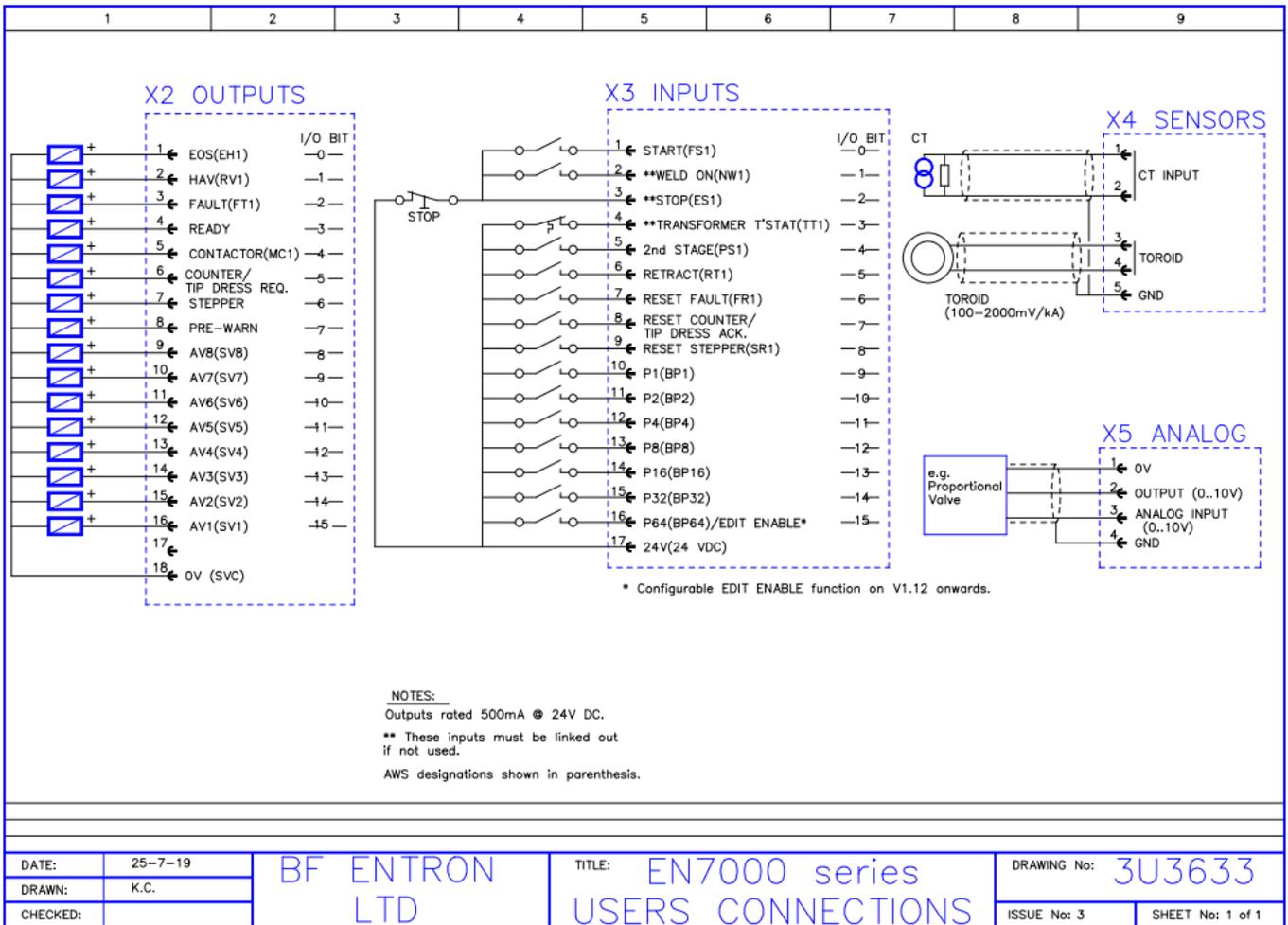


Figure 2: 3U3633

2.6 Standard Machine

A standard machine is a machine with a single weld transformer which in turn connects to a secondary circuit using one set of electrodes. The typical variants of standard machines are:

- Standard pedestal machines
- Manual weld guns
- Robot guns
- Seam welders

Below is a schematic showing an example of a single AC transformer connected to a single set of electrodes. The schematic represents a system where the EN7000v2 weld timer controls the actuation of the weld sequence. By activating the weld air valve (WAV) output to close the weld cylinder and execute the programmed sequence in the selected weld schedule (Program).

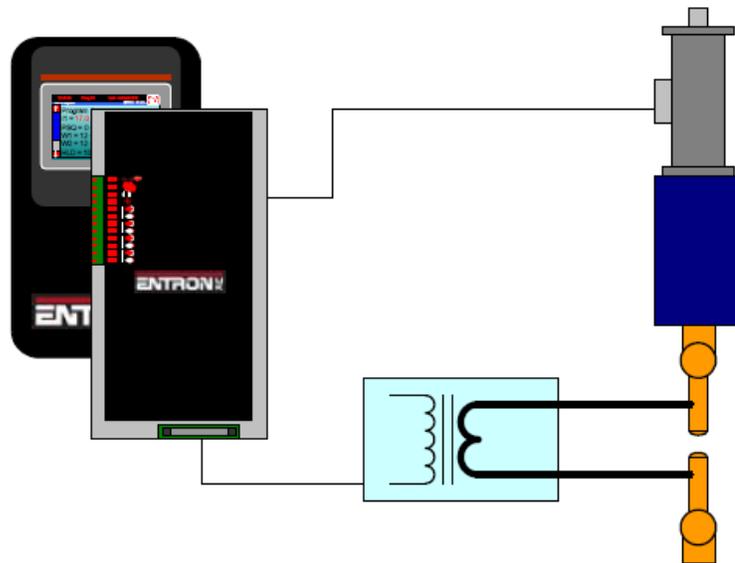


Figure 3: Standard Machine Schematic with Standard EN7000V2

2.7 Multi-Welding Machine

A Multi-Welding machine has multiple valves and/or multiple transformers that are controlled by a single weld control.

There are two types of multi-welding machines that are supported by the EN7000v2 weld timer.

- **Multi-Head Machine** – A Multi-Head machine has up to 8 valves and a single weld transformer. Each valve is typically controlled independently. This type of machine is also referred to as a **Multi-Electrode** or **Multi-Gun** configuration (Refer to the **Multi-weld Operations** Section for programming information).

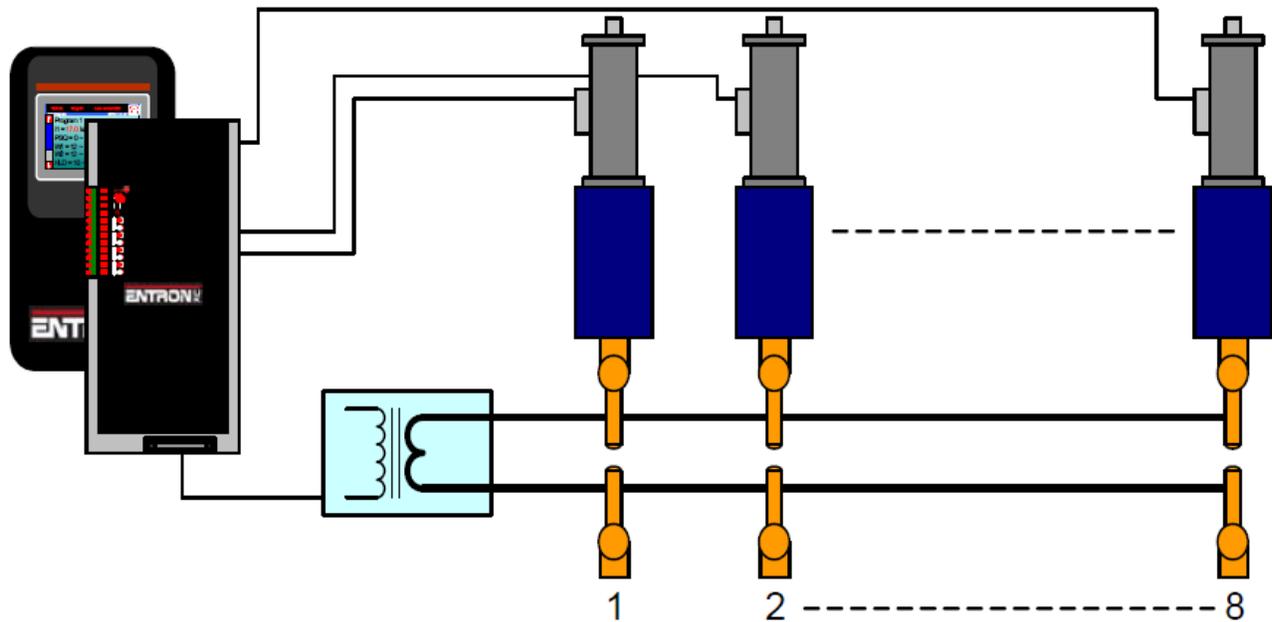


Figure 4: Multi-Head Machine Schematic

- Multi-Welder (Cascade) Machine** – A Multi-Welder machine has up to 8 valves and up to 8 weld transformers. Each valve can be controlled independently. The transformers are controlled independently. Each combination of valve and transformer executes a weld in a sequence or cascading manner. This is why this type of machine is typically referred to as a **Cascade**.

A Multi-Welder (Cascade) weld control requires additional SCRs to control the multiple transformers. A Multi-Welder control must be specified at the time of order with the number of transformers to be controlled.



Cascade / MUX

The EN7000v2 Cascade type weld controls can be identified by the part description. UK built controls the description must contain **e.g 150M or 300Mx2,3-8** which means additional SCRs have been installed in the cabinet to fire additional transformers.

USA built controls the description must contain **e.g 1200 or 1800 (2,3-8)** which means additional SCRs have been installed in the cabinet to fire additional transformers.

INTRODUCTION

Multi-Welding Machine

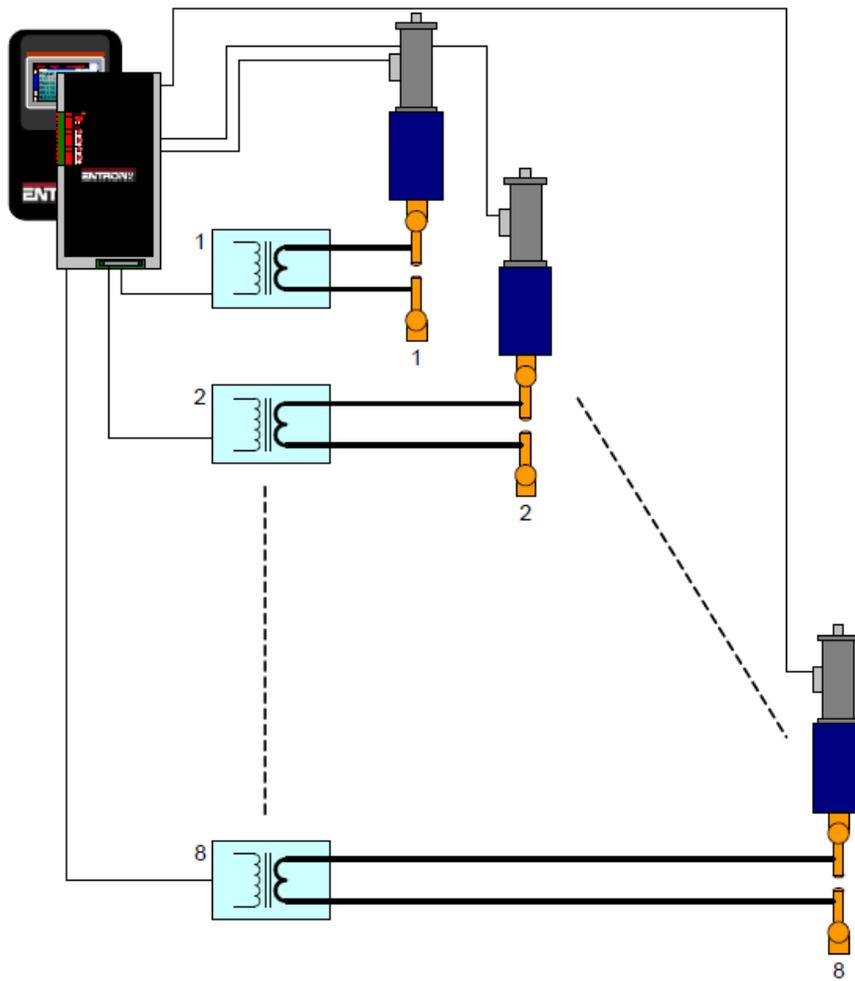


Figure 5: Multi-Welder Machine Schematic

2.8 Modes of Current Control

The EN7000v2 weld timer's primary function is to control the magnitude and duration of the weld current. There are two different modes of current control. The mode is set with each weld schedule. CCR Current control can be calibrated to match an external weld current meter. The calibration procedure tunes the EN7000v2 to match a user's Calibrated Weld Current Meter. Refer to the [Current Calibration](#) Section for detailed calibration instructions.

CONTROL MODES	Definition	Parameter Range	Units	Regulation	Range
PHA Phase Angle	The control triggers the SCRs to fire at a fixed Phase angle.	0% - 99.9% Phase angle (%Heat)	Percent Phase angle	No Regulation	0% - 99.9% ¹
CCR - Constant Current Regulation	Constant current regulation mode. The current parameter is adjustable, but the heat is automatically determined by the timer, as it regulates the current to the set level.	Min kA - Max kA	Amps /Kilo-Amps	Primary or Secondary Regulation	Min kA - Max kA
ANALOG Control	The control follows the analog input. The current heat output depends on the current mode set on the program. If PHA, the analog output is proportional to % heat in open loop mode. If CCR, the current is proportional to the Max available output.	0% - 99.9% Phase angle (%Heat) Min kA – Max kA	Percent Phase Angle /Kilo-Amps	None - Primary or Secondary	0% -99.9% Min kA – Max kA

Minimum firing angle is pre-set. The Maximum firing angles are determined by the power factor set in the current calibration.

The SCR minimum firing is set to avoid erratic gate triggering near zero crossing.

Maximum firing angles may produce little change at high firing angles due to machine power factor. Adjusting the power factor to a lower level, will remap the firing so a change in output is obtained for the full range of heat settings.

30° to 150°

Example: A machine with a long secondary (poor power factor) may have dead angles above certain percent firings. Maximum output current is reached at 70%. Above this point, the machine produces little or no current output change. A reduction of Power factor setting from 0.86 to 0.65, in this case, produces current adjustment up to 99.9%.

Note:- If the power factor is to low 0.40 this can limit the maximum current output of the welding machine.

Table 7: Current Control Modes

2.8.1 Phase Angle Mode “PHA”

Phase Angle Mode (PHA) is open loop control. The current and heat parameters are independently adjustable. Phase angle is maintained (fixed) throughout the weld time. The current parameter is only used for monitoring by comparing to the measured results from phase angle output. The required welding current is programmed in units of % heat.

2.8.2 Constant Current Regulation “CCR”

Firing in Constant Current Regulation (“CCR”) mode, produces a desired target current in kA by automatically varying the phase angle to reach and regulate the actual current. The current parameter in kA is adjustable by the user but the heat % required is automatically adjusted by the EN7000v2 weld control. The current target is programmed in units of Amps or kiloampere (kA) dependent upon measuring source and calibration set-up.

2.9 Installation

The installation of the EN7000v2 weld control should be performed by a trained electrician and all local safety protocols must be followed when installing the unit. These instructions should be carefully read before installation. Failure to adhere to these instructions may invalidate the warranty on the control

2.9.1 Installation Instructions

1) *Inspect Crate*

Upon receipt of the crated EN7000v2, the crate should be inspected for damage. If damage to the crate is found, immediately stop and begin the process to submit a claim with the shipper.

- a. If the shipping terms are FOB: Origin or Ex-Works; the claim should be submitted by the receiver.
- b. If the shipping terms are the responsibility of the seller; the claim should be submitted by the shipper of record.

2) *Unpack Control*

Unpack the control and examine the exterior and interior of the control for damage. Verify there are no loose components or wires inside the control.

DANGER!



SHIPPING DAMAGE!

If damage to the control is identified, do **NOT** hook up to a power source. Immediately contact ENTRON for support.

3) *Move Control to Machine*

The control should be lifted using a cable and lifting device rated for the weight of the control. The EN7000v2 may be supplied with eye bolts or two feet. When eye bolts are not supplied with the control, a spanner bar should be bolted to the control mounting tabs and connected to the lifting cable.

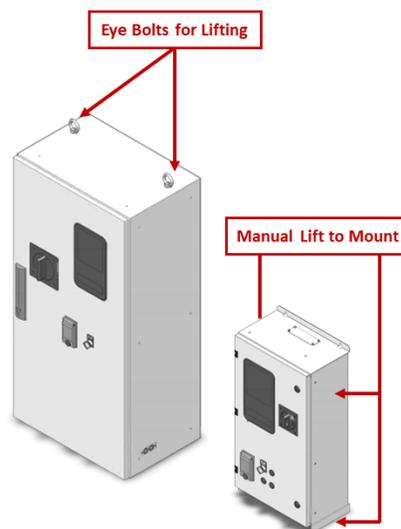


Figure 6: EN7000V2 Typical Lifting Points

WARNING!



DROPPED CONTROL!

If a control is dropped, immediately stop. Do NOT hook up to a power source. Immediately contact ENTRON for support.

4) Lock out Power

WARNING!



Verify the power source has been locked out at the distribution panel or other power source.

LOCKOUT / TAGOUT!

Always follow your local regulations and facility procedures for locking out electrical connections. Always verify power is OFF before wiring control.

5) Mount the Control

Mount the control in the desired location using the protruding mount tabs on the exterior of the cabinet. Properly sized bolts should be used based on the control weight.

6) Verify the circuit breaker is OFF

Verify the circuit breaker is in the OFF position

7) Remove and Modify Access Panels for Electrical Connections where applicable

- Remove the access panels on the top of the control where applicable. Cover internal parts prior to Drilling the desired access holes for Power cables and I/O connections.
- Wire all desired I/O connections.

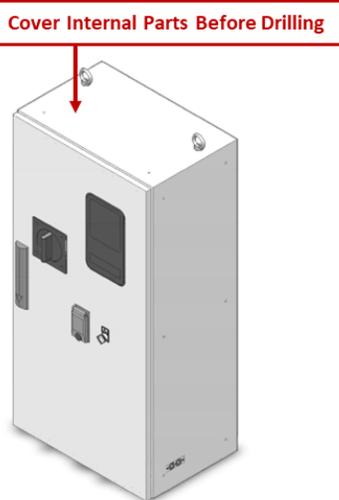


Figure 8: EN7000 Control without Access Points

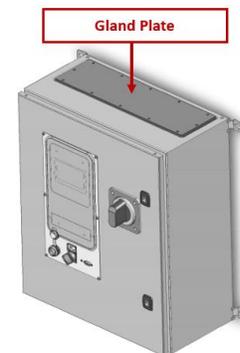


Figure 7: EN7000 Control with Access Plate Only

WARNING!



DRILLING INTO CABINET

It is not recommended that holes be drilled into the cabinet. Metal debris inside the cabinet can cause a short circuit, electric shock, or fire. If holes must be drilled is imperative that all components are protected from debris.

8) Connect Cooling Water

Plumb the IN and OUT cooling water lines to the water manifold. The standard configuration has the water manifold located on the bottom of the cabinet. This may vary depending on the case model.

9) Test Water Connections

Turn on the water-cooling circuit and verify there are no leaks inside or outside the cabinet. Verify the water flowrate meets the specifications for the SCR module.

10) Connect Ground

Connect plant ground to the grounding post inside the cabinet.

11) Connect AC Power

Connect the line power cables to L1, & L2 connection points on the input side of the circuit breaker (top). Refer to the wiring diagram for more information.

12) Connect the Weld Transformer

- a. Connect the Weld Transformer to the H1 and H2 connection points in the weld control. Refer to the wiring diagram for more information.
- b. Connect the Weld Transformer ground connection to the grounding bus bar connection inside the cabinet.
- c. Always route the transformer TLS and current coil leads (Toroid) in conduit separate from the power cables.

13) Inspect Connection Points

Inspect all electrical connections inside the cabinet to verify connections are tight and secure.

14) Close and Lock Door

Close the cabinet door. Using the provided key rotate the door locks to seal the cabinet door.

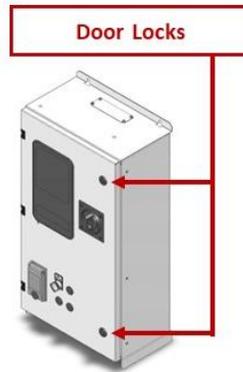


Figure 9: Location EN7000v2 Door Locks



DOOR INTERLOCK!

The cabinet door is interlocked with the breaker. NEVER defeat this safety device. NEVER open the cabinet door or access the interior of the cabinet when the unit is under power.

15) Connect WSP3 Pendant

If the WSP3 handheld pendant was purchased with the control, please connect this to the RS232 port on the front of the cabinet.

16) Remove Lock Out

Remove the Lock Out device at the power source

17) Verify Cooling Water is ON

Verify the cooling water is flowing at the proper flowrate and temperature for the control.

18) Turn ON Power

Turn the breaker handle to the ON position to power up the control.

19) Check WSP3 Pendant Messages

If the WSP3 pendant was purchased with the control, check the messages on the handheld pendant. If any faults are displayed, go to the [Fault and Status Messages](#) section for a detailed explanation.

20) Connect Desired Programming Device

Connect the desired programming device to the control.

21) Configure the Control

Configure the EN7000v2 welding control to your required resistance welding process. See the [Configure the Control](#) section for more details.

22) Set the IP Address of the Control

Set the IP address of the control following the procedure defined in [Set the IP Address of the Control](#) section.

23) Calibrate the Control

To optimize the performance of the EN7000v2 the unit should be calibrated to the machine secondary circuit and external weld current meter. Losses in the secondary circuit due to impedance or other factors can reduce the energy output between the electrodes. Refer to the [Calibrate Current](#) (Toroid / Rogowski coil) of the manual for detailed instructions. The method of calibration is a function of the mode of regulation set in the configuration (primary or secondary current).

24) Program Weld Schedules

The control is now ready for use. Begin programming or uploading your weld schedules to the EN7000v2 weld timer.

2.9.2 Configure the Control

The EN7000v2 weld timer is a flexible device that can be adapted in a variety of ways to fit your welding application. The configuration defines the following parameters:

- Features (Standard or Extended)
- Weld type
- 2nd Stage
- Sensor (Feedback)
- Toroid Test
- Frequency (50 / 60 Hz)
- Units (Metric / Imperial)
- Stop on fault
- EOS on fault
- Head Lock
- Prog select
- SCR select
- Electrodes
- Retract
- I/O Source
- Analog control
- Analog out
- Waveform 10v =
- Contactor
- Com2
- Com3
- Ethernet
- Backup to WSP3
- Restore from WSP3
- Initialise data (This resets to factory defaults)
- Restart system

The recommended method for configuring the control is with the NetFlash™ software. The NetFlash™ software has a single configuration tab that allows the user to see all of the configuration parameters on a single screen.

The configuration parameters can also be programmed via the WSP3 pendant and through ModBus communication.

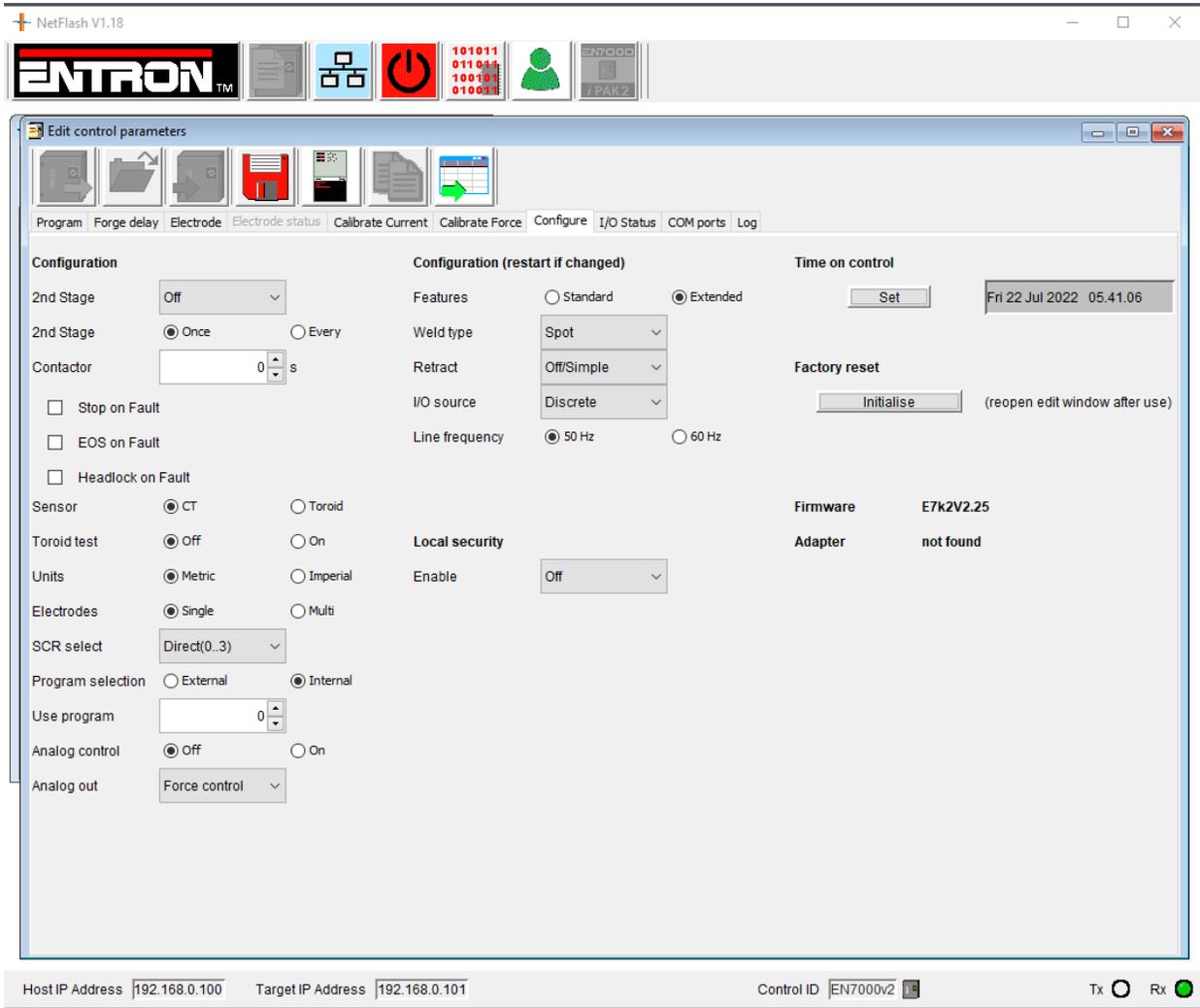


Figure 10: NetFlash Configuration Tab

The features checkbox allows the user to access advanced features in the control by selecting **Extended**.



The EN7000v2 must be restarted for this change to take effect.

VALUE	Description
Standard	Default setting with basic features. This is selected for spot, spot repeat, and projection welding applications. It is typically used with a Single Transformer Machine type.
Extended	Extended mode enables advanced features in the programming interface. This is selected for spot, spot-repeat, projection, multi-welding, cascade, roll-spot, and seam welding applications. It is typically used with Multi-Weld machine types and seam welding applications.

2.9.2.1 2nd Stage / Welder interlock wait.

The 2nd Stage parameter defines whether or not a second input signal is required for the control to complete the weld sequence. Typically, the 2nd stage input is a signal that defines a part is present or pressure limit has been reached. If a Welder interlock is used in the facility, the 2nd Stage may also be used to wait at the end of squeeze until it gets permission to weld from the Interlock.

Value	Description
Off	The 2 nd Stage input is not used.
Before Squeeze	<p>The 2nd stage input is checked before the Squeeze interval. The motor output is activated when 2nd Stage input is confirmed. The Motor Output is only used for Seam Welding applications.</p>
After Squeeze	<p>The 2nd Stage input is checked after the Squeeze interval. The motor output is activated when the 2nd Stage input is confirmed. The Motor Output is only used for Seam Welding applications.</p>
Once	The 2 nd Stage input is checked only at the start of a cascade sequence
Every	The 2 nd Stage input is checked at the start of every program within a cascade sequence

2.9.2.2 Contactor

The Contactor output can be sustained for a pre-defined time following the weld. This value can be set from 0 to 99 seconds.

2.9.2.3 Stop on Fault

The Stop on Fault checkbox is used to define how the system will react to a fault. When the parameter is checked the weld-air valve opens as normal but subsequent events are inhibited until a fault reset command is given.

2.9.2.4 EOS on Fault

When the “EOS (End of Sequence) on Fault” checkbox is checked the EOS signal will be activated even on a fault, when a fault is detected.

2.9.2.5 Headlock on Fault

When the “Headlock on Fault” checkbox is checked, the weld air-valve output is held On and subsequent welds are inhibited until the fault is reset.

2.9.2.6 Toroid Test

The Toroid Test checkbox defines whether the connected toroid (Rogowski coil) should be validated by the weld control. When the value is checked the signal from an external toroid (Rogowski coil) must lie with a range of 10 to 300 Ohms.

2.9.2.7 Units

The Units parameter defines the units of measure for the force parameter in the device.

Value	Description
Metric	Measure force in KN
Imperial	Measure force in lbf

2.9.2.8 Electrodes

Choice between a Single or Multiple Electrodes can be made. Electrodes have multiple functions within the weld control.

A) Electrode management in the form of STEPPERS - See Electrode Management/Stepper section.

B) SCR/Transformer can be assigned to up to 8 Electrodes, thereby allowing weld programs to turn on the assigned Transformer in a Cascade control. – See Cascade operation.

2.9.2.9 SCR Select

Value	Description
Direct (0-3)	Single SCRs or Cascade up to 4 SCR/Transformers
Encode (0-7)	Cascade Up to 8 SCRs
3 Phase	Fire 3 SCRs to drive 3 Phase Power supply "Inside Delta" configuration.

2.9.2.10 Program Select

The Program Select parameters defines what communication type defines the weld program to use.

Value	Description
External	Discrete Binary input state assign program selection in Discrete mode. Fieldbus Binary input state assigns program selection in Fieldbus mode.
Internal	The Use Program parameter selects the weld program. This can be set by Netflash™ or WSP3 Hand Held Pendant

2.9.2.11 Analog Output

The Analog Output parameter defines what signal the control will output on the analog channel.

Value	Description
Force	The analog output is used to control force.
Current	The analog output corresponds to the measured weld current. The measured current is defined by the Measure parameter.

2.9.2.12 Analog Control

The Analog Control setting diverts heat / current control to the Analog input port. The Heat / Current parameters in any program will be ignored. Instead, a 0-10V input will adjust current as needed from external means.

2.9.2.13 Retract

The Retract parameter defines the requirements for inputs and outputs related to a retraction value. The profiles of each setting are defined below.



The EN7000v2 must be restarted for this change to take effect.

Value	Description
Off/Simple	<p>The diagram for 'Off/Simple' shows four signals over time. Retract input is a single pulse. HAV output is a pulse that occurs during the Retract input pulse. START input is a pulse that occurs after the Retract input pulse. WAV output is a pulse that occurs during the START input pulse.</p>
Hi-Lift +	<p>The diagram for 'Hi-Lift +' shows four signals over time. Retract input has two pulses. HAV output is a pulse that occurs during the first Retract input pulse. START input is a pulse that occurs after the first Retract input pulse. WAV output is a pulse that occurs during the START input pulse.</p>
Hi-lift -	<p>The diagram for 'Hi-lift -' shows four signals over time. Retract input has two pulses. HAV output is a pulse that occurs during the second Retract input pulse. START input is a pulse that occurs after the second Retract input pulse. WAV output is a pulse that occurs during the START input pulse.</p>
maintained	<p>The diagram for 'maintained' shows four signals over time. Retract input has two pulses. HAV output is a pulse that occurs during the first Retract input pulse. START input is a pulse that occurs after the first Retract input pulse. WAV output is a pulse that occurs during the START input pulse.</p>

2.9.2.14 Sensor

Value	Description
CT – (Primary)	Measure the primary welding current (ie weld transformer primary current) The EN7000v2 can display secondary current when the relationship between primary and secondary current has been calibrated.
Toroid – (Secondary)	Measure the secondary welding current. <i>This function requires a toroid sensor (Rogowski coil) to be connected to the weld control.</i>

2.9.2.15 Line Frequency

The local operating Line Frequency should be set. 50Hz or 60Hz.

2.9.2.16 I/O Source

The I/O Source defines the communication of the inputs and outputs for the EN7000v2 weld timer.



The EN7000v2 must be restarted for this change to take effect.

Value	Description
Discrete	Use the discrete inputs and outputs
COM0	Use MODBUS TCP/IP (Ethernet) on COM0
COM1	Use MODBUS TCP/IP (Ethernet) on COM1
COM2	Use MODBUS RTU (RS485) on COM2
COM3	Use RS232 on COM3
COM4	Use MODBUS TCP/IP (Ethernet) on COM4
COM5	Use MODBUS TCP/IP (Ethernet) on COM5
COM6	Use EtherNet/IP on COM6

2.9.2.17 Local Security

The Local Security dropdown menu (*NetFlash*) allows the user to select a security function that prevents all users from changing the parameters. When the security feature has been enabled all parameters are Read-Only to users who do not have the security code or key.



The EN7000v2 must be restarted for this change to take effect.

Value	Description
Off	No security is enabled on the device. Any user can modify any parameters on the EN7000v2
Keyswitch	An external device such as a keyswitch can be connected to the control on the P64 input. The external device can be specified at the time of order.
PIN(WSP3)	A PIN number up to 5 digits long can be defined to access the parameters

2.9.2.18 Time on Control

The time on the control can be manually set by clicking the `Set` action button. This allows a user to set the physical time on the EN7000v2 to their time zone to ensure fault monitoring and the weld data log are timestamped to the user's local time.

The EN7000v2 must be restarted for this change to take effect.

2.9.2.19 Factory Reset

The control parameters can be set to the default values by clicking the `Initialise` action button.



The EN7000v2 must be restarted for this change to take effect.

CAUTION!



CAUTION!

Any previously stored parameters and calibration settings will be lost. Insure a backup file has been stored to a PC or WSP3 before executing a factory reset.

2.9.3 Current Calibration

The welding current can be measured using a CT (Current Transformer) on the primary or by a Toroid (Rogowski coil) on the secondary circuit.

The **CT** is sensor is supplied as standard. It measures the Primary Current. The EN7000v2 can display primary current or scaled to display secondary kA when a turns Ratio is applied. When using the 2 point calibration method, it closely tracks an external weld current meter. The external **Toroid** is mounted on the secondary of the welder and the EN7000v2 directly measures Secondary Current. The default sensitivity of 150mV/kA can be adjusted to match an external weld current meter.

Parameter	Units	Range	Description
Power Factor	Cos (Φ)	0-0.86	Power factor of the welding machine
Toroid	mV/kA	1-60000	Sensitivity of the toroid
Toroid Factor		1-10	Attenuator Ratio. 1 if No attenuator is present
CT	mV/kA	1-60000	Sensitivity of the CT
Point 1 Primary	kA	0-32.0	Measured Primary Current at Low heat
Point 1 Secondary	kA	0-500.0	Measured Secondary Current at Low heat
Point 2 Primary	kA	0-32.0	Measured Primary Current at High heat
Point 2 Secondary	kA	0-500.0	Measured Secondary Current at High heat
Apply conversion		Off/points/ratio	Use the conversion to display secondary current (CT) Only
Turns ratio		1-999	The turns ratio of the welding transformer (CT) only
CCR gain ¹		1-10	The CCR gain. Set to 5 as starting point
CCR 0V= ²	kA	0-500.0	Scales the Analog control input for CCR operation

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CCR 10V= ²	kA	0-500.0	Scales the Analog control input for CCR operation
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¹ Seam Mode Only. -- ² Analog control Only --

Typical Applications	Spot Projection Seam	Spot Projection Multi-Weld (Cascade) Multi-Head Seam Analog	Spot Projection Multi-Weld (Cascade) Multi-Head Seam Analog
Tool/Sensors Required	Weld Current Meter & Secondary Toroid Sensor (Rogowski coil)	Weld Current Meter	None
Regulation Configuration Setting	Toroid	CT	CT
Displayed Current Value	Secondary Current	Primary Current	Primary Current
Calibration Steps	1	Set Power Factor	Set Power Factor
	2	Match Control reading to Secondary current meter by adjusting toroid sensitivity	Set Turns-Ratio to the weld transformer Turns Ratio
	3		Take 2 readings and note Primary and Secondary Currents
	4		Set CT to 2 Point
	5		Fill the 4 corresponding fields with values obtained on Step 3
	6		Secondary Current Value Displayed

Learn Heat curve before using CCR	7	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA
		Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA
		Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA	Before using CCR Mode, program heat in % Phase angle to reach desired current. Once current is reached, switch to CCR and program current in kA

2.9.3.1 Set Power Factor of the Welder

An AC welding machine will have a power factor which is determined by the physical properties and geometry of the electrical system. Linear control of the machine over the full heat/current range can be achieved by programming the correct value for the power factor.

The following procedure involves running the machine at maximum output. Make sure that the mains supply and the secondary circuit are able to handle this power. Make sure that any cooling system is active. The machine must be cycled short circuit with no component.

1	Prepare a weld program with 5 cycles of main heat plus Squeeze and Hold time as appropriate. Set PHA mode, 0 %heat. Connect this program to the electrode to be calibrated
2	Select the connected electrode program and enter Power factor = 0.4
3	Cycle the machine and check that a current is measured.
4	Set 99.9 %heat in the weld program.
5	Cycle the machine then check the displayed conduction percentage, if this is less than > 99.9% Then increase the power factor and cycle the machine. Repeat this process until 99.9% is displayed.
6	If the STATUS shows conduction is at near 99.9%. Power Factor is set.

Repeat the procedure for each electrode program to be used.

2.9.3.2 CT Turns-Ratio – Not matched to external meter.

The Turns Ratio setting allows the user to set the turns-ratio of the weld transformer connected to the EN7000v2. The turns ratio is used to calculate the secondary current from the measured primary current.

The calibration procedure for setting the turns-ratio using NetFlash™ is:

- 1) Determine the Turns Ratio from the welding transformer data sheet or transformer product label
- 2) Connect the computer to the control via an Ethernet cable
- 3) Turn ON the EN7000v2 weld control
- 4) Open the NetFlash™ software application on a computer and connect to the target control
- 5) Load the parameters from the target control by clicking the **Load From Control** Icon



- 6) Navigate to the **Calibrate Current** tab

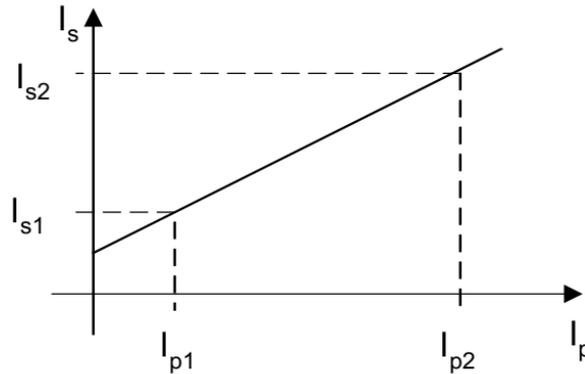
Power factor	0.86	
CT sensitivity	195	mV/kA (1950)
Toroid sensitivity	150	mV/kA (150)
Toroid Factor	1	x
CT current conversion (primary to secondary)		
Apply conversion	Use turns ratio	
Turns ratio	:1	

- 7) Select **Use Turns Ratio**
- 8) Enter the weld transformer Turns-Ratio into the **Turns-Ratio** field and press Enter or Tab to push the change to the control

CT current conversion (primary to secondary)	
Apply conversion	Use turns ratio
Turns ratio	50 :1

2.9.3.3 Points 1&2 Method. Match a calibrated current meter.

The Points 1&2 calibration method is more accurate than the Turns-Ratio method. This procedure requires an external current measuring device such as an ENTRON WA2 Weld Analyzer. The process requires the user to establish the relationship between the primary current and the secondary current over the desired output range. After calibration, the EN7000v2 uses the calibration table to calculate the secondary current from the measured primary current.

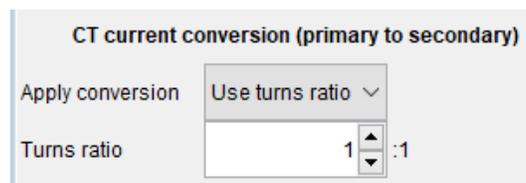


To calibrate the built-in CT sensor using the Point 1&2 method, follow the steps defined below:

- 1) Get an external current measuring device such as the ENTRON WA2 Weld Analyzer and setup the device to measure the secondary circuit.
- 2) Connect the computer to the control via an Ethernet cable
- 3) Turn ON the EN7000v2 weld control
- 4) Open NetFlash™ software application on a computer and connect to the target control
- 5) Load the parameters from the connected control by clicking the “Load From Control Icon”

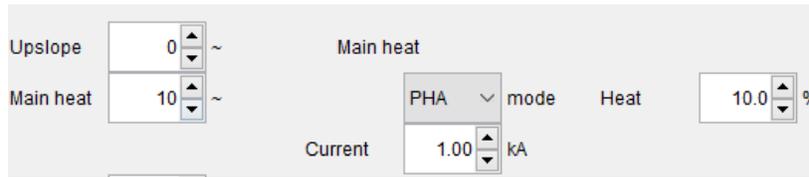


- 1) Navigate to the **Calibrate Current** tab
- 2) Check the **Turns Ratio** checkbox and set the Turns Ratio to 1 : 1



- 1) Navigate to the **Program** tab in NetFlash
- 2) For the active weld program
 - a. Set the **Squeeze** time to 99 cycles
 - b. Set the **Upslope** to 0
 - c. set the **Main Heat Mode** to PHA

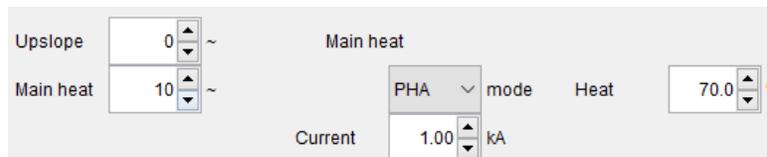
- d. set the **Heat** value to a low value such as 10.0%
- e. set the **Main heat** time to 10 Cycles.



PHA MODE

When the **Main Heat** input is set to **PHA** mode, the **Current** input value is ignored by the control. The output of the weld control will be a equivalent of **Heat** input.

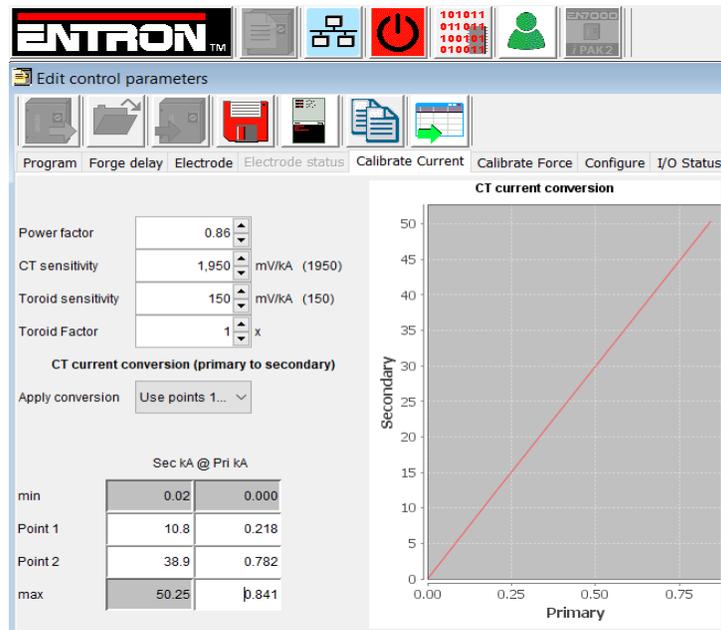
- 6) Produce a short circuit weld
- 7) Note the following values:
 - Ip1 = Primary Weld Current 1 (viewed in the Log tab or metrics window, timer touch screen status or WSP3 Pendant status)
 - Is1 = Secondary Weld Current 1 (measured by the external current monitor)
- 8) For the active weld program, set the **Heat** value to a higher value such as 70%



- 1) Produce a short circuit weld
- 2) Note the following values:
 - Ip2 = Primary Weld Current 2 (viewed in the Log tab or metrics window, timer touch screen status or WSP3 Pendant status)
 - Is2 = Secondary Weld Current 2 (measured by the external current monitor)
- 3) Navigate to the **Calibrate Current** tab
- 4) Enter the Ip1, Ip2, Is1 and Is2 values into the table as shown below

	Sec kA @ Pri kA	
min	0.02	0.000
Point 1	is1	ip1
Point 2	is2	ip2
max	50.25	0.841

- 1) After updating each of the Ip1, Ip2, Is1 and Is2 values, press Enter or Tab after each field change to update the control with the new value.
- 2) The CT current has now been calibrated.



VERIFY UPDATE

To verify the Is1, Is2, Ip1, and Ip2 have been stored by the control. Close the NetFlash™ program, reopen NetFlash™, and reconnect to the target control. The calibration values entered should show on the Calibrate Current tab.

2.9.3.4 Secondary Measuring (Toroid / Rogowski coil)

Calibration. Secondary Measuring requires an external toroid (Rogowski coil). The toroid is connected around the welding transformer secondary. Most such coils have a nominal output of 150 mV/kA. The EN7000v2 provides a sensitivity parameter which may be adjusted to provide absolute matching with an external current meter.

The procedure for adjusting the sensitivity of the Secondary Measuring output from the EN7000v2 is as follows.

- 1) Turn Off the EN7000v2 weld control
- 2) Install the Toroid (Rogowski coil) around the welding transformer secondary
- 3) Connect the Toroid (Rogowski coil) to the EN7000v2 via Connector X4(Sensors) as shown in User Connection Drawing 3U3633
- 4) Get an external current measuring device such as the ENTRON WA2 Weld Analyzer and setup the device to measure the secondary circuit.
- 5) Connect the computer to the control via an Ethernet cable

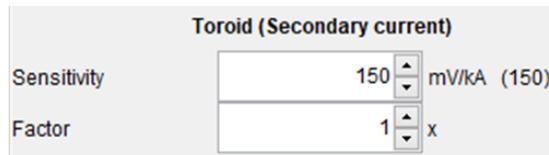
- 6) Turn ON the EN7000v2 weld control
- 7) Open NetFlash™ software application on a computer and connect to the target control
- 8) Load the parameters from the connected control by clicking the **Load From Control** Icon

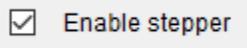
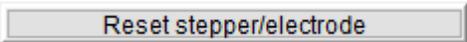


- 9) Navigate to the **Configure** tab
- 10) Select **TOROID** as the Sensor

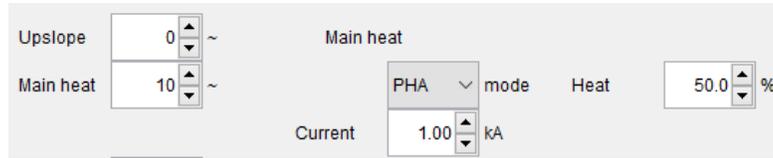


- 11) Navigate to the **Calibrate Current** tab
- 12) Set the **Factor** signal based on the expected Secondary Current
 - a. If the current is not expected to exceed 50 kA, then set the factor to 1
 - b. If the current is expected to exceed 50 kA, then the factor should be set based on the TAM/1 and the attenuator option (x1, x2, x3, etc.)



- 13) Navigate to the **Program** tab
 - a. If the active weld program has an **Electrode Stepper** programmed, the stepper must be reset to ensure the stepper does not modify the output during calibration.
 - i. Navigate to the **Electrode Tab**
 - ii. Check the **Enable Stepper** checkbox

 - iii. Click the Reset stepper/electrode checkbox

 - iv. Verify 0 in the **Spots done** textbox
 - v. Disable the Electrode stepper for the calibration procedure by unchecking the **Enable Stepper** checkbox


- 14) For the active weld program
 - a. Set **Squeeze** to 99 cycles
 - b. Set the **Upslope** to 0
 - c. set the **Main Heat Mode** to PHA
 - d. set the **Heat** value to a low value such as 50.0%
 - e. set the **Main heat** time to 10 cycles.



15) Produce a short circuit weld

Compare the Secondary Current measurement on the external meter with the Secondary Current output of the EN7000v2 viewed in the Log tab or metrics window, timer touch screen status or WSP3 Pendant status.

16) Navigate to the **Calibrate Current** tab

17) Adjust the Sensitivity value accordingly. If the readings are not close, adjust the Sensitivity value based on the equation below.

$$\text{Sensitivity} = (\text{Control reading} * 150) / \text{Meter Reading}$$

18) Repeat steps 18 until the EN7000v2. The current value should match the external meter

19) After the sensitivity field has been updated, press **Enter** or **Tab** to push the change to the control.



Multi-Electrode or Cascade (Multi-Welder) Systems

In multi-electrode or multi-transformer (cascade) systems it may be difficult to arrange toroids (Rogowski coils) for multiple secondary circuits. The toroids need to be switched in and out of circuit at the appropriate moment in the sequence or errors will occur. In these circumstances use primary measuring and the turns ratio or 1&2 Point method.

2.9.3.5 Analog Control Mode. PHA to CCR

If using analog control mode, set the calibration parameters and use PHA mode to verify that the control is measuring current correctly. Establish the current range of the machine by varying the heat parameter with the Analog input (0-10V). In this **example**, when the range is known, program the recorded values e.g. for the CCR 0V= 2.5 kA and CCR 10V= 20.0 kA parameters before using CCR mode.

	Control voltage
CCR 0V=	2.5 kA
CCR 10V=	20.00 kA



Analog Operational Band

You do not have to use the full current range of the machine; If required, use values which restrict the current to an operational band.

2.10 Force Calibration

The EN7000v2 weld controller has the ability to control weld force and read the weld force via analog signals. The analog input allows the control to read the output of an external force sensor (load cell) or a proportional pressure sensor to measure force. The analog output can be used to control a proportional air regulator valve to control weld force.

The analog input and output signals operate between 0 – 10V. The linear relationship between mV signal and the force must be programmed into the EN7000v2 during installation.

The calibration is based on a two-point lookup table and requires a weld force gauge.

The weld force can be calibrated in terms of kN or lbf. The units of measure are defined in the configuration section. Refer to the Configure the Control section for more information.

The Force calibration parameters are defined in [Table 8](#).

Parameter	Units	Range	Description
OUT Point 1	mV	0 - 10000	Analog output (point 1)
OUT Point 1	kN/lbf		Measured output force (point 1)
OUT Point 2	mV	0 - 10000	Analog output (point 2)
OUT Point 2	kN/lbf		Measured output force (point 2)
IN Point 1	mV	0 - 10000	Analog input (point 1)
IN Point 1	kN/lbf		Measured input force (point 1)
IN Point 2	mV	0 - 10000	Analog input (point 2)
IN Point 2	kN/lbf		Measured input force (point 2)

Table 8: Force Calibration Parameters

The default values for the kN units are shown in [Figure 11](#): Default Force Calibration Table Values in Units of kN

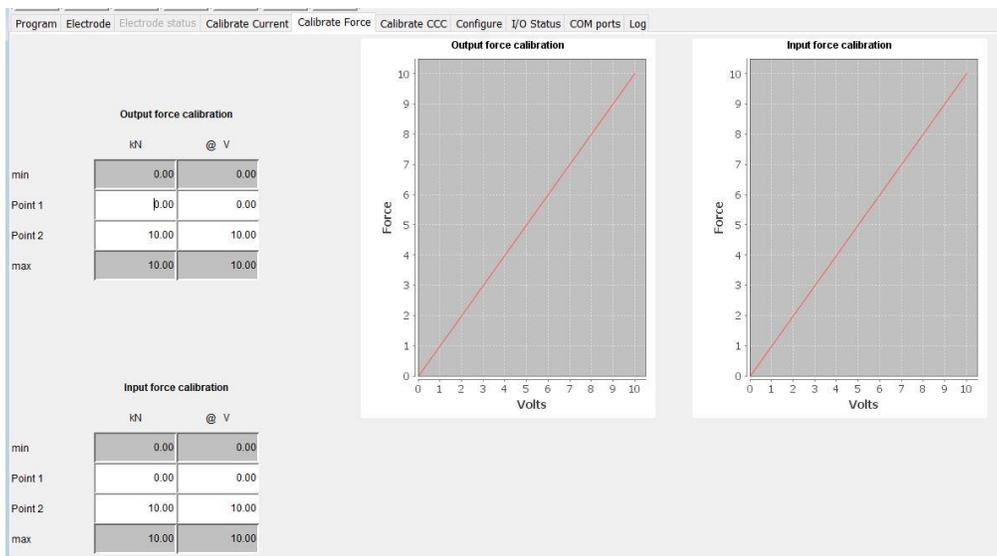
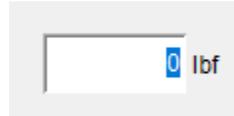


Figure 11: Default Force Calibration Table Values in Units of kN

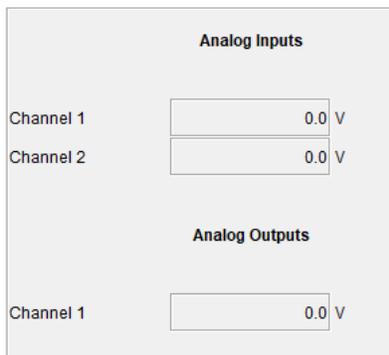
2.10.1 Force Calibration Procedure

To calibrate the Force via NetFlash™ follow the instructions below. This procedure can be performed for both the In and Out analog signals.

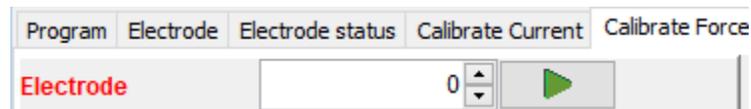
- 1) Open NetFlash™ and connect to the target control
- 2) Set the control to **No Weld** mode by setting the Weld On switch to OFF
- 3) Verify the active weld program has sufficient squeeze time to build weld force
- 4) On the **Program** tab, enter a reasonable value in the **Force field** for the first reading



- 5) Navigate to the **I/O status** tab and locate the analog readings.



- 6) Initiate a weld and document the following values during the weld:
 - a. The weld force reading from the gauge
 - b. The Analog Channel 1 Voltage reading for the signal you are calibrating (Input or Output)
- 7) Navigate to the **Calibrate Force** tab
- 8) Set the **Electrode** value corresponding to number of the electrode being calibrated
 - a. For standard machines, this value is always 0
 - b. For Multi type machines, this number will correspond to the specific electrode being calibrated (0-7)



- 9) Enter the weld force reading from the gauge and the corresponding voltage in the calibration table.
 - a. If the force reading is at the low end of the cylinder's output, enter in Point1
 - b. If the force reading is at the low end of the cylinder's output, enter in Point2

	lbf	@ V
min	0	0.00
Point 1	225	0.99
Point 2	2022	9
max	2250	10.00

10) Repeat Steps 4-9 to get a reading for the remaining point of the lookup table

CAUTION!



WELD OFF!

Always verify the EN7000v2 is in Weld OFF mode. Passing current through a weld force gauge can create a safety hazard or damage the gauge

2.11 Preventative Maintenance

The Preventative Maintenance schedule is defined below in [Table 9](#) and [Table 10](#).

It is recommended that Preventative Maintenance be performed with the power disconnected from the unit. Certain items in [Table 9](#) may require power to test the function of the electrical component. Appropriate Personal Protective Equipment must always be worn during maintenance and inspection of the EN7000v2 Weld Control.

WARNING!



WARNING!

All preventative maintenance procedures should only be performed by properly trained personnel with appropriate Personal Protective Equipment

System	Instructions	Frequency	Power Status
Circuit Breaker	Operate shunt trip button monthly	Monthly	ON
Isolation Contactor	Verify that the contactor turns ON/OFF smoothly	Monthly	ON
Outside Conductors	Inspect outside conductors for wear. Verify mechanical connections are secure	Quarterly	ON
Water Cooling System	Inspect the water-cooling system for leaks, cracks, wear, or loose connections. Verify water flow is appropriate for inverter module.	Quarterly	ON
Cabinet	Inspect cabinet for damage or deterioration	Annually	ON
Cabinet Doors	Verify doors operate and verify the door properly seals to prevent contaminants from entering the cabinet. If seals are worn, they should be replaced.	Annually	ON

Table 9: Preventative Maintenance Items That May Be Performed Under Power

The Preventative Maintenance items below require the power to be disconnected from the control. The user must follow local laws, regulations, and/or corporate policies governing Lockout and Tagout Procedures or equivalent.

System	Instructions	Frequency	Power Status
Mounting	Verify mounting of the control is solid. Tighten loose bolts as needed.	Quarterly	OFF
Heavy Gauge Cables	Inspect the heavy gauge wire cables. Verify there are no loose connections or cable wear.	Quarterly	OFF
Terminal Strips and Terminals	Visually and mechanically check all connections. Tighten any loose wires and connections.	Quarterly	OFF

Table 10: Preventative Maintenance Items That Require Power to Be Disconnected from Unit

DANGER!



DANGER!

Power must be disconnected before performing any of the Preventative Maintenance checks defined in **Table 10**. Failure to comply may result in a hazard with a high level of risk which, if not avoided, will result in immediate, serious personal injury or loss of life.

3 COMMUNICATIONS SETUP

3.1 Overview

The EN7000v2 weld controller is designed to communicate with external devices such as PLCs with standard communication protocols for industrial systems. This section of the manual describes how to configure the EN7000v2 weld control to the user desired communication method.

After the EN7000v2 control has been configured refer to the **READ & WRITE DATA WITH EXTERNAL DEVICES** section for detailed information on how to read and write parameters.

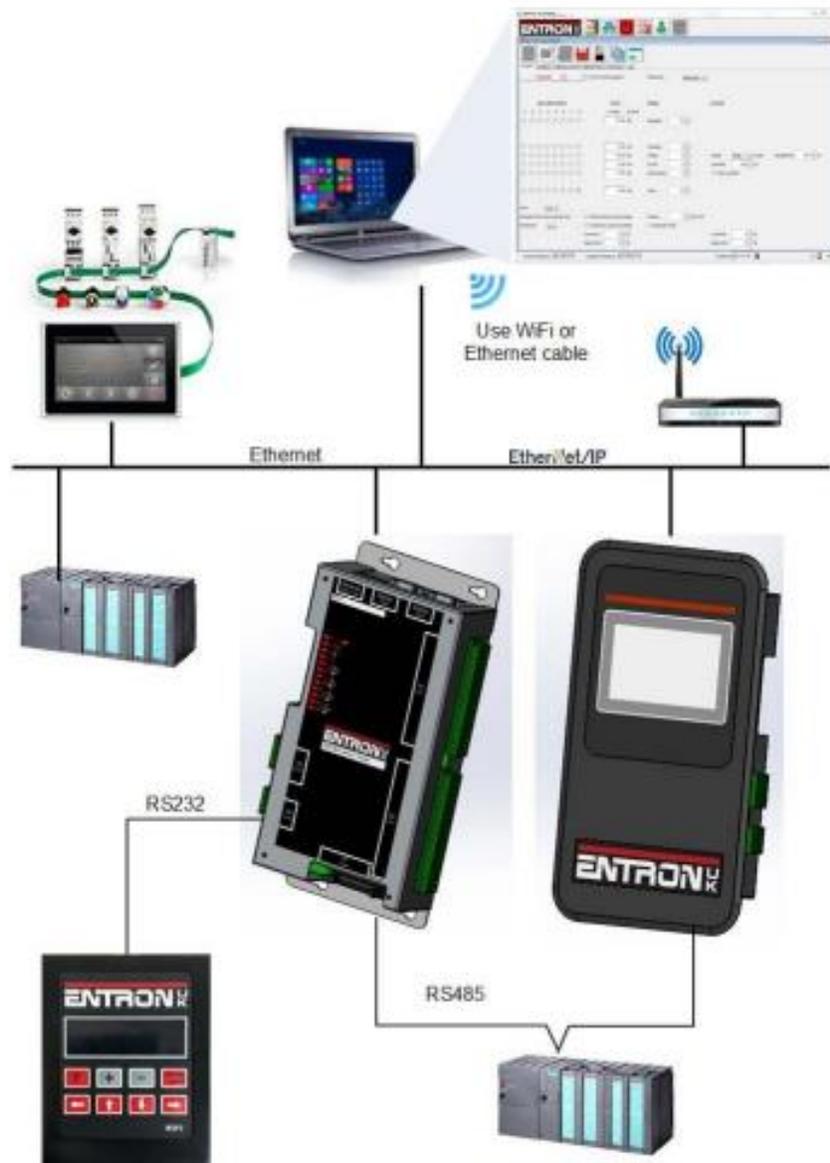


Figure 12: EN7000v2 Communication Overview

Port	Comm. Protocol	COM Port	Port Number	Description
Ethernet/IP	Ethernet/IP (EIP)	COM6	44818 & 2222	The EIP port provides full data exchange of I/O and weld programming parameters with any standard EIP device. The EN7000v2 supports Common Industrial Protocol (CIP™).
Ethernet	MODBUS-TCP/IP	COM5	502	The Ethernet port provides communication exchanges of both I/O data and welding parameters with remote MODBUS devices.
Ethernet	Ethernet	COM4	503 & 30718	The Ethernet port provides standard communication of I/O data exchange and welding programming parameters. This port is typically used for interfacing with the NetFlash™ software.
RS232		COM3		The RS232 port supports I/O data exchange and welding programming parameters with the WSPS Handheld Pendant.
RS485	MODBUS-RTU	COM2		The RS485 port supports I/O data exchange and welding programming parameters via MODBUS communication.

3.2 Set the IP Address of the Control

The IP Address is critical for communication with external devices. The EN7000v2 has an integrated sub-system for the Ethernet and EtherNet/IP communications on COM4, COM5, and COM6.

The IP Address, Subnet mask, and Gateway are set to defaults by the factory. The factory defaults are defined in [Table 11](#).

Parameter	Default Value
IP Address	192.168.0.101
Subnet Mask	255.255.255.0
Gateway	192.168.0.254

Table 11: Default IP Communication Settings



Target IP and Host

The Target IP address and the HOST IP address must be on the same sub-net, otherwise the communication is impossible. The IP Address is typically set to a range from 192.168.0.2 to 192.168.0.253 in the field. If needed, it can be adapted to local subnet.

The IP Address of the control can be changed using the NetFlash™ software, EN7000 Touch Screen and the WSP3 Handheld Pendant. The instructions below define how to change the IP Address of the EN7000v2 weld controller using NetFlash™.



Update Java

Prior to running NetFlash™, **always update** the Java Runtime Environment on your PC.

- 1) Connect the EN7000v2 weld controller via an Ethernet cable
 - a. If connecting directly to a PC, a crossover ethernet cable must be used
 - b. If connecting to a router or switch, a standard ethernet cable must be used
- 2) Turn ON the EN7000v2 weld control
- 3) Open the NetFlash™ software application
- 4) Click the **Network Configuration** icon to open the Networking window



COMMUNICATIONS SETUP

Set the IP Address of the Control

- 5) If the control is not known by the PC, click the **Scan Network for Controls** icon to find the control.



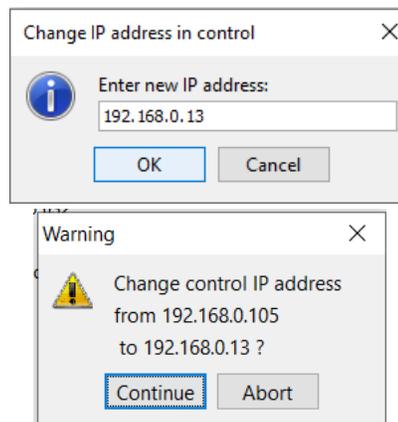
Control Not Found

If the control is not recognized by the PC, make sure the firewall does not block Ethernet ports 503 and 30718 used for NetFlash™.

- 6) Select the desired control and click the **Change IP Address in Control** icon



- 7) Enter the desired IP Address in the popup window



- 8) The IP Address of the control has now been modified. The control must be restarted. When using Netflash™ the control will automatically be restarted upon IP Address change and allow communication. However, a power restart is recommended.



- 9) Now that the control is known by the PC, the IP Address, Subnet Mask, and Gateway can be updated from the **COM Ports** tab in NetFlash.
- Click the **Load from Control** Icon

COMMUNICATIONS SETUP

Set the IP Address of the Control



- b. Navigate to Any tab to begin programming the control. ie **Configure**
- c. Update the desired fields. Then press **Enter** or **Tab** to push the change to the control

The screenshot displays the ENTRON NetFlash V1.18 software interface. The main window is titled 'Edit control parameters' and features a menu bar with options: Program, Forge delay, Electrode, Electrode status, Calibrate Current, Calibrate Force, Configure (selected), I/O Status, COM ports, and Log. The interface is divided into several sections:

- Configuration:** Includes settings for 2nd Stage (Off), 2nd Stage timing (Once selected, Every), Contactor (0 s), Stop on Fault, EOS on Fault, Headlock on Fault, Sensor (CT selected, Toroid), Toroid test (Off selected, On), Units (Metric selected, Imperial), Electrodes (Single selected, Multi), SCR select (Direct(0.3)), Program selection (External selected, Internal), Analog control (Off selected, On), and Analog out (Force control).
- Configuration (restart if changed):** Includes Features (Standard, Extended selected), Weld type (Spot), Retract (Off/Simple), I/O source (Discrete), Line frequency (50 Hz, 60 Hz selected), and Local security (Enable: Off).
- Time on control:** Shows a 'Set' button and a timestamp: Fri 15 Jul 2022 09:08:51.
- Factory reset:** Includes an 'Initialise' button with the note '(reopen edit window after use)'. The current Firmware is E7kV1.25.

At the bottom of the window, the Host IP Address is 192.168.0.97, Target IP Address is 192.168.0.13, and Control ID is EN7000. Status indicators for Tx and Rx are shown as green circles.

3.3 Ethernet Communications

The EN7000v2 weld control has one built in Ethernet connector on the timer board. The Ethernet connector supports EtherNet/IP communications with EIP devices. The Ethernet connector also supports read write functions with MODBUS-TCP/IP external devices, programming via the NetFlash™, and read only data outputs.

Table 12 shows the communications available through the Ethernet port on the weld control.

Port	Comm. Protocol	Port Number	Description
Ethernet	Ethernet/IP (EIP)	44818 & 2222	The EIP port provides full data exchange of I/O and weld programming parameters with any standard EIP device. The EN7000v2 supports Common Industrial Protocol (CIP™).
Ethernet	MODBUS-TCP/IP	502	The Ethernet port provides communication exchanges of both I/O data and welding parameters with remote MODBUS devices.
Ethernet	Standard Ethernet	503 & 30718	The Ethernet port provides standard communication of I/O data exchange and welding programming parameters. This port is typically used for interfacing with the NetFlash™ software or read only communications (Implicit Messaging).

Table 12: EN7000v2 Ethernet Communications

The location of Ethernet port on the EN7000v2 weld control is shown in Figure 13.

3.3.1 Connect via NetFlash™ Programming Software

The NetFlash™ software is a PC program designed for Windows devices. The software program allows a user to do the following tasks:

- Configure the control
- Program the control
- View status information
- View and export History logs
- Update the firmware
- Upload configuration and settings to the control
- Export configuration and settings to the control

The NetFlash™ software is included with the purchase of a control. The software is delivered is provided on a USB flash drive. The application files need be copied or extracted to a PC.



Update Java

Prior to running NetFlash™, **always update** the Java Runtime Environment on your PC.

To use the NetFlash™ software:

- 1) Connect the EN7000v2 weld controller via an Ethernet cable



Ethernet Cable Type

If the control is connected directly to the PC, a ***crossover Ethernet*** cable must be used. If the control is connected through a router, a ***standard ethernet cable*** must be used.

- 2) Turn ON the EN7000v2 weld control
- 3) Open the NetFlash™ software application
- 4) Click the ***Network Configuration*** icon to see options.



- 5) If the control is not known by the PC, click the ***Scan Network for Controls*** icon to find the control.



Control Not Found

If the control is not recognized by the PC, make sure the firewall does not block Ethernet ports 503 and 30718 used for NetFlash™

- 6) Select the desired control and double click.
- 7) Navigate to the Edit control parameters window and click the ***Load from control*** icon



- 8) The NetFlash™ program is now communicating directly with the control. The user now has the ability to update read and write parameters to the control



Live Data Update

When connected to a control, updates to control parameters occur on a field change in NetFlash™. For checkboxes and arrows, the change is written to the control on a mouse click. For text fields updated with a keyboard entry, the user must press **Enter** or **Tab** after a field change to push the data to the control.

3.3.2 Configure for EtherNet/IP (EIP)

The EN7000v2 Control supports the Common Industrial Protocol (CIP™) through Ethernet/IP (EIP). With Ethernet/IP communication, the EN7000v2 control provides Implicit messaging and Explicit messaging.

To enable Ethernet IP I/O control. The EN7000v2 I/O in EIP field must have the I/O source of the control's input set to COM6 (E/IP).

The steps to configure the I/O source to COM6(E/IP) using the NetFlash™ software are below. The configuration parameters can also be set via WSP3 handheld pendant.

- 1) Connect the PC to the EN7000v2 control with an Ethernet cable

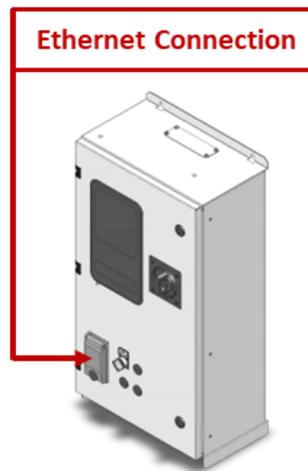
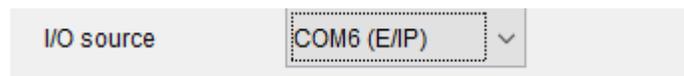


Figure 13: EN7000v2 Control Ethernet Port

- 2) Turn ON the EN7000v2 weld control
- 3) Open the NetFlash™ software on a Windows PC and connect to target control
- 4) Load the parameters from the control by clicking the **Load from control** icon



- 5) Navigate to the **Configure** tab
- 6) Set the I/O source to **COM6 (E/IP)**



- 7) Restart the control for the I/O source field change to take effect by clicking the **Restart control** icon



- 8) After the control has powered up, navigate to the **COM Ports** tab to verify the COM6 connection shows connected



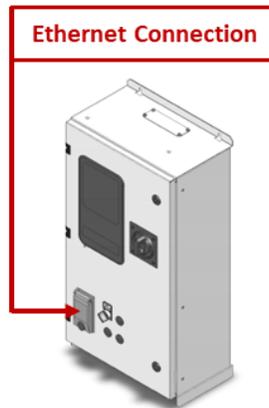
3.3.3 Configure for MODBUS-TCP/IP

The EN7000v2 supports MODBUS-TCP/IP communication to exchange both I/O data and the welding parameters with a remote MODBUS device. The remote MODBUS device communicates with the EN7000v2 control via an Ethernet (RJ45) cable.

To enable MODBUS-TCP/IP data and activate the inputs, the I/O source of the control's input must be mapped to COM5.

The steps to configure the I/O Source to COM5 using the NetFlash™ software are defined below. The configuration parameters can also be set via WSP3 handheld pendant.

- 1) Connect the PC to the EN7000v2 control with an Ethernet cable



- 2) Turn ON the EN7000v2 weld control
- 3) Open the NetFlash™ software on a Windows PC and connect to the target control
- 4) Load the parameters from the control by clicking the **Load from control** icon



- 5) Navigate to the **Configure** tab
- 6) Set the I/O source to **COM5**



- 7) Restart the control for the I/O source field change to take effect by clicking the **Restart control** icon



- 8) Connect the remote MODBUS Device to the EN7000v2 weld control and attempt to ping the weld control IP Address to verify the connection.

3.4 MODBUS-RTU

The EN7000v2 supports MODBUS-RTU communication to exchange both I/O data with a remote MODBUS device. The remote MODBUS device communicates with the EN7000v2 control via a DSUB9 (RS485) cable.

The RS485 port on the EN7000v2 weld control is shown below in [Figure 14](#).

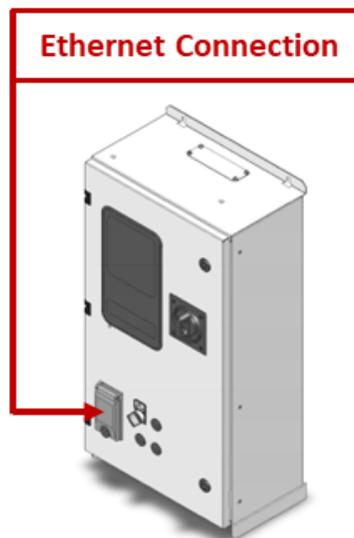


Figure 14: EN7000v2 Control RS485 Port

To enable MODBUS-RTU data and activate the inputs, the I/O source of the control's input must be mapped to COM2.

The steps to configure the I/O source to COM2 using the NetFlash™ software are defined below. The configuration parameters can also be set via WSP3 handheld pendant.

- 1) Connect the PC to the EN7000v2 control with an Ethernet cable



- 2) Turn ON the EN7000v2 weld control
- 3) Open the NetFlash™ software on a Windows PC and connect to the target control
- 4) Load the parameters from the control by clicking the **Load from control** icon



- 5) Navigate to the **Configure** tab
- 6) Set the I/O source to **COM2**



- 7) Restart the control for the I/O source field change to take effect by clicking the **Restart control** icon



- 8) Connect the remote MODBUS Device to the EN7000v2 weld control and attempt to ping the weld control IP Address to verify the connection.

4 ENTRON PROGRAMMING TOOLS

This section defines information on programming with the NetFlash™ software and the WSP3 pendant. Both tools can be used to configure and program an iPAKv2 or EN7000v2 product.

For information on programming the EN7000v2 weld control from a PLC or remote device using EtherNetIP or MODBUS refer to the **READ & WRITE DATA WITH EXTERNAL DEVICES** section.

4.1 NetFlash™

NetFlash™ is PC software for use with ENTRON welding controls. It provides a common user interface (UI) for multiple control types so that users do not have to learn different programming tools for each control. It achieves this through the use of 'descriptor' files which each control type serves up to NetFlash™, describing how the UI should appear. When changes are made to a control (e.g. the addition of a new feature) its descriptor is updated to reflect this and no change is required to the NetFlash™ software. Thus, a user can have different control types and even controls with different versions of firmware and still only use a single common programming tool – **NetFlash™**.



Target IP and Host

The Target IP address and the HOST IP address must be on the same sub-net, otherwise the communication is impossible. The IP Address is typically set to 192.168.0.13 in the field.

Features include:

- Parameter editing
- Firmware update tool
- Network management tools
- Backup and restore tools
- Weld data logging
- Security system

4.1.1 System requirements

NetFlash™ requires that the Java Runtime Environment (JRE) is installed on the host PC. This is available as a free download at:

<https://java.com>



Update Java

Prior to running NetFlash™, **always update** the Java Runtime Environment on your PC.

4.1.2 Installing NetFlash™

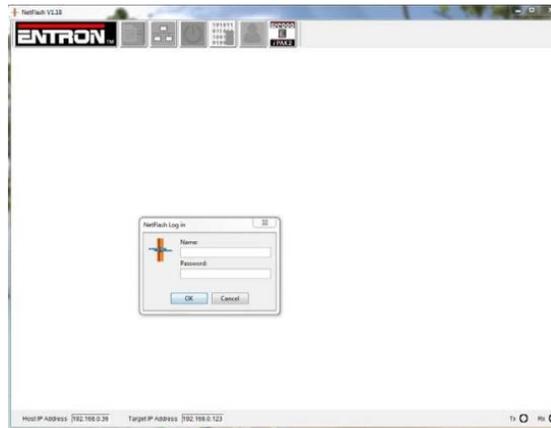
NetFlash™ does not need to be installed. Copy the NetFlash folder and its contents from the supplied media to the PC.

4.1.3 Removing NetFlash™

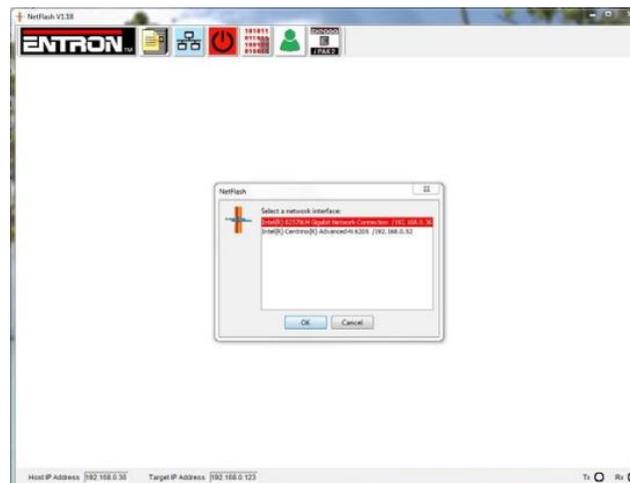
NetFlash™ does not need to be uninstalled. To remove NetFlash™, delete the NetFlash™ folder and its contents from the PC.

4.1.4 Running NetFlash™

Open the installation folder and run NetFlash.exe. The Main window will open. If the security function is enabled, you will be asked to log in:



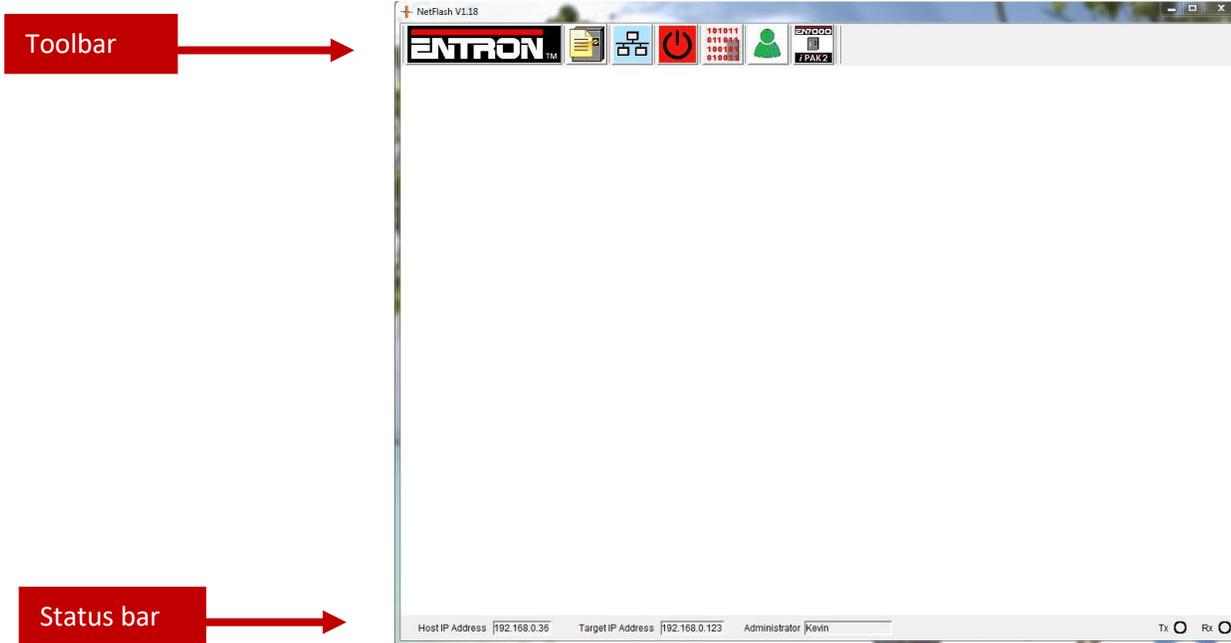
Now select which interface on the PC to use for the network connection:



NetFlash™ is now ready to use, with the main window open.

4.1.5 Main window components

The NetFlash™ has a Toolbar on the top of the window for navigation to sub-windows for setup. The Status bar is located on the bottom of the window and shows the status of connection information.



4.1.5.1 Toolbar

The definition of each of the Toolbar icons are defined in [Table 13](#).

Icon	Name	Description
	Contact Details	Show Entron contact information
	Edit Control Parameters	Opens the Edit Parameters window for control configuration, calibration, and weld programs
	Network Configuration	Opens the Networks window
	Restart Control	Restarts the control
	Flash Programming Tool	Opens the Flash Programming window for firmware updates and management
	Setup NetFlash users/security	Opens the NetFlash security window
	Select Control Type	Set the Control Type. NetFlash can be used to program other ENTRON Products

Table 13: NetFlash Toolbar Icons

4.1.5.2 Status bar

The definition the information displayed on the Status bar is defined below in Table 14.

Icon	Name	Description
	Host IP Address	Shows the IP Address in use by the PC
	Target IP Address	Shows the IP Address of the control to be accessed
	User Information	If security is enabled, the field shows the user type and the name of the user logged in
	Control ID	When the window is open and data is loaded, the Control ID shows the source. An icon is used to indicate the source of the data:  data source is a file  data source is a control
	Communication Status	Indicates communication activity

Table 14: NetFlash Status Bar Icons

4.1.6 The target IP address

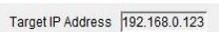
When NetFlash™ needs to communicate with a control, it needs to know its IP address on the network. NetFlash™ refers to this as the **Target IP address**. There are several methods of setting this



Networks window – **set control as target** tool



Networks window – **scan** tool



Double-click the address in the **Target IP address** box on the status-bar.



Target IP and Host

The Target IP address and the HOST IP address must be on the same sub-net, otherwise the communication is impossible.

4.1.7 Restart control

On a click, the Restart Control icon sends a command to the control to restart it. Typically used after changing key configuration parameters.



CAUTION!



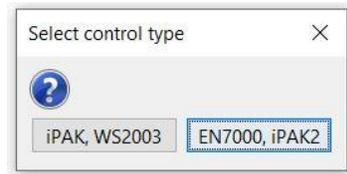
CAUTION – ACUTATOR MOTION

Use CAUTION when clicking the restart control icon when the control is in use. The restart function will reset the value outputs which can cause unexpected motion.

4.1.8 Control type

The Control Type icon selects the control generation. NetFlash™ needs to know which generation control is being used. Click on the tool to select from the two groups:

- 1) WS2003, iPAK
- 2) EN7000, iPAK2



Communication Error

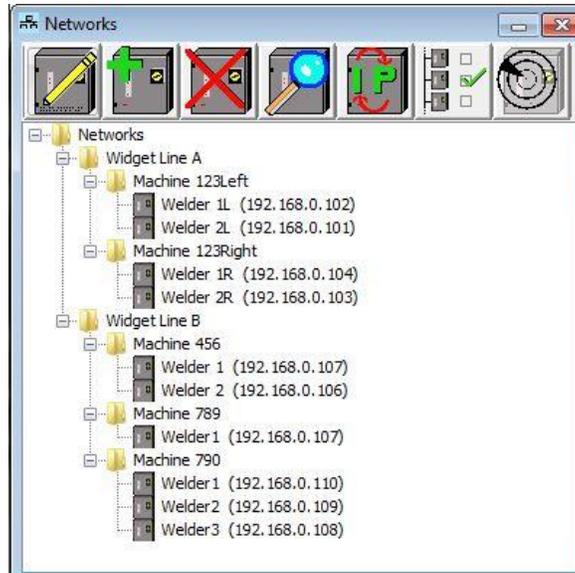
Communication will fail if the control type is not properly set.

4.1.9 Networks window

The **Networks** window can be viewed by clicking on the tool-bar button on the main screen. The window contains tools for managing and accessing controls on the network. It allows controls to be assigned descriptive text so that they may be selected without knowing the IP address. Multiple networks can be defined (e.g. for different areas within a factory).



An example of the Networks Window is shown below.



4.1.9.1 Building the network table

The Network table is built using the following icons.

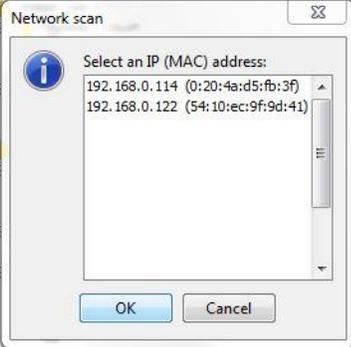
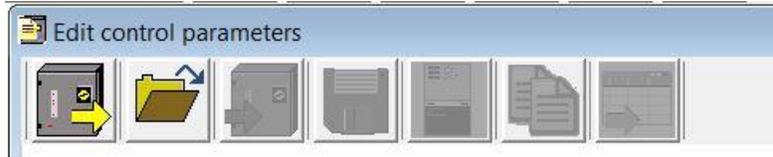
Icon	Name	Description
	Edit Control Description	Allows the description of a control already in the table to be edited. Click on the control to be edited then click on this tool.
	Add A Control	Adds a new control to the table
	Delete a Control	Deletes a control from the table. Click on the control to be deleted then click on this tool.
	Scan Network for Controls	<p>The scan tool will search the connected network and report a list of controls found. To assist with identification, both the IP address and MAC number are reported.</p> <p>Click on any control in the list then click OK to set it as the Target IP address.</p> 
	Change IP Address in Control	Allows the IP address in the target control to be changed. Don't forget to change the NetFlash™ Target IP address if you subsequently wish to access the control with its new IP address
	Set Control as Target	A control may be selected by first clicking on it in the table, then clicking on this tool. The Target IP address box on the main screen status bar will be updated.
	Ping Target IP Address	Performs a low-level communications test on the target control. Use this tool to confirm that the target control is physically connected to the network.

Table 15: NetFlash Network Window Icons

4.1.10 Edit Control Parameters

The Edit Control Parameters window can be viewed by clicking on the  **Edit Control Parameters** button on the main screen. The edit window has its own tool-bar.



Example: Edit Control Parameters window after clicking the  **Load from control** icon.

The screenshot shows the 'Edit control parameters' window with the following settings:

- Program:** 0
- Link/Cascade:**
- Softstart:** START
- Inhibit program:** (AV1-8 may not operate)
- Electrode:** 0
- Aux valves (AVx):** 8 valves, all
- Force:** 650 lbf
- Timing:**
 - Presqueeze: 0
 - Squeeze: 30
 - Upslope: 0
 - Main heat: 10
 - Downslope: 0
 - Hold: 5
- Current:**
 - Pre-heat:
 - Main heat: PHA mode, Heat: 60.0 %
 - Current: 5.00 kA
 - Monitor: Off, On
 - Post-heat:
- WAV (Overrides AVx):**
 - Force profile:
 - Wait for force at 2nd stage:
 - Repeat mode:
 - Test force at end of main heat:
 - Low limit: 5 %
 - High limit: 5 %
- Pulses:** 1 Main->C2
- Retry:** Off, On
- Low limit:** 5 %
- High limit:** 5 %
- C-Monitor(Shunt):**
- C-Monitor(Wear):**

4.1.10.1 Edit window tool-bar

The Edit window Tool bar has the icons defined in Table 16.

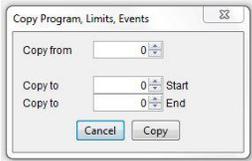
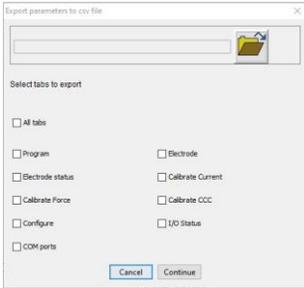
Icon	Name	Description
	Load from Control	The user interface and data are loaded from the control at the Target IP address. NetFlash™ has a Cache function which it uses to avoid repeatedly downloading interfaces which it has used before, thus speeding up loading.
	Load From File	The user interface and data are loaded from a previously saved file.
	Save To Control	This tool is available after the Load from file function was used. It transfers all data items to the control at the Target IP address. Can be used as part of a backup/restore process, or for transferring settings to another control.
	Save to File	Saves the interface and all data to a file on the PC. A browsing window will open and you will be prompted for a file name and location. Can be used as part of a backup/restore process, or for transferring settings to another control.
	Open/Close Metrics Window	The Metrics window shows key information about the status of the target control, such as measurements and error messages. The window is floatable and may be resized and dragged to any place on your display. Clicking this tool alternately opens and closes the Metrics window. The  button on the Metrics window may be used to send a Fault Reset command to the target control.
	Copy Programs etc	Copies a full set of parameters from one program to another, or from one electrode to another. You will be prompted for the source and the range to be copied to: 
	Export Parameters to CSV file	Data is exported to a file on the PC, in csv format (Microsoft Excel compatible). You can customize which data is included by checking the boxes:  Click on the  icon to open a browser window to set the file name and location.

Table 16: NetFlash Edit Window Icons

4.1.11 Editing Parameters

When editing parameters, new values are automatically sent to the target control where a mouse click is used to make the change. For parameters where the keyboard is used to enter a value, you must press **Enter** or **TAB** to complete the operation, otherwise the value is not sent.

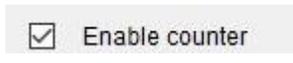
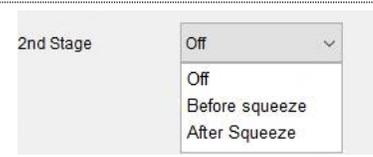
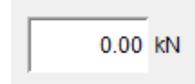
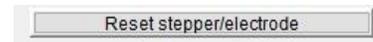
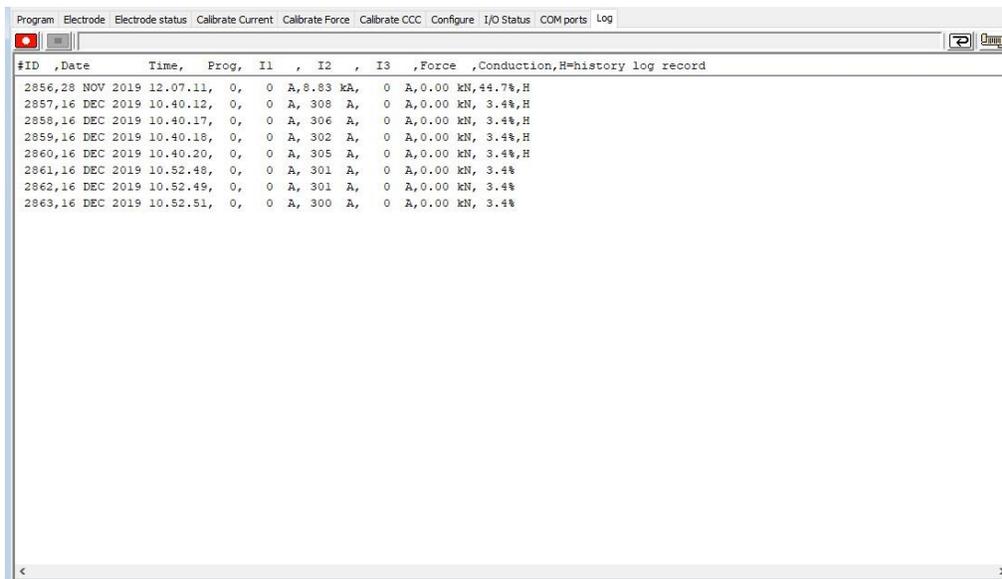
Icon	Name	Description	Example
	Checkbox	Click in the box to enable the function (the tick appears). Click again to disable the function (the tick disappears).	
	Radio Button	A radio button works like on old-time car radio where pushing in one button makes all other buttons pop out. Click on the option you want to select.	
	Combo box	A combo box provides a drop-down list from which an option may be selected. Click on the down-arrow on the right to reveal the list then select the required option.	
	Spinner	A spinner allows the parameter to be incremented or decremented by 1 unit by clicking on the up-arrow or down-arrow. A new value for the parameter can also be entered by first highlighting the parameter with the mouse (click and hold down the mouse button to the left of the number then drag the mouse across the number). Now type the new value using the keyboard, then press Enter/Return (important!).	
	Textbox	A text box parameter always requires editing using the keyboard. You can use the same technique shown for Spinner. You must press Enter/Return to complete the edit.	
	GoTo Button	A GoTo button provides a shortcut to connected parameters which are on another tab in the editor window.	In this example (Electrodes,Multi), the Electrode parameter (which is set on the Program tab) is set to 0. To jump to the tab for calibrating Electrode 0, just click on the green arrow. 
	Control Button	A control button provides a means of signaling the indicated action to the control.	 In this example, clicking on the button will signal the control to reset the electrode. You will be asked to confirm or abort the command before it is actually sent. 

Table 17: NetFlash Editing Parameters Icons

4.1.12 Log Tab

Controls in spot-weld mode may provide a log function. If available, then this is shown on the Log tab in the editor window. The Log tab provides a record of every spot weld made. Each time a control makes a spot weld, another record is added to the window. The exact composition of the record will vary from control to control, depending upon its capabilities.



Icon	Name	Description	Example
	Start Recording Log Data to File	Clicking this button opens a file (you will be prompted for a file name and location). All subsequently received records will be written to this file.	
	Stop Recording Log Data to File	Stops recording log data to file.	
	Clear Screen	Clicking this button will clear the log window. It does not erase records recorded to the file nor does it erase records stored in the control's own memory.	
	Get History Log from Control	If the control supports a history log in its own memory, then records stored there may be extracted and added to the NetFlash™ log window. These historical records are indicated by the H symbol at the end of the line (see example above).	<p>Click the button to open the dialog:</p> <p>In the example, the control has 67 records stored. The most recent 5 records will be extracted by clicking Get records, or all 67 records by clicking Get all. Click the Clear history option to clear the records stored on the control.</p>

Table 18: NetFlash Log Tab Icons

4.1.13 Flash Programming Tool

The **Flash Programming Tool** window can be viewed by clicking on the tool-bar button on the main screen.

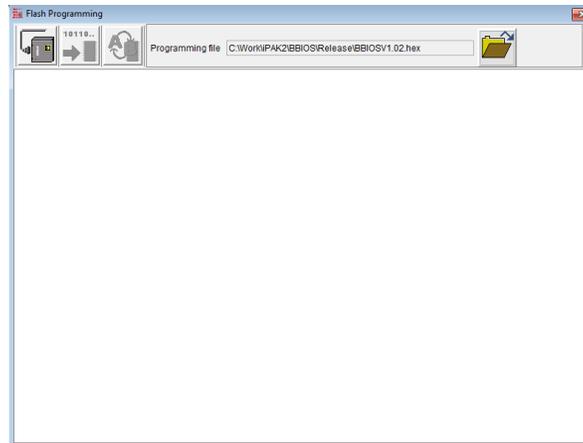


This window is used to:

- Get information about the target control
- Update firmware in the target control

Be sure to set the correct **Target IP address** before proceeding.

Click on the tool and the flash programming window opens:



The icons shown in the Flash Window are defined in [Table 19](#).

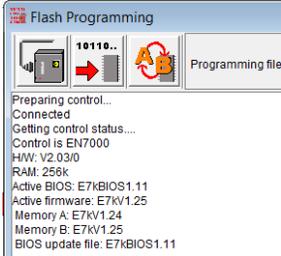
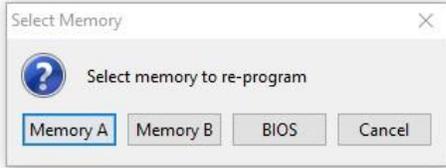
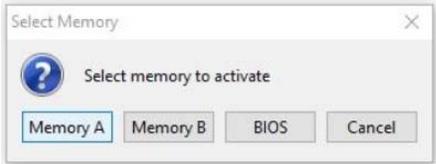
Icon	Name	Description	Example
	Connect with Control	Information about the target control is extracted and displayed.	<p>After clicking the icon information extracted from the control will be displayed in the Flash Window.</p> 
	Select Flash File	The icon opens the Windows File Explorer to search the PC for the selected firmware.	<p>Once the firmware has been selected, Click Open. The filename will now appear at the top of the Flash Window.</p>
	Start Transfer to Control	Click on this tool to begin the firmware transfer to the control.	<p>You will be prompted to choose which memory is to be updated.</p>  <p>Click on the button for the required memory and the transfer will begin. Note that NetFlash cross-checks that the selected file is suitable for the chosen destination.</p> 
	Change Active Memory	<p>This tool allows users to:</p> <ol style="list-style-type: none"> 1) Activate newly installed firmware 2) Switch to the firmware in the alternate memory 	<p>You will be prompted to choose which memory to make active:</p>  <p>Click on the button for the required memory. The control will then need to be restarted in order for the change to take effect.</p>

Table 19: NetFlash Flash Window Icons

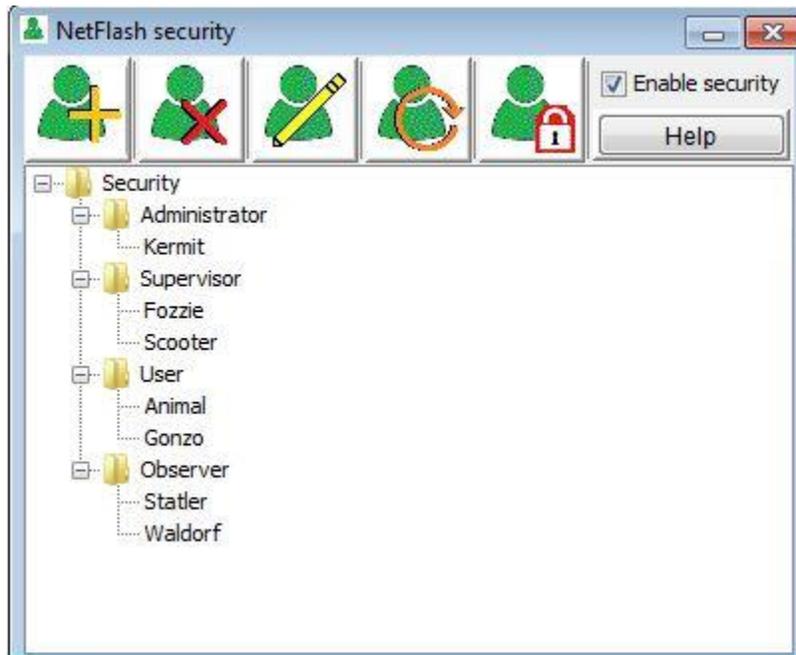
4.1.14 Setup NetFlash™ Users/Security

The Security window can be viewed by clicking on the tool-bar button on the main screen.



This window is used to:

- 1) Configure user's names, passwords and security scope.
- 2) Enable/disable the NetFlash™ security feature.
- 3) Login/logout users.



The definition of each of the icons is defined in [Table 20](#).

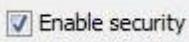
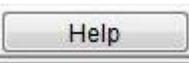
Icon	Name	Description
	Add A User	Add a new user. A dialog opens for entry of the required fields.: <ul style="list-style-type: none"> • Name • Password • Scope (permissions) <p>Note that a duplicate name is not allowed.</p>
	Delete a User	Deletes an existing user. Click on the user in the table, then click the tool.
	Edit Existing User	Edits information for an existing user. Click on the user in the table, then click the tool. A dialog opens showing the existing assignments which may then be edited.
	Login a Different User	Logs-out current user and prompts for new user to log in.
	Log Out User	Logs out user and leaves the system at Observer (read-only) scope.
	Enable Security	Click the box to turn the security system on or off
	Security Help	Displays information about the security scope field.

Table 20: NetFlash Security Icons

4.2 WSP3

The WSP3 pendant is a handheld programming pendant with a 20x4 character display and a sealed keypad. The WSP3 works with other products in the ENTRON product offering such as the iPAK, iPAK2v2, WS2003, and EN7000 giving users the ability to program a number of controls with a single device.

The WSP3 part number is 90-90-55. The unit is not included with a control and must be purchased separately.

The WSP3 can be used to **access diagnostic information** and **set all parameters** in the weld control.

The WSP3 uses RS232 to communicate with the EN7000v2 and should be connected to the COM3 port on the timer. Complete controls typically come pre-wired with a COM3 connection mounted to the door of the control to allow a customer to connect to the EN7000v2 without entering the cabinet.

CAUTION!



ONLY USE RS232 WITH WSP3 Pendant

The wiring of the RS232 connector on the EN7000v2 Weld Control is not standard should only be used with the ENTRON WSP3 Pendant. The RS232 cannot be used for communications with other devices.

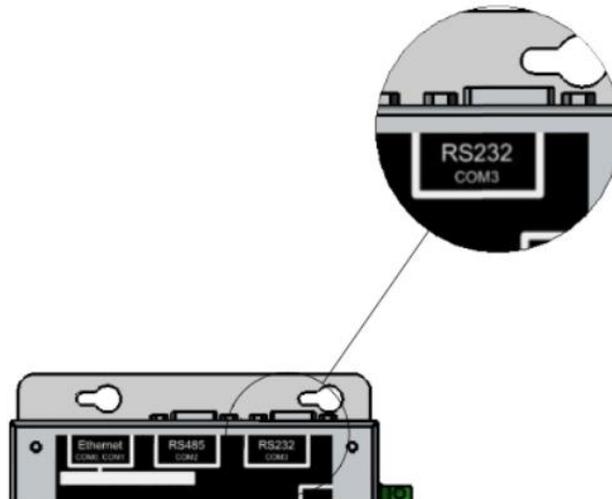


Figure 16: WSP3 Connection Location

4.2.1 Keypad

The WSP3 has a keypad has eight buttons on the keypad that allow the user to navigate menus and update parameters in the WSP3. The function of each button is defined in [Figure 17](#).

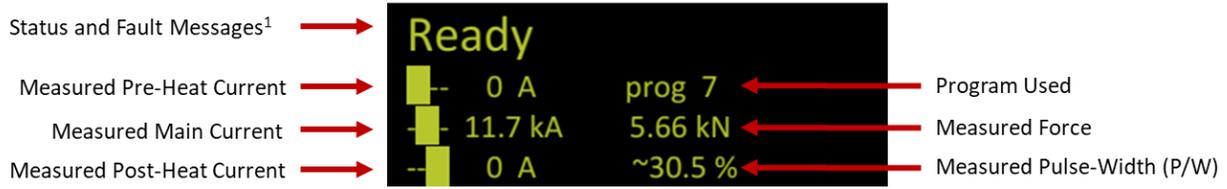


-  Use F key to return to the previous screen or move between menus.
-   Use the arrow keys to scroll through the available selections in a menu.
-   Use the arrow keys to select a different function or parameter. The selected function or parameter will flash.
-   Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.
-  Use the Enter key to access the selected menu.
-  +  From the <<MAIN MENU>> field or the EDIT CONFIGURATION option, press and hold Enter then press the F key to access the configuration menu.

Figure 17: WSP3 Button Function

4.2.2 Diagnostic Screen

The Diagnostic Screen is the default screen for the WSP3 and displays error messages and the measured values of the last executed weld program. To navigate to the Diagnostic Screen, press the **F** key until you reach the diagnostic menu as shown in Figure 18.



1. If more than one fault message is present, they will display sequentially

Figure 18: WSP3 Diagnostic Screen



Diagnostic Screen when Programming

When editing parameters, you can quickly switch to the diagnostic screen by pressing the **Enter** key, then switch back to the menu item by pressing **F**.

4.2.3 Menus

The WSP3 has a main menu which contains a list of sub-menus. The menus contain all of the program parameters, status information, configuration settings, system information, and history log. The current menu is shown at the top of the screen inside the chevron symbols <<menu name>>. The menu tree is shown in Figure 19.

The user can navigate scroll through the menu items using the up and down arrows. The currently selected menu will flash. To open a sub-menu, the user should press the ENTER key. To return the previous menu, a user should press the F key.

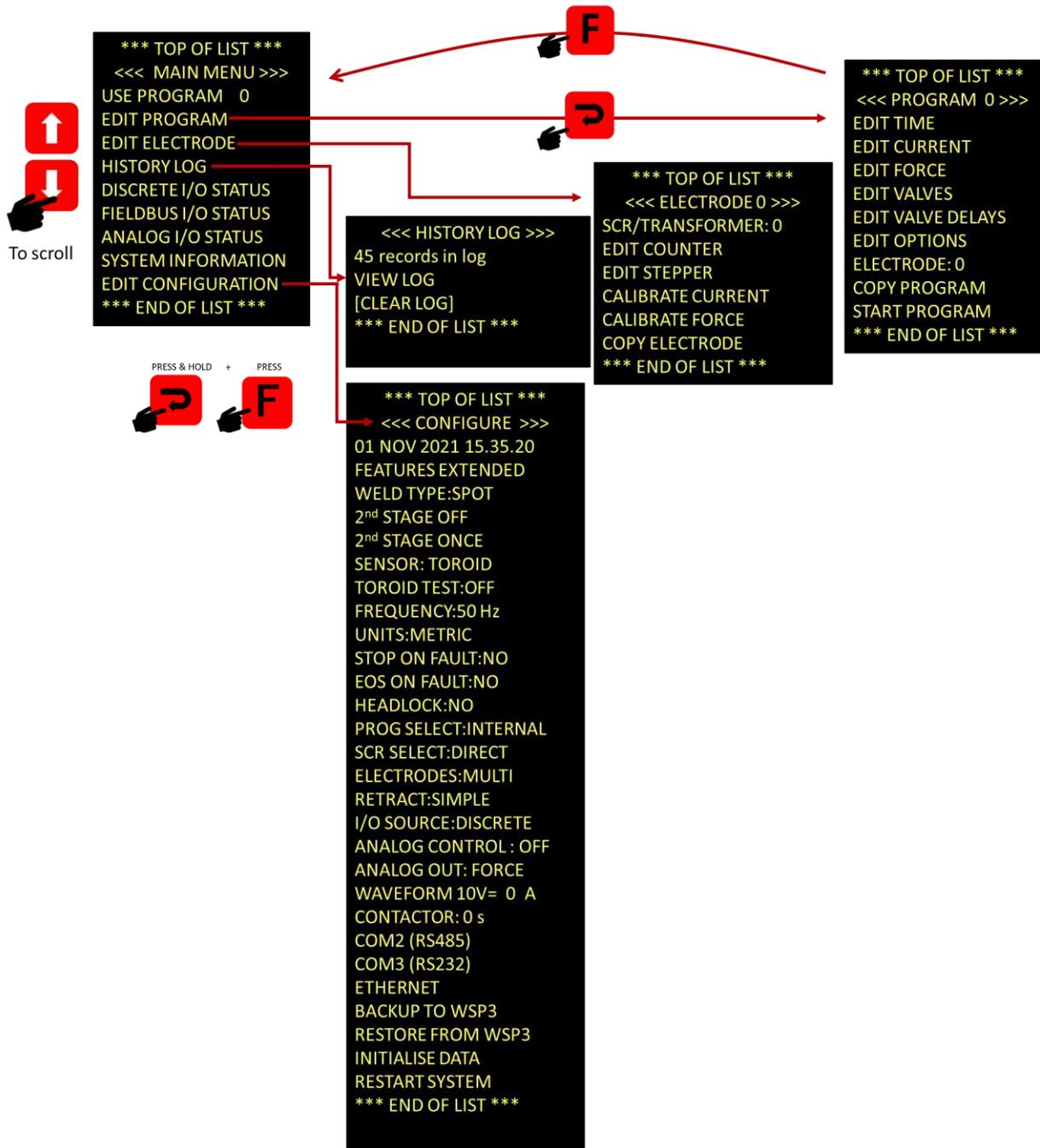


Figure 19: WSP3 Menus

4.3 Built-in Touch screen

The EN7000v2-TS (Touch screen) has a built-in touch screen panel which provides easy access to all parameters and indications.

4.3.1 Touch screen

The EN7000v2-TS has a navigation touch screen which displays buttons and scroll bars to allow the user to navigate menus. On power up the display will show the **Splash screen** shown in [Figure 20: Splash screen](#).



[Figure 20: Splash screen](#)

4.3.2 Status screen

The Status screen displays the timer messages and the information from the last weld program used. To navigate to the **Status** screen, press the **HOME** button which is highlighted in [Figure 20: Splash screen](#). Pressing the **HOME** button will take you to the **Main menu** shown in [Figure 21: Main menu](#). To access the **Status** screen page, press the  icon located on the blue bar behind the text at the top of the screen, the location of the  icon is shown below in [Figure 21: Main menu](#).

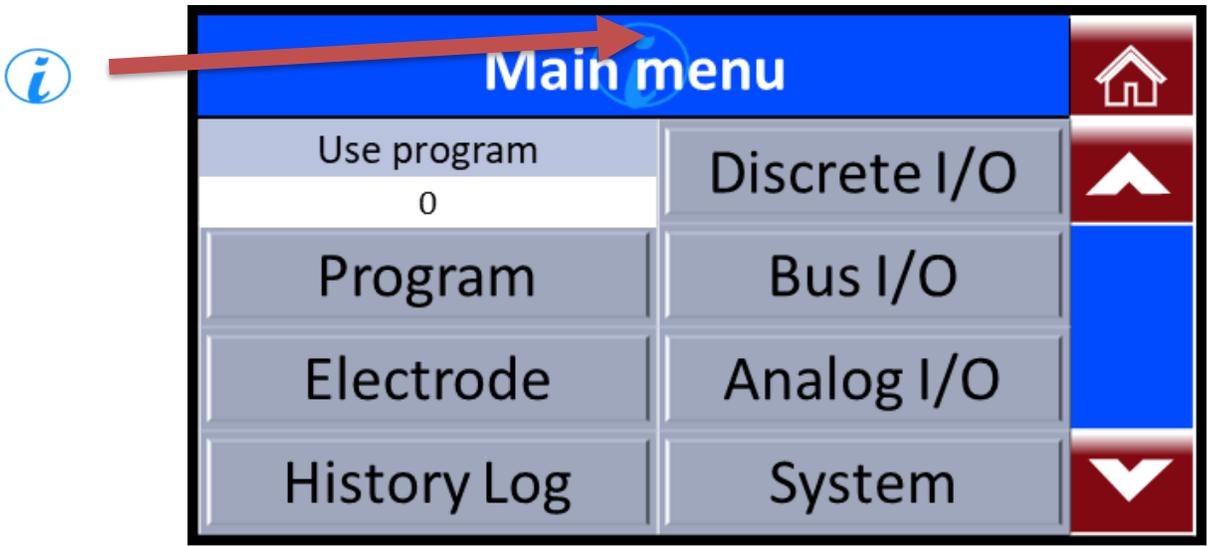


Figure 21: Main menu

Following this process, the Status screen will be displayed as shown in Figure 22: Status Screen.

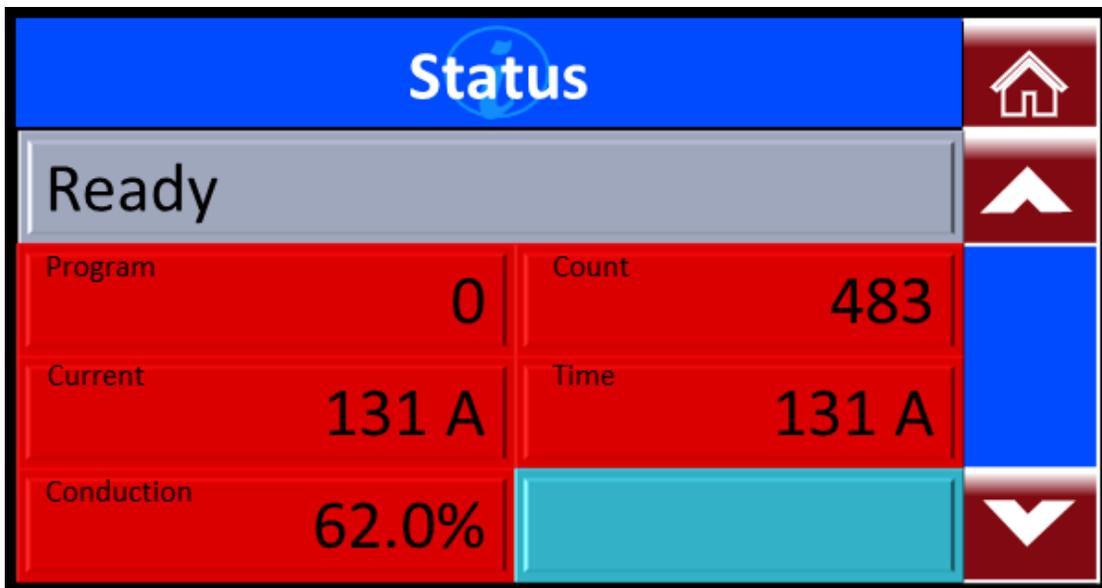


Figure 22: Status Screen



Status screen when Programming

When editing parameters, you can quickly return to the Status screen by pressing the  icon , then switch back to previous menu by pressing  icon again.

4.3.3 Main menu

The built-in touch screen has a **Main menu** which contains sub-menu buttons. The sub-menus contain all of the program parameters, status information, configuration settings, system information, and history log. The Menu that the user is on is displayed at the top of the screen inside the blue box. The **Main menu** is shown in [Figure 19](#).

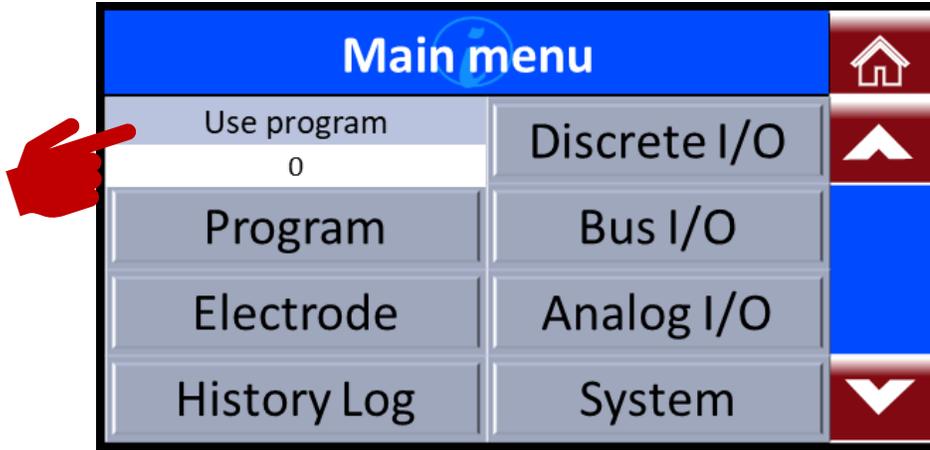


Figure 23: Main menu

The user can navigate through the menu items by pressing the selection buttons or dragging the slider. In the example in [Figure 23](#) after pressing the **Program** button the user is taken to the **Program menu**, Program 0 which is shown in [Figure 23](#). To open any of the sub-menus related to this program, the user should select the needed sub-menu. As an example, [Figure 24](#) shows the user selecting the **Current** sub-menu so the user can change the current/heat and monitoring parameters.



Figure 24: Program menu example

Following on from the example above in [Figure 24](#), below we are going to show an example of a user changing the Main heat within the **Current** sub-menu. The Main heat parameter in this example is set at 99.9% and the user will change this parameter to 50.0%.

In [Figure 25](#) the user is shown pressing the Main heat button.

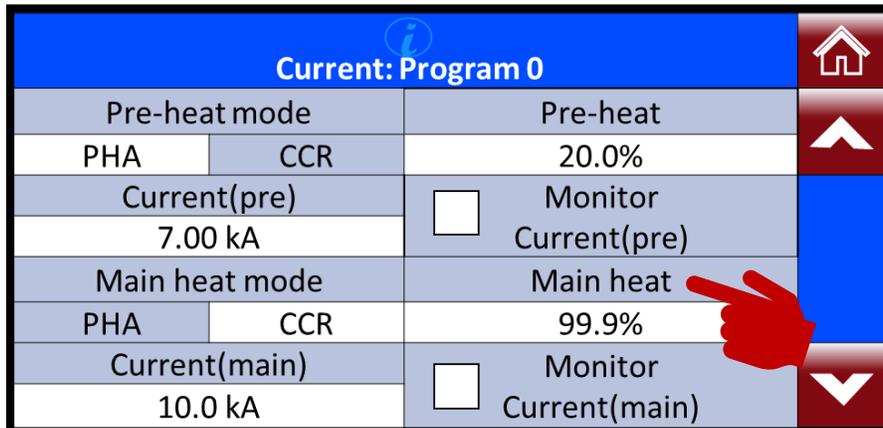


Figure 25: Current: Program menu example

After pressing the Main heat button, the value of the parameter can be changed.

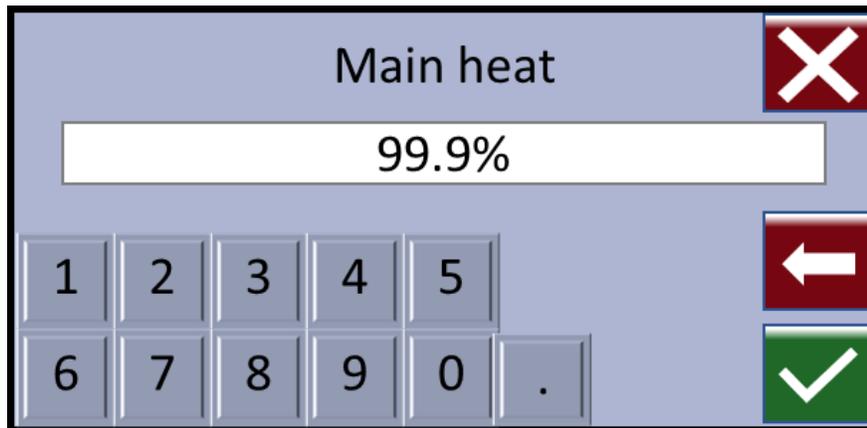


Figure 26: Main heat original value

The user can then change the value of the parameter using the numerical buttons as shown in Figure 27: Main heat new value.

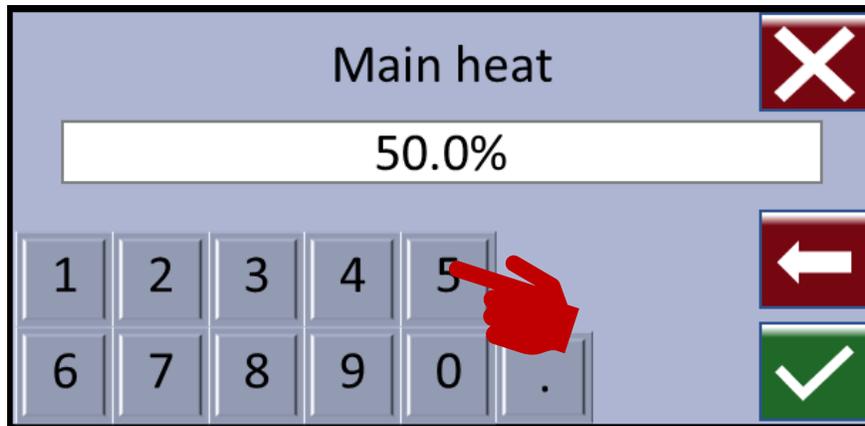


Figure 27: Main heat new value

To confirm the parameter value change, the user will press the check box located at the bottom right of the screen as shown in Figure 28: Main heat value conformation.

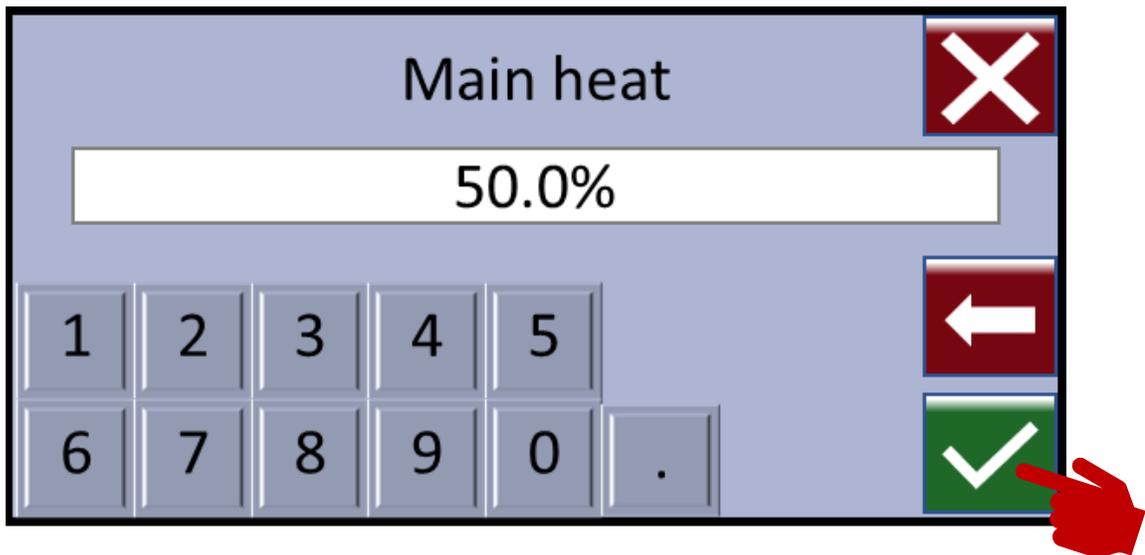


Figure 28: Main heat value conformation

After the user has pressed the check box they will be returned to the Current: Program sub-menu as shown in Figure 29.

 Current: Program 0			
Pre-heat mode		Pre-heat	
PHA	CCR	20.0%	
Current(pre)		<input type="checkbox"/> Monitor Current(pre)	
7.00 kA			
Main heat mode		Main heat	
PHA	CCR	50.0%	
Current(main)		<input type="checkbox"/> Monitor Current(main)	
10.0 kA			

Figure 29: Current: Program example

After a parameter value has been changed the user can quickly return to the Status page by pressing on the  icon.

5 PROGRAMMING WELD PROGRAMS

5.1 Overview

The EN7000v2 weld control's primary function is to control the weld sequence by using the I/O and weld program (schedule) parameters. This section provides an overview of the weld types supported by the EN7000v2 and a guide to programming a basic spot weld program (schedule).

5.2 What is a weld program?

A weld program (schedule) is a timed sequence of operations to control secondary current and time at the welding electrodes (tips) and the actuator used to generate the weld force from the start to the end of the sequence.

The EN7000v2 weld controller is a flexible system that allows a user to create a unique weld program (schedule) for their specific machine application. This section is designed to provide an overview of the key parameters for you to build your unique weld program (schedule).

Resistance welding is a process that fuses two pieces of metal using the electrical property of resistance to create a weld. Resistance welding does not require a filler metal and is a very efficient way to join metal.

To make a resistance weld, the two pieces of metal are squeezed together by electrodes on the welding machine. Then electric current is passed through the two pieces of metal. The resistance between the two pieces of metal generates heat until the metal begins to melt at the spot where the materials are squeezed. The molten metal from the two pieces flows together. Then the electrical current is turned off and the molten metal solidifies, forming a solid metallic bond between the two workpieces.

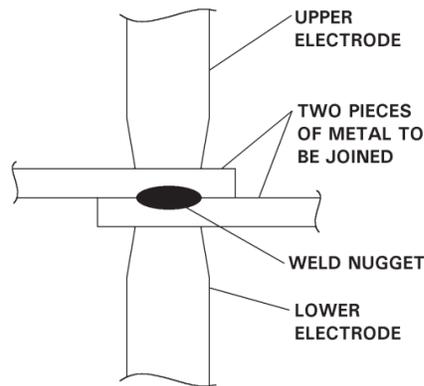


Figure 30: Spot Weld Diagram

A basic resistance welding sequence for a spot weld is defined in Figure 31. A spot weld can be broken down into three primary phases – squeeze time, weld time, and hold time.

- **Squeeze Time** – the interval of time between the initial application of the electrode force on the work and the first application of current. To the weld control, this is the time between the sequence initiation

(START) and the application of weld current. Squeeze time is required due to the dynamics of the actuator and allows the actuator to reach weld force before the weld current is applied.

- **Weld Time** – Weld time is the time during which the weld current is applied to the work piece. The parameters of the weld program (schedule) can be used to define the profile of the applied current. The profile of the weld current may have pre-heat, cooling, upslope, main heat, down slope, and post-heat components.
- **Hold Time** – Hold time is the time during which electrode force is maintained after the last impulse of weld current. This phase is necessary to allow the weld nugget to solidify before the weld force is removed.

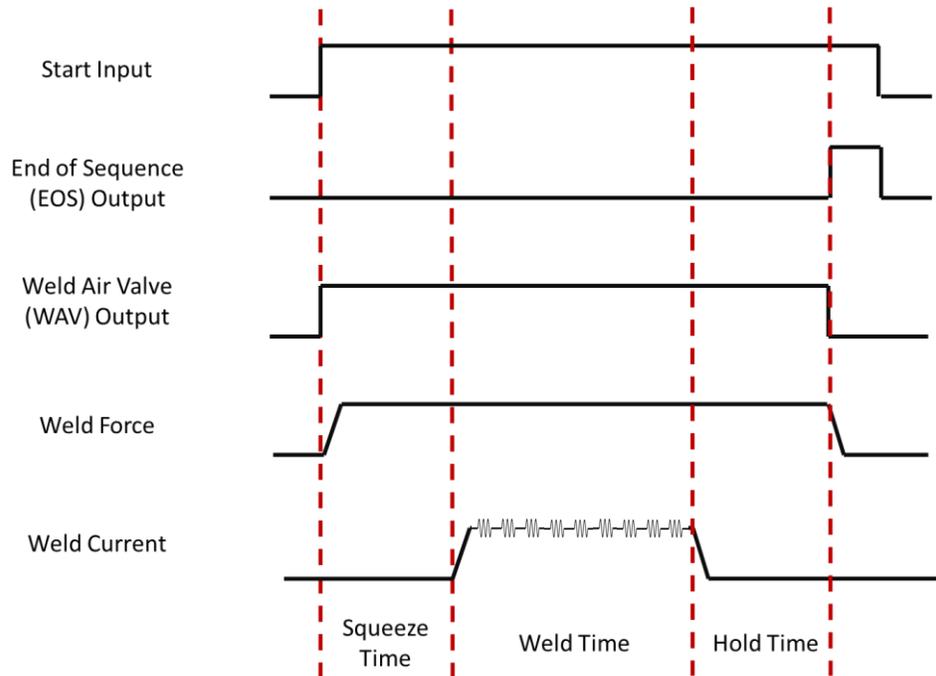


Figure 31: Weld Sequence Diagram

5.3 Parameters

The EN7000v2 weld control has a flexible design with options that allows a user to create an extensive variety of weld programs. An infinite number of combinations may sound daunting; Each weld program will follow the same squeeze, weld, hold, profile defined in [Figure 31](#).

The main parameters for programming a weld program (schedule) is defined in this section. These parameters are sequenced together to create unique weld programs.

5.3.1.1 Weld Program Options

Each weld program (schedule) can be expanded by means of a number of optional features that can be enabled or disabled. Below is the list of optional features for each weld program.

Parameter - OPTIONS	Range	Description
Program Inhibit ¹	YES/NO	An inhibited program will not run
Pre-Heat	YES/NO	Enables or disables the Pre-heat parameters. Pre-heat allows the workpieces to be heated prior to the application of the main heat.
Post-heat	YES/NO	Enables or disables the Post-heat parameters. Post-heat allows the weld nugget to be tempered or cooled in a controlled manner to minimize cracking.
Pulsations	0-99	The number of times the Main heat – Cool2 interval is repeated
Link ²	YES/NO	The next welding program will be started automatically if the input signals are maintained Note:- Bad link is due to a program being linked to its self. Maximum Linked programs = 9
Repeat Mode	YES/NO	The welding program will be repeated if the input signals are maintained
Force Profile	YES/NO	Use multiple force values during the weld
Retry	ON/OFF	The weld program will re-run if a Low Main Current is detected. This function should only be selected for spot welding.
C-Monitor shunt	ON/OFF	The measured conduction will be checked against the C-monitor shunt limit
C-Monitor wear	ON/OFF	The measured conduction will be checked against the C-monitor wear limit

¹ If an inhibited program is not linked when attempting to run it will produce an error message. If the program is linked, then the program will be skipped and the next linked program will run. This feature may be used to temporarily disable a program in a cascade

² Extended mode must be set in Configuration to use this feature

Table 21: Weld Option Parameters

5.3.1.2 Weld Timing Parameters

The EN7000v2 controls the weld sequence I/O in conjunction with the weld parameters. The parameters are stored in programs in the weld control. Typically, a unique weld program (schedule) is stored for a specific job or weld. The EN7000v2 control can store up to 256 weld programs.

The timing parameters for the weld program are defined in **Table 22**. These values determine the duration of each parameter in cycles (~ Cy) of the line frequency (50Hz / 60Hz).

Parameter – EDIT TIME	Range	Units	Description
Presqueeze ⁵	0-99	~ Cy	The time for the electrodes to close onto the workpiece
Squeeze	0-99	~ Cy	The time between the initial application of the electrode force and the first application of welding current
Pre-heat ¹	0-99	~ Cy	The time the pre-heat welding current is applied
Cool1 ¹	0-99	~ Cy	The time the material is allowed to cool with electrode force applied
Upslope	0-99	~ Cy	The time the welding current is increased to the Main heat current
Main heat	0-99	~ Cy	The time the main welding current is applied
Cool2 ²	0-99	~ Cy	The time the material is allowed to cool with the electrode force applied
Downslope	0-99	~ Cy	The time which welding current is decreased to the Post-heat current
Post-heat ³	0-99	~ Cy	The time the post-heat welding current is applied
Hold	0-99	~ Cy	The time the electrode force continues after the welding current has finished
Off ⁴	0-99	~ Cy	Electrode force is released until the next sequence begins
Pulsation ⁶	0-99	Pulses	Number of times the Main heat is repeated.

¹. Pre-heat program must be enabled in <<< **OPTIONS** >>> to use this feature

². Pulsations program option must be greater than 1 to use this feature

³. Post-heat program option must be enabled in <<< **OPTIONS** >>> to use this **extended** feature

⁴. Repeat mode or Roll-spot program option

⁵. Requires **Extended** mode to be enabled in the configuration

⁶. When Pulsations > 1, the Cool2 event is used even in the absence of Post Heat

Table 22: Weld Timing Parameters

5.3.1.3 Current Control Parameters

The weld programs contain the current parameters listed in **Table 23**. It should be noted that for each current interval, the firing mode must be defined. The modes of current control are:

- PHA Mode**
 Phase Angle – The heat parameter adjusts the output pulse-width. No current regulation takes place. The current parameter is used for monitoring only
- CCR Mode**
 Constant Current Regulation – The current parameter is set in terms of kA. Current is regulated. The current parameter is also used for monitoring.

Parameter - CURRENT	Units	Range	Description
Pre: mode: ¹		PHA/CCR	Operating mode of the Pre-heat interval.
Pre: heat: ¹	%	0.0 – 99.9	The % heat used during the Pre-heat interval in PHA mode.
Pre: current: ¹	kA	0.00 – 500	The current used during the Pre-heat interval in CCR mode. Set point for monitoring.
Pre: Monitor: ¹		YES/NO	Enables monitoring for Pre-heat interval.
Main: mode:		PHA/CCR	Operating mode of the Main heat interval
Main: heat:	%	0.0 – 99.9	The % heat used during the Main heat interval in PHA mode
Main: current:	kA	0.00 – 500	The current used during the Main heat interval in CCR mode. Set point for monitoring.
Main: Monitor:		YES/NO	Enables monitoring for Main mode.
Post: mode: ²		PHA/CCR	Operating mode of the Post-heat interval
Post: heat: ²	%	0.0 – 99.9	The % heat used during the Post-heat interval in PHA mode
Post: current: ²	kA	0.00 – 500	The current used during the Post-heat interval in CCR mode. Set point for monitoring.
Post: Monitor: ²		YES/NO	Enables monitoring for Post-heat interval.
Low limit:	%	0 - 99	Current low limit
High limit	%	0 - 99	Current high limit
¹ Pre-heat program must be enabled in <<< OPTIONS >>> to use this feature			
² Post-heat program option must be enabled in <<< OPTIONS >>> to use this feature, extended mode must be enabled in Configuration.			

Table 23: Weld Current Control Parameters

5.3.1.4 Force Control Parameters

The EN7000v2 has the ability to control the force of a pneumatic actuator through the analog output. The pneumatic actuator must be calibrated to correlate the analog output with the generated force (see the Force Calibration section for detailed instructions).

To use Force control, the EN7000v2 analog output parameter must be set to **ANALOG OUT: FORCE**.

The EN7000v2 has the ability to control up to 8 air valves. Multi-valve operation requires **Extended** mode to be enabled in the configuration.

The list of all Force Profile Control parameters that can be defined in a weld program can be found in [Table 24](#).

<<< FORCE >>> Parameter	Units	Range	Description
Squeeze: ¹	kN/lbf	variable	Force used from the start of the Squeeze interval
Pre-heat: ¹	kN/lbf	variable	Force used from the start the Pre-heat interval
Cool 1: ¹	kN/lbf	variable	Force used from the start the Cool1 interval
Upslope: ¹	kN/lbf	variable	Force used from the start the Upslope interval
Force: (Main heat)	kN/lbf	variable	Force used from the start of the Main heat interval
Cool2	kN/lbf	variable	Force used from the start of the Cool2 interval
Downslope: ¹	kN/lbf	variable	Force used from the start of the Downslope interval
Post-heat: ¹	kN/lbf	variable	Force used from the start the Post-heat interval
Hold: ¹	kN/lbf	variable	Force used from the start the Hold interval
Wait for force: ²		YES/NO	Wait until the applied force has been reached
Test force:		YES/NO	Test the applied force at the end of the Main interval
Low limit:	%	0 - 99	Force low limit
High limit:	%	0 - 99	Force high limit
1. Force profile program option must be enabled, FORCE PROFILE: YES to use this <i>extended</i> feature. If the force profile option is disabled the Main heat force is used for the duration of the weld.			
2. Occurs at the same time as 2nd stage. If Wait for force is required without 2nd stage, select 2nd stage Before or After Squeeze (See Configuration section) and permanently assert the 2nd stage input.			

Table 24: Force Control Parameters

5.3.1.5 Valve Control Parameters

The EN7000v2 has eight discrete outputs (AV1 – AV8) that can be operated independently during a welding sequence. The valves are categorized as WAV, MOTOR, or AUX valves. The outputs are 24 V dc short circuit protected, monitored guided contact relay.

- WAV – a valve turns on at the start at the sequence and turns off at the end of the Hold interval.
- MOTOR – a valve that turns on after the 2nd Stage test, and turns off at the start of the Hold interval
- AUX – an output (valve) may be programmed to come on during any interval of the weld sequence, including during Off time in repeat or roll-spot mode. **Note: This is similar to Event programming on WS2003 timer.**

The use of the AV2-AV8 output is dependent on the configuration of the EN7000v2 control. [Table 25](#) shows the settings required.

EN7000v2 Feature Parameter	Configuration	WAV Function	MOTOR Function	Description
Standard	All	AV1	n/a	AV1 is automatically selected
Extended (spot)	Single electrode	AV1	n/a	AV1 is automatically selected
	Multi-electrode	AV1 – AV8	n/a	Any combination of AV1 to AV8 may be selected
Extended (seam)	Single electrode	AV1	AV2	AV1 and AV2 are automatically selected
	Multi-electrode	AV1 – AV8	AV1 – AV8	Any combination of AV1 to AV8 may be selected

Table 25: EN7000v2 Valve Control Configuration Parameters

The AUX/valve control parameters are defined in [Table 26](#).

Parameter	Units	Range	Description
WAV		AV1 – AV8	WAV output
Motor ¹		AV1 – AV8	Motor output
Squeeze	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Squeeze interval
Pre-heat	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Pre-heat interval
Cool ¹	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Cool1 interval
Upslope	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Upslope interval
Main heat	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Main heat interval
Cool ²	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Cool2 interval
Downslope	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Downslope interval
Post-heat	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Post-heat interval
Hold	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Hold interval
Off ²	AV1 – AV8	■(off) 1-8 (on)	Valve starts during the Off interval
<i>1 Seam mode only</i>			
<i>2 Repeat mode or Roll-Spot program option must be enabled to use this feature</i>			

Table 26: Valve Control Parameters

5.3.1.6 Multi-Electrode Parameters

The EN7000v2 is available for Multi-Welders where the EN7000v2 weld controller can control up to 8 valves and 8 transformers (see section XX for diagram).

The EN7000v2 must be configured for **Extended** mode to use the Multi-Electrode functions.

Each electrode must be assigned a SCR/TRANSFORMER number for the control to know which transformer to fire for the weld program. In addition, the electrode number is also used to access the appropriate stepper, counter, and calibration information.

Parameter	Range	Description
Electrode	0 - 7	The electrode number

Table 27: Multi-Electrode Parameters

5.4 Weld Program Types

The EN7000v2 is a flexible solution that allows a user to control the force, current, and duration (time) for their specific resistance welding application. Below is a list of common resistance welding types that the EN7000v2 supports.

- spot welding
- spot pulsation
- spot repeat
- seam
- roll-spot welds

A weld sequence is provided for each of these common welds to give the user an idea of the current and force profiles that can be created with the EN7000v2. This list is not exhaustive and is only intended to provide an overview of what can be done with the control.

5.4.1.1 Spot Weld

A spot weld is a single point weld. A weld sequence timing diagram showing a spot weld with the air valve actuated by the EN7000v2 weld controller and a single main heat to create the weld nugget is shown in [Figure 32](#).

The weld program options are set as follows:

Parameter <<< OPTIONS >>>	Value
Program Inhibit	NO
Pre-Heat	On
Post-heat	On
Pulsations	1
Link:	NO
Repeat Mode:	NO
Force Profile:	NO
Retry:	OFF
C-Monitor:	OFF
C-Monitor:	OFF

Table 28: Spot Weld Timing Diagram Weld Options

The timing sequence follows the order of operations defined below:

- 1) Pre-squeeze and squeeze time for the actuator to reach the desired weld force.
- 2) A pre-heat weld pulse followed by a cool pulse is applied to heat the workpiece.



Galvanized Steel
 A pre-heat pulse is typically used when welding galvanized steel to displace the zinc coating off the base material.

- 3) An upslope pulse is used to ramp the weld current to the main current in a controlled manner
- 4) The main current is applied
- 5) A downslope current is used to ramp the weld current to the post heat current in a controlled manner
- 6) The post-heat is weld current is applied. Typically used to control the solidification of the weld nugget and minimize cracking.
- 7) A hold is used to allow the weld nugget to cool while still under force
- 8) The End of Sequence (EOS) Output is generated when the sequence is complete.

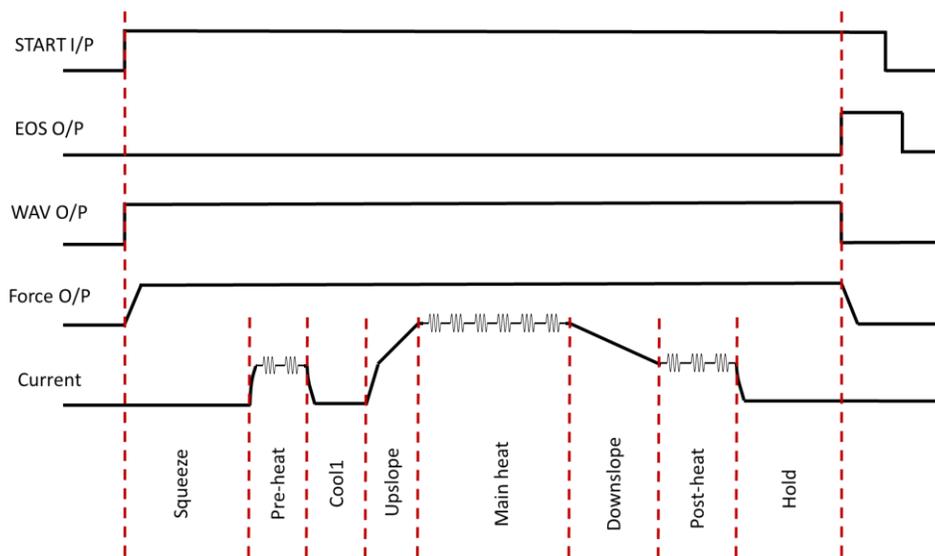


Figure 32: Spot Weld Timing Diagram

5.4.1.2 Spot Pulsation

A spot weld with pulsation is a single point weld where the main heat weld current is repeated multiple times. A pulsation spot weld is typically used to control the growth of the weld nugget without overheating the workpieces which can result in expulsion.

A weld sequence timing diagram showing pulsation spot weld with the air valve actuated by the EN7000v2 weld controller and the main heat is pulsed three times to create the weld nugget is shown in **Figure 33**.

The weld program options are set as follows:

Parameter <<< OPTIONS >>>	Value
Program Inhibit:	NO
Pre-Heat:	NO
Post-heat:	NO

Pulsations:	3
Link:	NO
Repeat Mode:	NO
Force Profile:	NO
Retry:	OFF
C-Monitor:	OFF
C-Monitor:	OFF

Table 29: Pulsation Spot Weld Time Diagram Weld Options

The timing sequence follows the order of operations defined below:

- 1) Pre-squeeze and squeeze time for the actuator to reach the desired weld force.
- 2) An upslope pulse is used to ramp the weld current to the main current in a controlled manner
- 3) The first pulse of the main current is applied
- 4) A cool2 time is applied
- 5) The second pulse of the main current is applied
- 6) A second cool2 time is applied
- 7) The third pulse of the main current is applied
- 8) A downslope current is applied to ramp down the current in a controlled manner
- 9) A hold is used to allow the weld nugget to cool while still under force
- 10) The End of Sequence (EOS) Output is generated when the sequence is complete.

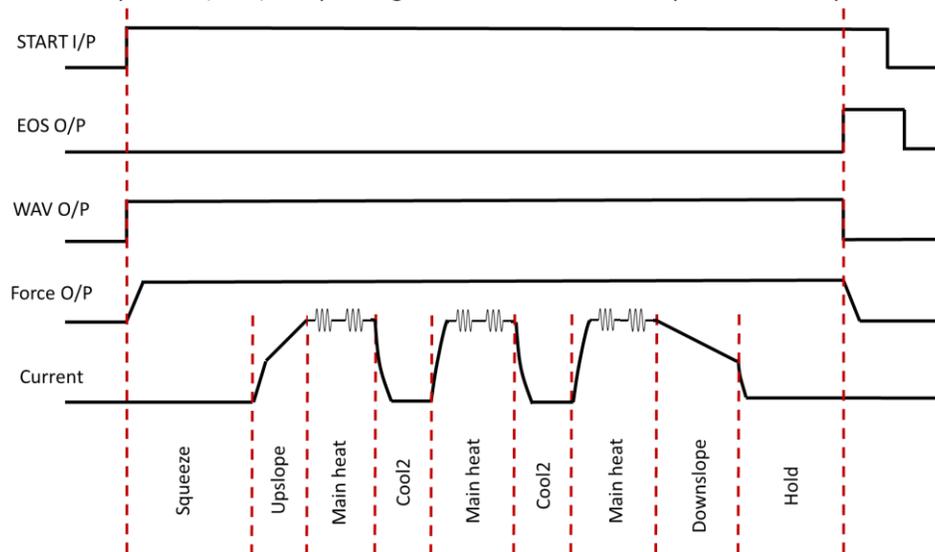


Figure 33: Pulsation Spot Weld Timing Diagram

5.4.1.3 Spot Repeat

A spot weld with repeat is a single point where the squeeze, weld, hold profile is repeated multiple times. A Spot Repeat weld is typically used in stitch welding applications where an operator may keep the foot pedal engaged to repeat the weld program. The electrodes will open during the OFF sequence which allows the workpiece to be repositioned for the next weld.

A weld sequence timing diagram showing a spot repeat weld with the air valve actuated by the EN7000v2 weld controller and the squeeze, weld, hold sequence repeated while the START input is maintained (see [Figure 34](#)).

The weld program options are set as follows:

Parameter <<< OPTIONS >>>	Value
Program Inhibit:	NO
Pre-Heat:	NO
Post-heat:	NO
Pulsations:	1
Link:	NO
Repeat Mode:	YES
Force Profile:	NO
Retry:	OFF
C-Monitor:	OFF
C-Monitor:	OFF

Table 30: Pulsation Spot Weld Time Diagram Weld Options

The timing sequence follows the order of operations defined below:

- 1) The Start input is initiated and maintained on.
- 2) Pre-squeeze and squeeze time for the actuator to reach the desired weld force.
- 3) The main heat weld current is applied
- 4) The hold sequence is executed
- 5) The off sequence is executed and the WAV signal is off which allows the electrodes to open
- 6) The START input is still maintained, so the squeeze weld hold sequence is repeated
- 7) The off sequence is executed and the WAV signal is off which allows the electrodes to open
- 8) The START input is still maintained, so the squeeze weld hold sequence is repeated
- 9) The off sequence is executed and the WAV signal is off which allows the electrodes to open
- 10) The START input is no longer maintained
- 11) The program is exited

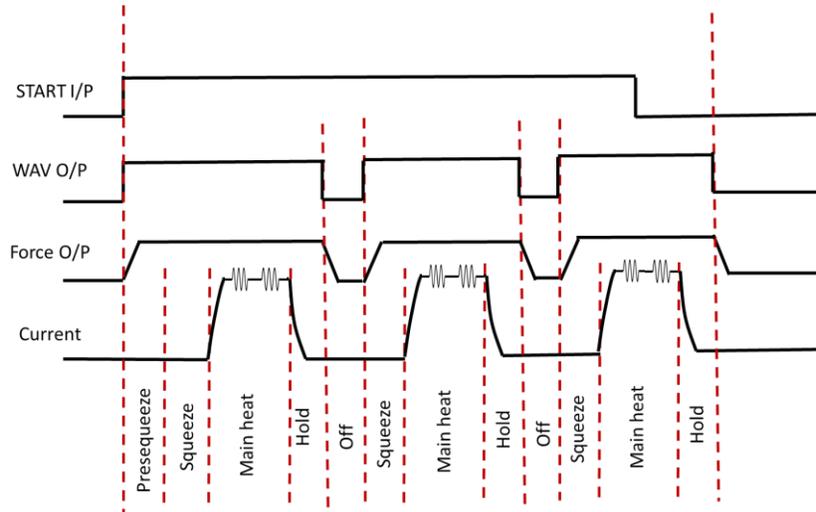


Figure 34: Spot Repeat Weld Timing Diagram

5.4.1.4 Seam

Resistance seam welding is a variation of resistance spot welding with the main difference being that the motor driven welding wheel electrodes are used rather than stationary electrodes. Figure 35 shows a typical timing diagram for a seam weld.

To use seam welding Mode, the configuration must be set as follows:

Configuration Parameter	Value
Features	Extended
Weld Type	Seam

Table 31: Configuration Parameters for Seam Weld Timing Diagram

The weld program options are set as follows:

Parameter	Value
Pre-Heat	ON
Post-heat	ON
Pulsations	1
Force Profile	OFF
Roll Spot	NO

Table 32: Seam Weld Timing Diagram Weld Options

The timing sequence follows the order of operations defined below:

- 1) The START input is initiated
- 2) The WAV output is enabled to actuate the force
- 3) The Presqueeze sequence is executed and the MOTOR output is enabled to drive the weld wheels
- 4) The Squeeze sequence is executed
- 5) The Cool1 sequence is executed
- 6) An upslope current pulse is executed to ramp the current to the main heat in a controlled manner
- 7) The Main heat current pulse is executed followed by the Cool2 sequence
- 8) The Main heat current and Cool2 pulse is repeated while the START signal is maintained
- 9) The START input is removed
- 10) A downslope current pulse ramps down the current in a controlled manner
- 11) A post heat weld pulse is executed
- 12) The MOTOR output is disabled
- 13) A Hold sequence is executed
- 14) The WAV output is disabled to release the actuator

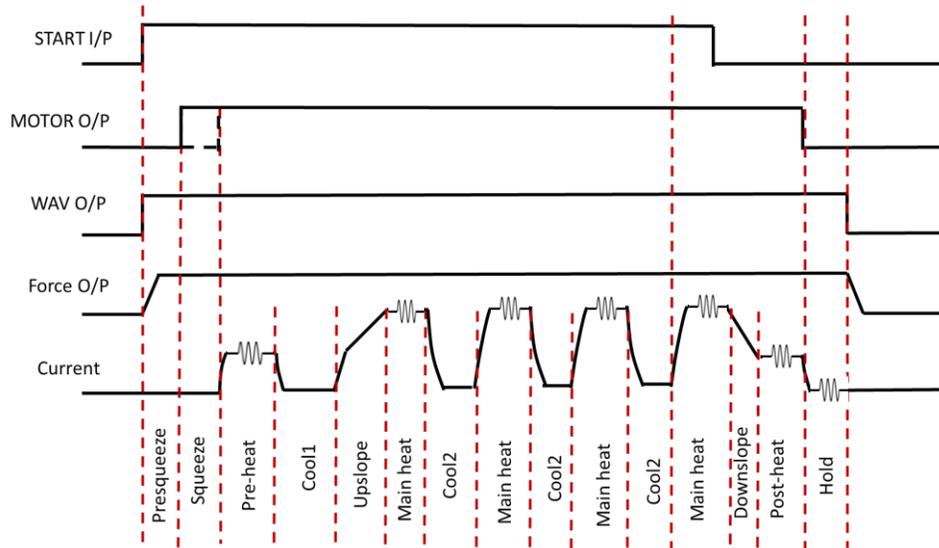


Figure 35: Seam Weld Timing Diagram



Continuous Seam Weld

For a continuous seam weld, the Cool2 parameter should be set to 0.



MOTOR – 2nd Stage

The initiation of the MOTOR output signal is a function of the Second Stage parameter.

5.4.1.5 Roll-spot

A Roll-spot weld sequence is a seam weld where the weld current is pulsed in a cyclical manner when the weld wheels are stationary creating a series of spot welds on the workpiece. This type of weld does not create a hermetic seal.



MOTOR Drive

The MOTOR output is enabled during the weld off time.

To use seam welding Mode, the configuration must be set as follows:

Configuration Parameter	Value
Features	Extended
Weld Type	Seam

Table 33: Configuration Parameters for Roll-Spot Weld Timing Diagram

The weld program options are set as follows:

Parameter	Value
Pre-Heat	Off
Post-heat	Off
Pulsations	1
Force Profile	Off
Repeat	On

Table 34: Roll Spot Weld Timing Diagram Weld Options

The timing sequence follows the order of operations defined below:

- 1) The START input is initiated
- 2) The WAV output is enabled to actuate the force
- 3) The Presqueeze sequence is executed
- 4) The Squeeze sequence is executed
- 5) The Main heat current pulse is executed followed by the Hold sequence
- 6) The OFF sequence is started and MOTOR output is enabled to roll the material to the next location of the spot weld
- 7) The Squeeze, Main Heat, Hold, OFF sequence is repeated while the START signal is maintained
- 8) The START input is disabled
- 9) The active Squeeze, Weld, Hold sequence is completed
- 10) The WAV output is disabled to release the actuator

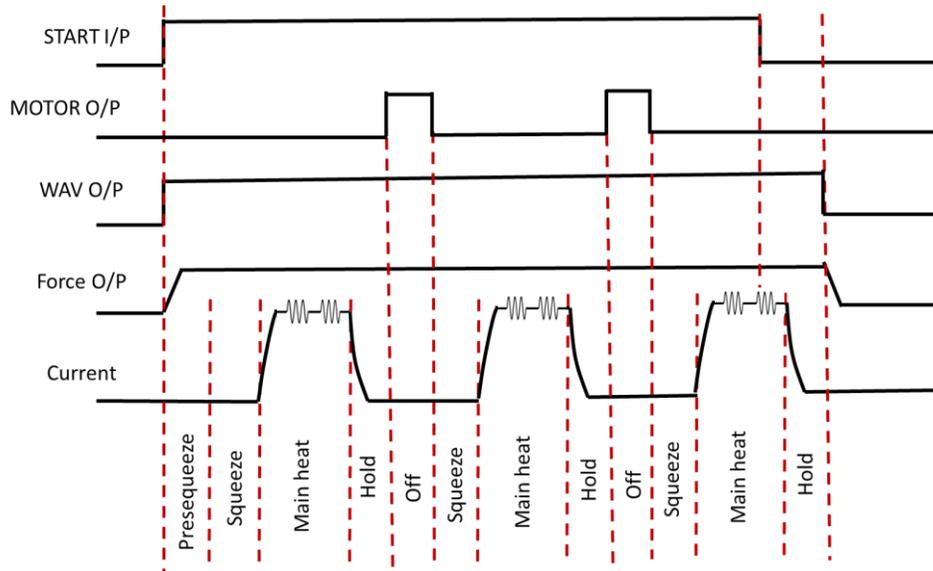


Figure 36: Roll-Spot Weld Timing Diagram

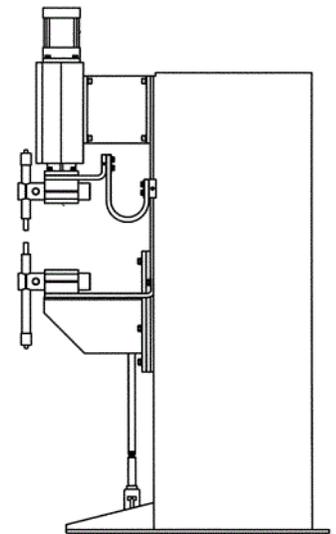
5.5 Programming a Spot Weld with the WSP3

This section provides an overview of how to program a simple spot weld program using the WSP3 Pendant. This example provides an overview of the process for programming a weld program (schedule). The skills learned in this section can be built upon to create a weld program for your unique resistance welding application.

This section assumes that the control has been installed, calibrated, and the user has connected to the WSP3 to the control. If this has not been completed refer to the [Installation](#) section.

The weld program (schedule) to be programmed will follow the Spot Welding timing diagram shown in [Figure 37](#). This example is based on a machine with the configuration defined below:

- Standard Machine with a single air valve controlled by the EN7000v2
- The unit has been configured and calibrated for Secondary Regulation using a toroid sensor.



PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with the WSP3

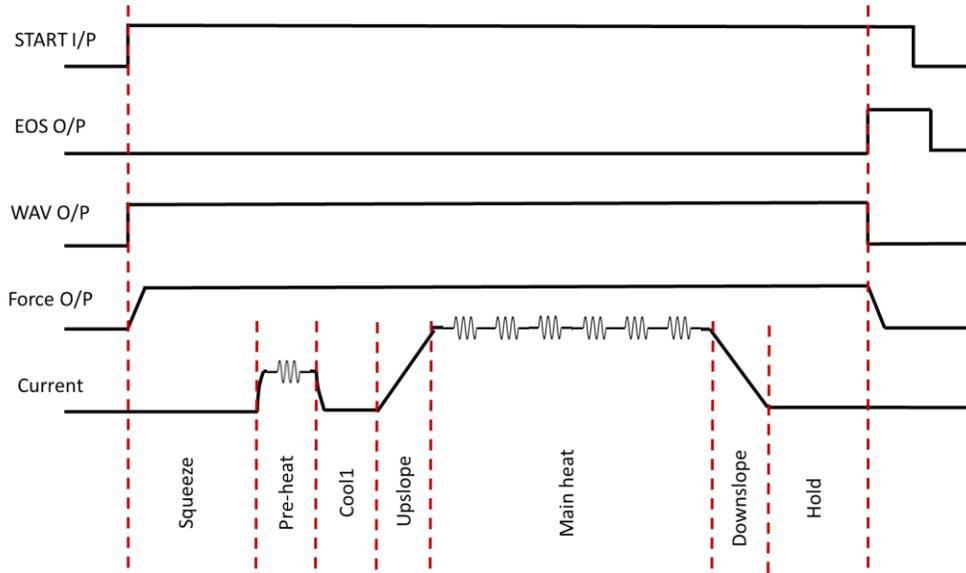


Figure 37: Simple Spot Welding Timing Diagram

The step-by-step instructions for programming a simple spot weld with the WSP3 is shown in [Table 35: Instructions to Program a Simple Spot Weld with the WSP3](#).

Step	Description	Screen / Parameters	Key Inputs								
1	Turn ON the EN7000v2 Weld Control										
2	The Status Screen will be displayed on the WSP3										
3	Press the F key to navigate to the <<Main Menu>>		To Enter Menu								
4	Scroll down to the Edit Configuration line using the Down arrow		To scroll Down								
5	Press RETURN and F simultaneously to enter the Configuration Menu										
6	Set all of the configuration parameters as shown below.	<table border="1"> <thead> <tr> <th>Configuration Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>FEATURES:</td> <td>STANDARD</td> </tr> <tr> <td>2ND STAGE:</td> <td>OFF</td> </tr> <tr> <td>2ND STAGE:</td> <td>ONCE</td> </tr> </tbody> </table>	Configuration Parameter	Value	FEATURES:	STANDARD	2 ND STAGE:	OFF	2 ND STAGE:	ONCE	
Configuration Parameter	Value										
FEATURES:	STANDARD										
2 ND STAGE:	OFF										
2 ND STAGE:	ONCE										

PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with the WSP3

Step	Description	Screen / Parameters	Key Inputs																																										
	 <p>RESTART CONTROL If the <i>Features</i> setting is changed the control must be restarted (Power On/Off).</p>	<table border="1"> <tr><td>SENSOR:</td><td>TOROID</td></tr> <tr><td>TOROID TEST:</td><td>OFF</td></tr> <tr><td>FREQUENCY:</td><td>50 Hz</td></tr> <tr><td>UNITS:</td><td>METRIC</td></tr> <tr><td>STOP ON FAULT:</td><td>NO</td></tr> <tr><td>EOS ON FAULT:</td><td>NO</td></tr> <tr><td>HEADLOCK:</td><td>NO</td></tr> <tr><td>PROG SELECTION:</td><td>INTERNAL</td></tr> <tr><td>RETRACT:</td><td>SIMPLE</td></tr> <tr><td>I/O SOURCE:</td><td>DISCRETE</td></tr> <tr><td>ANALOG CONTROL:</td><td>OFF</td></tr> <tr><td>ANALOG OUT:</td><td>FORCE</td></tr> <tr><td>WAVE FORM 10V:</td><td>30.0 kA</td></tr> <tr><td>CONTACTOR:</td><td>0 s</td></tr> <tr><td>COM2 (RS485)</td><td></td></tr> <tr><td>COM3 (RS232)</td><td></td></tr> <tr><td>ETHERNET</td><td></td></tr> <tr><td>BACKUP TO WSP3</td><td></td></tr> <tr><td>RESTORE FROM WSP3</td><td></td></tr> <tr><td>INITIALISE ALL DATA</td><td></td></tr> <tr><td>RESTART SYSTEM</td><td></td></tr> </table>	SENSOR:	TOROID	TOROID TEST:	OFF	FREQUENCY:	50 Hz	UNITS:	METRIC	STOP ON FAULT:	NO	EOS ON FAULT:	NO	HEADLOCK:	NO	PROG SELECTION:	INTERNAL	RETRACT:	SIMPLE	I/O SOURCE:	DISCRETE	ANALOG CONTROL:	OFF	ANALOG OUT:	FORCE	WAVE FORM 10V:	30.0 kA	CONTACTOR:	0 s	COM2 (RS485)		COM3 (RS232)		ETHERNET		BACKUP TO WSP3		RESTORE FROM WSP3		INITIALISE ALL DATA		RESTART SYSTEM		Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.
SENSOR:	TOROID																																												
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RESTORE FROM WSP3																																													
INITIALISE ALL DATA																																													
RESTART SYSTEM																																													
7	Press F to return to the MAIN MENU		 To Enter Menu																																										
8	Scroll using the Up & Down keys to the EDIT PROGRAM line and press the RETURN key		 To scroll  To Enter Menu																																										
9	On the <<<PROGRAM XX >>> line use the + and – keys to select PROGRAM 0		 <p>Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.</p>																																										
10	Now use the Down Key to EDIT TIME menu and press RETURN.		 To Scroll Down																																										

PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with the WSP3

Step	Description	Screen / Parameters	Key Inputs
			 To Enter Menu
11	<p>The TIMING menu allows the user to adjust the programming parameter times <i>not Heat or Current</i>. Use the Up & Down Arrows to select the parameter and the + and – keys to adjust the timing.</p>	<pre> <<< TIMING >>> PRESQUEEZE: 0~ SQUEEZE: 50~ PRE-HEAT: 3~ COOL 1: 1~ UPSLOPE: 2~ MAIN HEAT: 10~ COOL 2: 0~ DOWNSLOPE: 2~ HOLD: 20~ *** END OF LIST *** </pre>	 To scroll  Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.
12	<p>After all TIMING parameters have been set, press F key to return to the program menu</p>	<pre> <<< PROGRAM 0 >>> EDIT TIME EDIT CURRENT EDIT FORCE EDIT VALVES EDIT VALVES DELAYS EDIT OPTIONS COPY PROGRAM START PROGRAM *** END OF LIST *** </pre>	
13	<p>Scroll down using the Down Arrow key to EDIT CURRENT option and press Return key</p>	<pre> EDIT CURRENT </pre>	 To Scroll Down  To Enter Menu

PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with the WSP3

Step	Description	Screen / Parameters	Key Inputs
14	<p>The CURRENT menu allows the user to adjust the Current / Heat parameters, <i>not Times</i>. Use the Up & Down Arrows to select the parameter and the + and – keys to adjust the Current/Heat parameter and other options.</p>	<pre> <<< CURRENT >>> PRE: MODE: PHA PRE: HEAT: 20% PRE: CURRENT: 7.00 kA PRE: MONITOR: NO MAIN: MODE: CCR MAIN: HEAT: 30% MAIN: CURRENT: 10.0 kA MAIN MONITOR: NO LOW LIMIT: 10% HIGH LIMIT: 10% *** END OF LIST *** </pre>	 <p>To scroll</p>  <p>Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.</p>
15	<p>After all CURRENT parameters have been set, press F key to return to the program menu</p>	<pre> <<< PROGRAM 0 >>> EDIT TIME EDIT CURRENT EDIT FORCE EDIT VALVES EDIT VALVE DELAYS EDIT OPTIONS COPY PROGRAM START PROGRAM *** END OF LIST *** </pre>	
16	<p>If using a Proportional Valve Regulator Scroll down using the Down Arrow key to EDIT FORCE parameters press Return key</p>	<pre> EDIT FORCE </pre>	 <p>To Scroll Down</p>  <p>To Enter Menu</p>
17	<p>Scroll down using the Down Arrow key and the + and - keys to edit the force parameters,</p>	<pre> <<< EDIT FORCE >>> FORCE: 3.00kN WAIT FOR FORCE: NO TEST FORCE: NO LOW LIMIT: 10% HIGH LIMIT: 10% *** END OF LIST *** </pre>	 <p>To scroll</p>  <p>Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.</p>

PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with the WSP3

Step	Description	Screen / Parameters	Key Inputs
18	After all FORCE parameters have been set, press F key to return to the program menu	<pre> <<< PROGRAM 0 >>> EDIT TIME EDIT CURRENT EDIT FORCE EDIT VALVES EDIT VALVE DELAYS EDIT OPTIONS COPY PROGRAM START PROGRAM *** END OF LIST *** </pre>	
19	Scroll down using the Down Arrow key to EDIT OPTIONS and press RETURN key	<pre> EDIT OPTIONS </pre>	 To Scroll Down  To Enter Menu
20	<p>The OPTIONS menu allows the user to:</p> <ul style="list-style-type: none"> inhibit the program from running if not required. Enable the pre-heat parameter. pulse the current in weld enable repeat welding if required <p>To return to the Timer Status screen press the F key 3 times.</p>	<pre> <<< OPTIONS >>> PROGRAM INHIBIT: NO PRE-HEAT: YES PULSATIONS: 1 REPEAT MODE: NO *** END OF LIST *** </pre>	 To scroll  Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.
21	<p>After the OPTIONS have been set, press the F key 3 times to return to the Status Screen.</p> <p>STATUS SCREEN UPDATE</p>  <p>The Status Screen will update after each weld.</p>	<pre> Ready -- 0 A PROG 0 - - 11.7 kA 5.66 kN -- 0 A ~30.5% </pre>	 3 times

Table 35: Instructions to Program a Simple Spot Weld with the WSP3

5.6 Programming a Spot Weld with NetFlash

This section provides an overview of how to program a simple spot weld program using the NetFlash™ software. This example provides an overview of the process for programming a weld program (schedule). The skills learned in this section can be built upon to create a weld program for your unique resistance welding application.

This section assumes that the control has been installed, calibrated, and the user has connected to the control via the NetFlash™ software. If this has not been completed refer to the **Installation** section.

The weld program (schedule) to be programmed will follow the Spot Welding timing diagram shown in **Figure 38**. This example is based on a machine with the configuration defined below:

- Standard Machine with a single air valve controlled by the EN7000v2
- The unit has been configured and calibrated for Secondary Regulation using a toroid sensor.

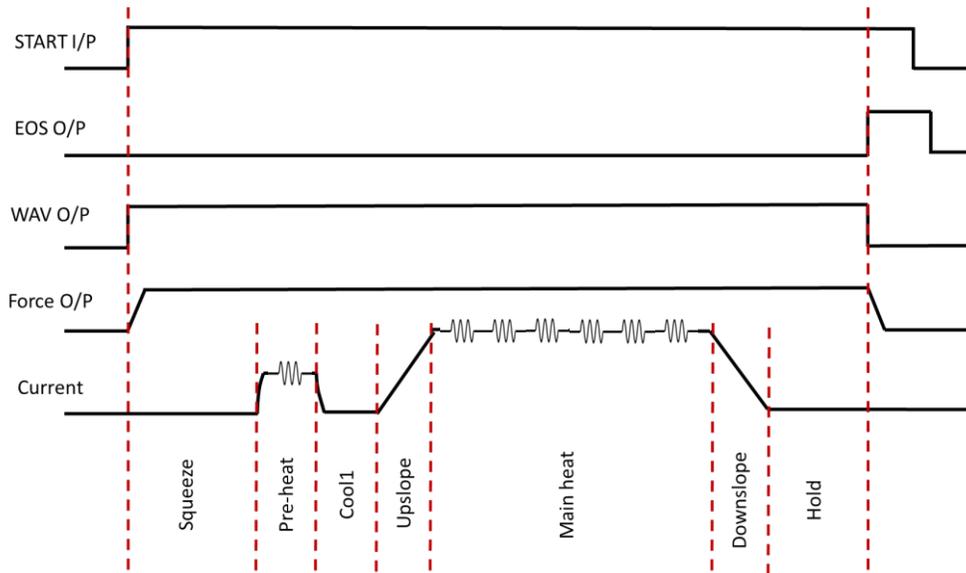
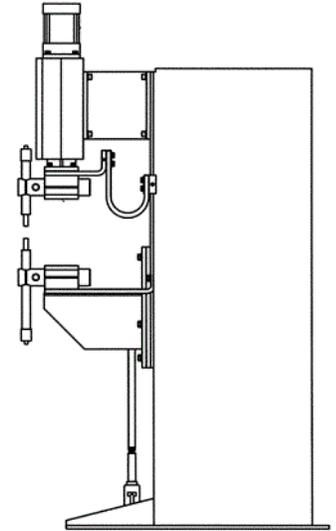


Figure 38: Simple Spot Weld Timing Diagram



Live Data Update

When connected to a control, updates to control parameters occur on a field change in NetFlash™. For checkboxes and arrows, the change is written to the control on a mouse click. For text fields updated with a keyboard entry, the user must press **Enter** or **Tab** after a field change to push the data to the control.

The steps to program the Weld Program above are as follows:

- 1) Open the NetFlash™ application and connect to the target control
- 2) Load the parameters from the control by clicking the **Load from Control** icon

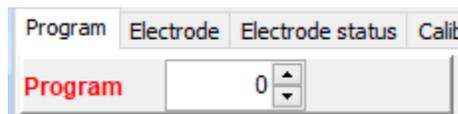


- 3) Navigate to the **Configuration** tab to verify the EN7000v2 is configured for a spot weld on a standard machine:

Configuration Parameter	Value
Features	Standard
Weld Type	Spot
Retract	Off/Simple
I/O Source	Discrete
2 nd Stage	Off
Sensor	Toroid
Electrodes	Single
Program Selection	Internal
Analog Out	Force Control

Table 36: EN7000v2 Configuration for Spot Welding Example

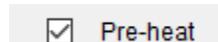
- 4) Navigate to the **Program** Tab
- 5) Enter the **weld program number** to edit in the Program field and press ENTER.



- 6) Set the **Pulses** value to 1 for a single Main Heat current pulse, then press ENTER



- 7) Enable the **Pre-heat** function by clicking the checkbox



- 8) Set the **Force** value to your desired value, then press ENTER

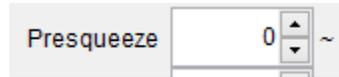


9) Set the **Squeeze** value to the desired values in cycles, then press ENTER



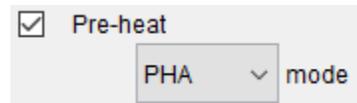
A screenshot of a control panel for the 'Squeeze' parameter. The label 'Squeeze' is on the left. To its right is a numeric input field containing the value '50'. To the right of the input field are two small vertical arrows (up and down) and a tilde symbol '~'.

10) Set the **Pre-Heat** time in cycles, then press ENTER



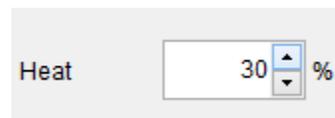
A screenshot of a control panel for the 'Presqueeze' parameter. The label 'Presqueeze' is on the left. To its right is a numeric input field containing the value '0'. To the right of the input field are two small vertical arrows (up and down) and a tilde symbol '~'.

11) Set the **Pre-heat Mode** to PHA.



A screenshot of a control panel for the 'Pre-heat' mode. On the left, there is a checked checkbox followed by the text 'Pre-heat'. To the right is a dropdown menu showing 'PHA' and a tilde symbol '~'. Below the dropdown menu is the word 'mode'.

12) Since we are controlling the heat in PHA mode, the magnitude of the weld pulse is set in terms of % **Heat**. Set this value to your desired % **Heat**.



A screenshot of a control panel for the 'Heat' parameter. The label 'Heat' is on the left. To its right is a numeric input field containing the value '30'. To the right of the input field is a tilde symbol '~' and a '%' sign.

13) Set the duration of the **Cool1** pulse.



A screenshot of a control panel for the 'Cool1' parameter. The label 'Cool1' is on the left. To its right is a numeric input field containing the value '1'. To the right of the input field are two small vertical arrows (up and down) and a tilde symbol '~'.

14) Set the **Upslope** parameter in cycles. This defines the time it will take for the control to ramp up to the Main Heat/Current.



A screenshot of a control panel for the 'Upslope' parameter. The label 'Upslope' is on the left. To its right is a numeric input field containing the value '2'. To the right of the input field are two small vertical arrows (up and down) and a tilde symbol '~'.

15) Set the **Main Heat Mode** to **CCR** mode which allows us to program the output current in terms of KA.



A screenshot of a control panel for the 'Main heat' mode. The label 'Main heat' is on the left. To its right is a dropdown menu showing 'CCR' and a tilde symbol '~'. Below the dropdown menu is the word 'mode'.

16) Set the **Current** to the desired weld current for the main current



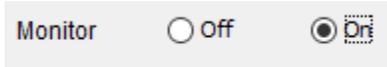
A screenshot of a control panel for the 'Current' parameter. The label 'Current' is on the left. To its right is a numeric input field containing the value '8.00'. To the right of the input field is a tilde symbol '~' and the unit 'kA'.

17) Set the **Main heat** parameter in cycles to define the duration of the pulse.



A screenshot of a control panel for the 'Main heat' parameter. The label 'Main heat' is on the left. To its right is a numeric input field containing the value '10'. To the right of the input field are two small vertical arrows (up and down) and a tilde symbol '~'.

18) Turn the **Monitor** On for the Main Current to store the measured secondary current in the History Log file.



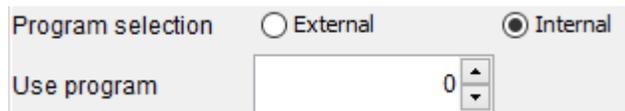
19) Set the **Downslope** value in cycles. This defines the time the control will take to ramp down from the Main Heat/Current to the Post-heat current.



20) Set the **Hold** time to allow the weld nugget to solidify.



21) Navigate to the Configure tab and verify the **Use Program** field is to the weld program that you edited.



22) The Spot Weld program corresponding to the spot welding timing diagram in **Figure 38** has now been stored in the EN7000v2 weld control and it is ready for use.

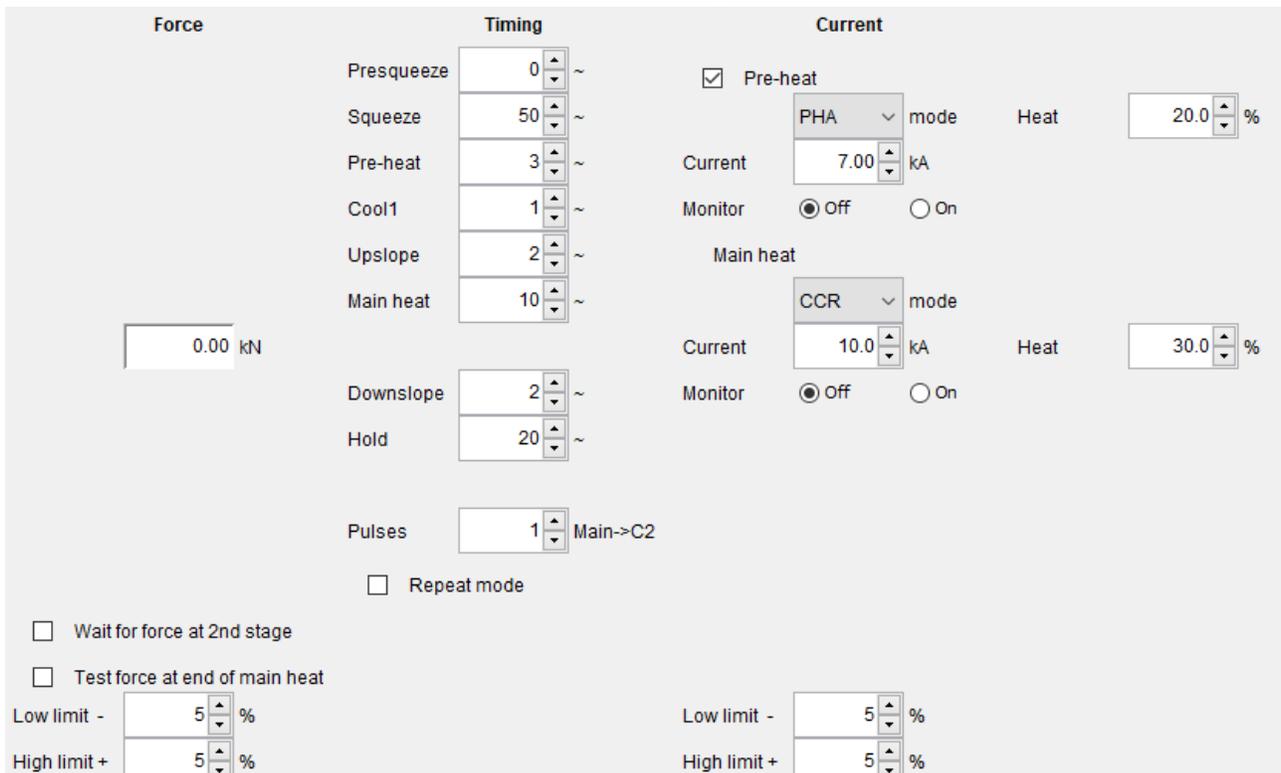


Figure 39: Spot Weld Program Example in NetFlash

5.7 Programming a Spot Weld with Touchscreen

This section provides an overview of how to program a simple spot weld program using the built-in touchscreen. This example provides an overview of the process for programming a weld program (schedule). The skills learned in this section can be built upon to create a weld program for your unique resistance welding application.

This section assumes that the control has been installed and calibrated. If this has not been completed refer to the **Installation** section.

The weld program (schedule) to be programmed will follow the Spot Welding timing diagram shown in **Figure 37**. This example is based on a machine with the configuration defined

- Standard Machine with a single air valve controlled by the EN7000v2
- The unit has been configured and calibrated for Secondary Regulation using a Toroid sensor

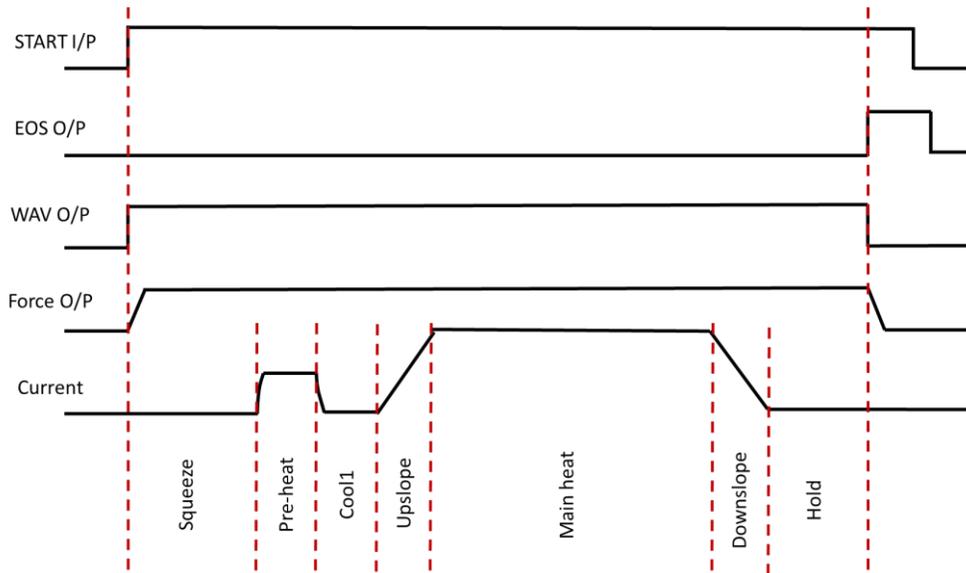
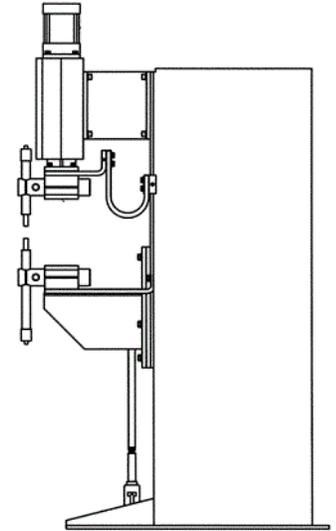
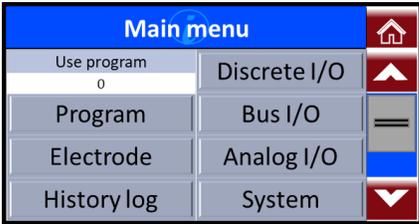
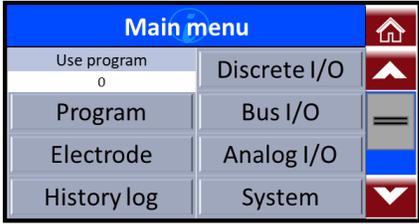
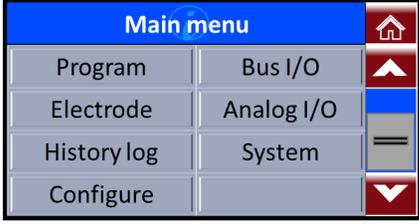
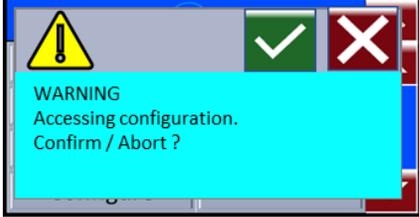


Figure 40: Simple Spot Welding Timing Diagram

PROGRAMMING WELD PROGRAMS

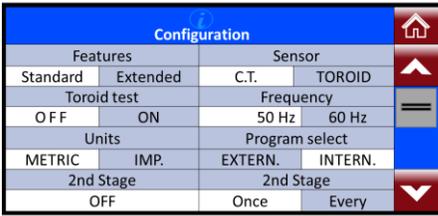
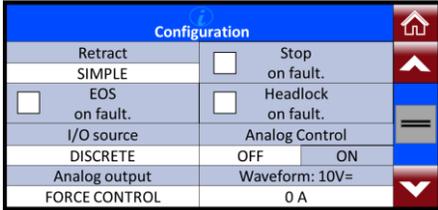
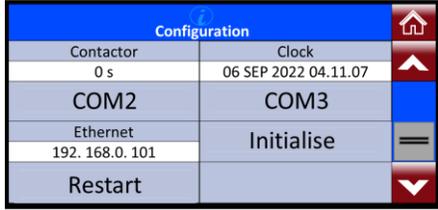
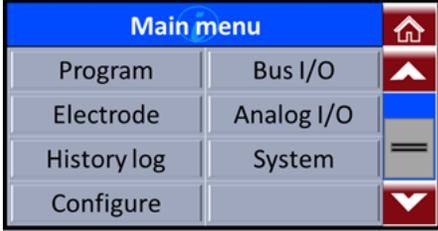
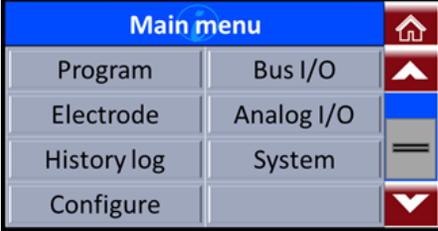
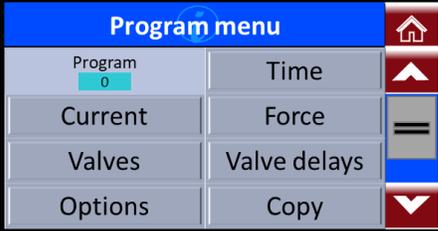
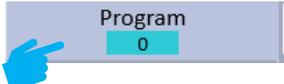
Programming a Spot Weld with Touchscreen

The step-by-step instructions for programming a simple spot weld with the built-in touchscreen is shown in Table 37

Step	Description	Screen / Parameters	Key Inputs
1	Turn ON the EN7000v2-TS Weld Control		
2	The Splash Screen will be displayed on the touchscreen display		
3	Press the HOME button to go Main menu		 To Enter Menu
4	Scroll down to the Configure button using the Down arrow		 To scroll Down
5	Press Configure button to enter Configuration Menu		
6	A warning message appears prior to entering the Configuration menu. Press the check box to proceed.		

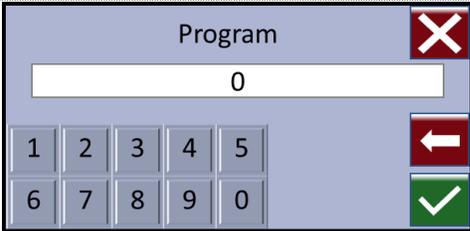
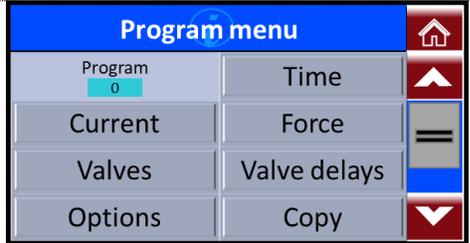
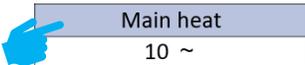
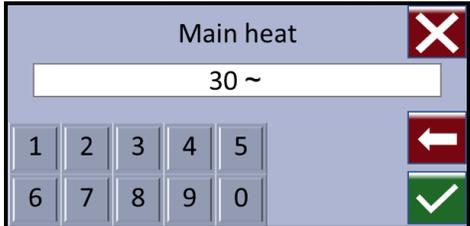
PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with Touchscreen

Step	Description	Screen / Parameters	Key Inputs
7	<p>Set all of the configuration parameters as shown.</p>  <p>RESTART CONTROL</p> <p>If the <i>Features</i> setting is changed the control must be restarted (Power On/Off). This message will also be displayed on the Status screen.</p>	  	 <p>Use the Up/Down arrows or slider until the parameter that needs changing is visible</p>
8	<p>Press HOME button to return to the Main menu</p>		 To Enter Menu
9	<p>Press the Program button to open the Program menu</p>		
10	<p>Select the program you wish to edit e.g program 0 press the program number button</p>		

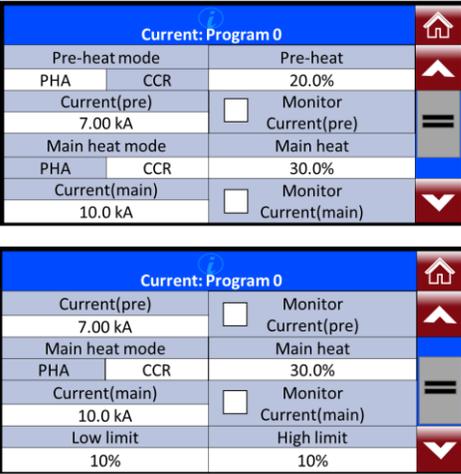
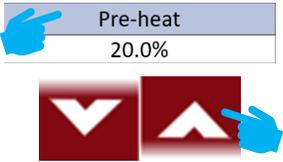
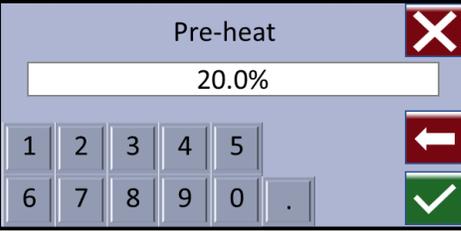
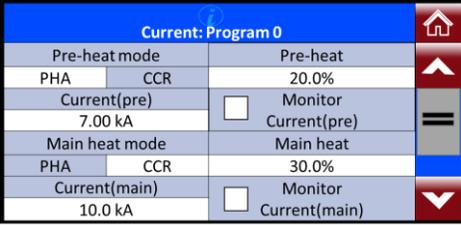
PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with Touchscreen

Step	Description	Screen / Parameters	Key Inputs
11	To select the program required use the numerical keypad then press the check box		
12	Now press the Time button		
13	The TIMING menu allows the user to adjust the programming parameter times <i>not Heat or Current</i> . To change the value, select the appropriate button.		
14	To select the time required use the numerical keypad then press the check box		
15	This will return you back to the Timing menu with updated value		
16	After all TIMING parameters have been set, press HOME button to return to the program menu		

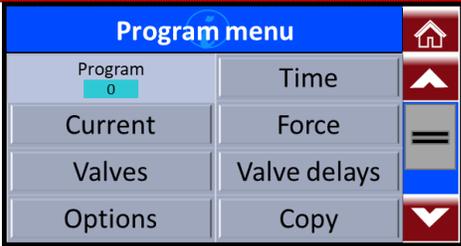
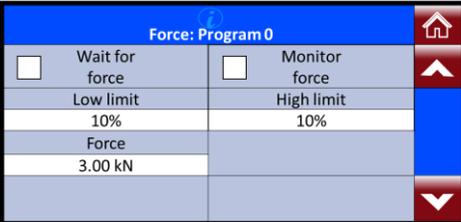
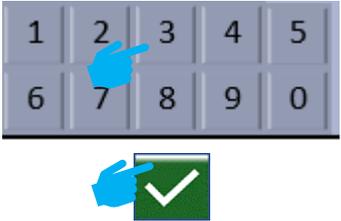
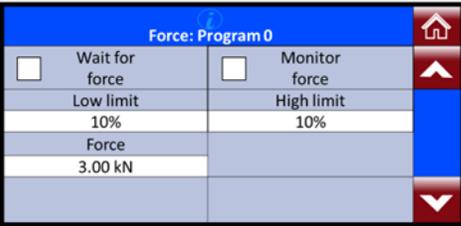
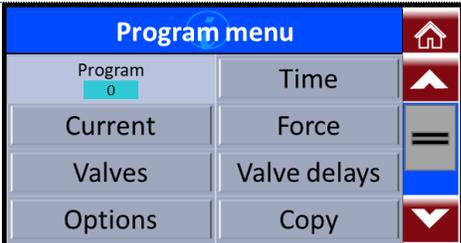
PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with Touchscreen

Step	Description	Screen / Parameters	Key Inputs
17	Press the Current button to access the Current menu		
18	The Current menu allows the user to adjust the mode of operation, programming parameters, Heat, Current and Monitoring values. To change the value, select the appropriate button.		 <p>Use the Up/Down arrows or slider until the parameter that needs changing is visible</p>
19	To select the value required use the numerical keypad then press the check box		
20	This will return you back to the Current menu with the updated value.		
21	After all CURRENT parameters have been set, press the HOME button to return to the Program menu		

PROGRAMMING WELD PROGRAMS

Programming a Spot Weld with Touchscreen

Step	Description	Screen / Parameters	Key Inputs
22	If using a Proportional Valve Regulator Press the Force button to access the Force menu		
23	The Force menu allows the user to adjust the force parameter, limits and feedback. To change the value, select the appropriate button.		
24	To select the value required use the numerical keypad then press the check box		
25	This will return you back to the Force menu with the updated value.		
26	After all Force parameters have been set, press the HOME button to return to the Program menu		
27	Press the Options button to access the Options menu		

Step	Description	Screen / Parameters	Key Inputs
28	<p>The OPTIONS menu allows the user to:</p> <ul style="list-style-type: none"> inhibit the program from running if not required. Enable the pre-heat parameter. pulse the current in weld enable repeat welding if required 		
29	<p>To select the value required use the numerical keypad then press the check box</p>		
30	<p>This will return you back to the Options menu with the updated value.</p>		
31	<p>To return back to the Status screen press the icon.</p> <hr/> <p>STATUS SCREEN UPDATE</p> <p>The Status Screen will update after each weld.</p>		

Table 37

5.8 Program Selection

The EN7000v2 weld control can store up to 256 weld programs to allow users to store programs that are unique to specific jobs or materials. A user can select the weld program in different ways. The available method of program selection will be a function of the communication setup and configuration.

The different methods for program selection are:

- Internal Program Selection
- External Program Selection

5.8.1 Internal Program Selection

The Internal Program selection requires the **Program Select** configuration parameter to be set to **Internal**.

The weld program to be used is taken from the **Use Program** parameter. This can be set manually in NetFlash™ in the **Configure** Tab or via the WSP3 pendant. This parameter can be accessed in touchscreen model via the **Configuration** menu.

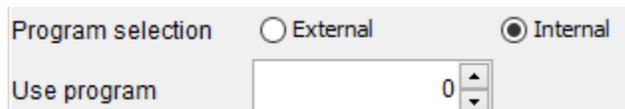


Figure 41: Use Program Field in NetFlash

5.8.2 External Program Selection

The External Program selection requires the **Program Select** configuration parameter to be set to **External**.

The program to be used is read from the values set in the **I/O source** configuration parameter. Note that the Discrete interface can only select programs 0 to 127. The Bus interfaces can select programs 0 to 255.

5.8.3 Program Selection for Spot Welding

The program select inputs are scanned at the same time as the START signal. The Use Program inputs can be changed after the weld program begins without affecting the weld in progress.

5.8.4 Program Selection for Seam Welding

The program select inputs are scanned at the same time as the START signal. The inputs may be changed during the execution of a weld program and the control will switch to the newly selected weld program.



Extended Mode

Seam Welding requires the Extended Mode to be enabled in the EN7000v2 configuration.

6 FAULTS & TROUBLESHOOTING

This section of the manual provides an overview of the fault and error messages output by the EN7000v2. When an error message is encountered, this section of the manual should be consulted for a detailed definition of the fault or error message.

6.1 Fault and Status Messages

Fault and Status messages can be read through the various communication methods that the EN7000v2 supports.

NetFlash™ and the WSP3 pendant show the status messages when connected.

The status messages can also be read from the bus outputs. The **READ & WRITE DATA WITH EXTERNAL DEVICES** section of the manual should be consulted for the detailed data structures.

Code	Pendent status	Status/Condition	Action
0	Ready -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Normal	
1	Stop -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Stop	Check the Stop input – Guide to User Connections drawing – Fieldbus inputs
2	No Sync 50 Hz -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Sync. error	Check 27 V ac sync signal and/or the Frequency parameter in Configuration (50 or 60 Hz)
3	Retract not ready -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Retract not ready	Operate the Retract input – Check configuration retract input setting
4	SCR Hot -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	SCR hot	Check SCR cooling
5	Transformer Hot -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Transformer hot	Check weld transformer cooling – Guide to User Connections drawing
6	Pilot Fault -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Pilot fault	Check timer 24 volts - Safety relay fault. Do not use the EN7000v2 and return it for service.
7	Restart Required -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%	Restart required	Configuration change requires restart. Restart the EN7000v2

FAULTS & TROUBLESHOOTING

Program Selection

8	<p>Headlocked -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Headlocked	The welding head is locked because of a fault condition – Monitored weld fault Function may be disabled if not required.
9	<p>Toroid Short Circuit -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Toroid short circuit	Connection to Toroid input (secondary feedback coil) is short-circuit – Nominal 25 ohms – Check User Connections
10	<p>Toroid Open Circuit -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Toroid open circuit	Connection to Toroid input (secondary feedback coil) is open-circuit – Nominal 25 ohms – Check User Connections
16		Test mode	For service use only
17	<p>Start ON -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Start on	The Start input is on following a weld sequence or stop/power-up condition To get rid of this message open Start input prior to start up – Guide to User Connections Drawing
18	<p>Weld Off -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Weld off	Check the Weld On input – Check User Connections
19	<p>Program Inhibited -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Program inhibited	This parameter prevents the weld schedule from running. The selected weld program is inhibited – Check Options Settings – Check User Connections for invalid external program selection.
20	<p>Output Fault -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Output fault	One or more outputs have failed – Replace Timer / Return timer for Service
22	<p>Too Many Links -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Too many links	Too many weld programs are linked together
23	<p>Bad Link -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Bad link	A link has been made to a weld program that cannot be used
24	<p>Max Current -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Max. current	Reduce heat/current. Check Electrode max current parameter is set correctly. Check relevant electrode calibration.
25	<p>Toroid overrange -- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	Toroid overrange	Reduce current or use an Toroid Attenuator Module (TAM). Check Toroid factor setting in Current Calibration

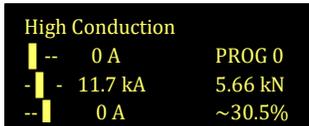
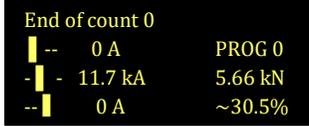
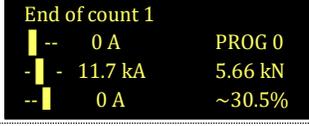
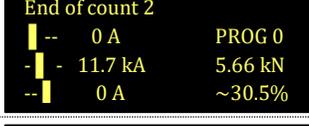
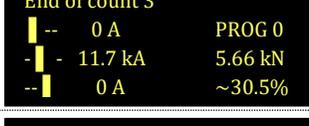
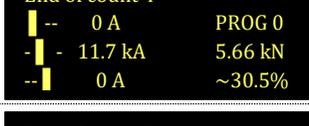
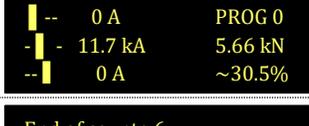
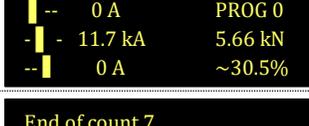
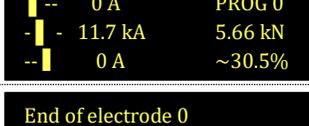
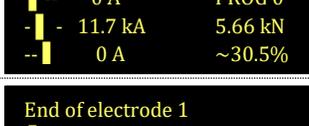
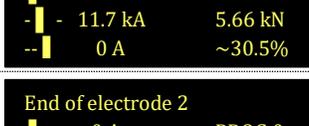
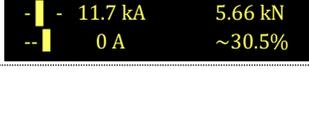
FAULTS & TROUBLESHOOTING

Program Selection

26	<p>CT overrange</p>	CT overrange	Check calibration parameters.
33	<p>Low force</p>	Low force	Check the analog input and output circuits and/or adjust force parameters – Check air pressure and calibration
34	<p>High force</p>	High force	Check the analog input and output circuits and/or adjust force parameters - Check air pressure and calibration
35	<p>Low Pre-current</p>	Low pre-current	Measured current is below the pre current low limit level.
36	<p>High pre-current</p>	High pre-current	Measured current is above the pre current high limit level.
37	<p>Low main current</p>	Low main current	Measured current is below the main current low limit level.
38	<p>High main current</p>	High main current	Measured current is above the main current high limit level.
39	<p>Low post current</p>	Low post-current	Measured current is below the post current low limit level.
40	<p>High post-current</p>	High post-current	Measured current is above the post current high limit level.
41	<p>No Second Stage</p>	No 2 nd stage	Check the 2 nd Stage input – Check User Connections – Insure configurations parameters.
42	<p>No force</p>	No force	Check analog input circuit – Check air pressure and calibration
43	<p>Low Conduction</p>	Low conduction (Shunt)	There may be a shunt condition on the weld transformer secondary circuit

FAULTS & TROUBLESHOOTING

Program Selection

44	<p>High Conduction</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	High conduction (wear)	The weld transformer secondary circuit conductors may have degraded.
49	<p>End of count 0</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 0	Reset counter 0
50	<p>End of count 1</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 1	Reset counter 1
51	<p>End of count 2</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 2	Reset counter 2
52	<p>End of count 3</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 3	Reset counter 3
53	<p>End of count 4</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 4	Reset counter 4
54	<p>End of count 5</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 5	Reset counter 5
55	<p>End of counte 6</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 6	Reset counter 6
56	<p>End of count 7</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of count 7	Reset counter 8
65	<p>End of electrode 0</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of electrode 0	Reset stepper 0
66	<p>End of electrode 1</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of electrode 1	Reset stepper 1
67	<p>End of electrode 2</p>  <p>-- 0 A PROG 0 - 11.7 kA 5.66 kN -- 0 A ~30.5%</p>	End of electrode 2	Reset stepper 2

FAULTS & TROUBLESHOOTING

Program Selection

68	<p>End of electrode 3</p>	End of electrode 3	Reset stepper 3
69	<p>End of electrode 4</p>	End of electrode 4	Reset stepper 4
70	<p>End of electrode 5</p>	End of electrode 5	Reset stepper 5
71	<p>End of electrode 6</p>	End of electrode 6	Reset stepper 6
72	<p>End of electrode 7</p>	End of electrode 7	Reset stepper 7
81	<p>Tip dress 0</p>	Tip dress 0	Dress the electrodes and then reset counter 0
82	<p>Tip dress 1</p>	Tip dress 1	Dress the electrodes and then reset counter 1
83	<p>Tip dress 2</p>	Tip dress 2	Dress the electrodes and then reset counter 2
84	<p>Tip dress 3</p>	Tip dress 3	Dress the electrodes and then reset counter 3
85	<p>Tip dress 4</p>	Tip dress 4	Dress the electrodes and then reset counter 4
86	<p>Tip dress 5</p>	Tip dress 5	Dress the electrodes and then reset counter 5
87	<p>Tip dress 6</p>	Tip dress 6	Dress the electrodes and then reset counter 6

88		Tip dress 7	Dress the electrodes and then reset counter 7
97		Prewarn 0	Stepper 0 has completed its 9th step
98		Prewarn 1	Stepper 1 has completed its 9th step
99		Prewarn 2	Stepper 2 has completed its 9th step
100		Prewarn 3	Stepper 3 has completed its 9th step
101		Prewarn 4	Stepper 4 has completed its 9th step
102		Prewarn 5	Stepper 5 has completed its 9th step
103		Prewarn 6	Stepper 6 has completed its 9th step
104		Prewarn 7	Stepper 7 has completed its 9th step

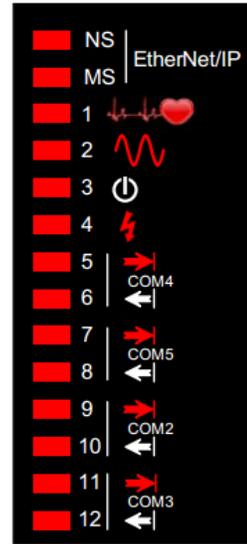
Figure 42: Fault / Status Message List

6.2 LED Indicators on Timer

The EN7000v2 weld timer has an array of LED lights that indicate activity and status information.

LED	FUNCTION
NS	EtherNet/IP network status
MS	EtherNet/IP module status
1	Heartbeat (Flashes at 1 Hz)
2	Ready (Flashes at 1Hz)
3	Sequence initiated
4	Weld current
5	Data receive COM0/4
6	Data send COM0/4
7	Data receive COM1/5
8	Data send COM1/5
9	Data receive COM2
10	Data send COM2
11	Data receive COM3
12	Data send COM3

Table 38: EN7000v2 Weld Timer LED Indicators



EN7000v2

6.2.1 Heartbeat LED

The Heartbeat LED should always be flashing at 1 Hz. The duty indicates information as defined in Table 39.

LED Pulse	State
Long ON, Short OFF	The control is in BIOS only mode. Use NetFlash™ to install an application
Short ON, Long OFF	The control is running an application

Table 39: Heartbeat LED States

6.2.2 Ready LED

The Ready LED defines whether or not the control is ready for use.

LED Pulse	State
Flashing at 1 Hz	The control is ready for use
OFF	The control is not Ready. Check status messages

Table 40: Ready LED States

6.2.3 Sequence LED

The Sequence LED is ON when the control has accepted a START signal is actively running a weld program.

6.2.4 Weld LED

The Weld LED is ON when the control turns on the welding current.

6.2.5 Data Send/Receive LEDs

Lights numbered 5 through 12 correspond signals for the COM ports numbered 2 through 5. The Send LEDs are defined with odd numbers. The Receive LEDs are defined by even numbers. When communications are being sent or received, the LED will flash.

6.2.6 Network Status / Module Status LEDs

The Network Status (NS) and Module Status (MS) LEDs show the status of the EtherNet/IP port.

Upon power up the LEDs will perform the sequence in [Table 41](#) to initialize.

LE1/MS	LE2/NS	Duration [s]
Green	Off	0.25
Red	Off	0.25
Off	Green	0.25
Off	Red	0.25

Table 41: NS/MS LED Power Up Sequence

After the power-up sequence is complete the LEDs indicate as follows:

LE1/MS – EtherNet/IP	Status
Green	OK
Red	Fault

Table 42: MS EtherNet/IP Status LED

LE12/NS – Network	Status
Green Flashing	Ready, no EtherNet/IP connection
Green Solid	EtherNet/IP class 1 connection
Red Flashing	EtherNet/IP class 1 connection lost

Table 43: NS Network Status LED

6.3 How to Reset Faults

There are multiple ways to clear the fault conditions and error messages on the EN7000v2. The fault messages can be reset or cleared by using one of the following communication methods:

- WSP3 Pendant
- NetFlash™ Software
- Discrete Input
- Fieldbus Input

The method you choose to reset the faults will be dependent on how the EN7000v2 has been configured for communications.

6.3.1 WSP3 Pendant

The WSP3 Pendant is a quick way to clear the messages directly at the machine. When on the Diagnostic screen, the fault conditions and error message at the top of the screen will rotate through all messages.

To clear the faults, follow the steps below identified below:

Step	Description	Screen / Parameters	Key Inputs
1	Press the F key until you reach the Status Screen		
2	From the Status Screen, press the RETURN key to clear the faults		 To Clear Faults

6.3.2 NetFlash™ Software

The NetFlash software can be used to clear the fault conditions and error messages. The instructions to clear the faults are below:

- 1) With the NetFlash™ software open and connected to the targeted control, then click the **Open/Close Metrics** icon.

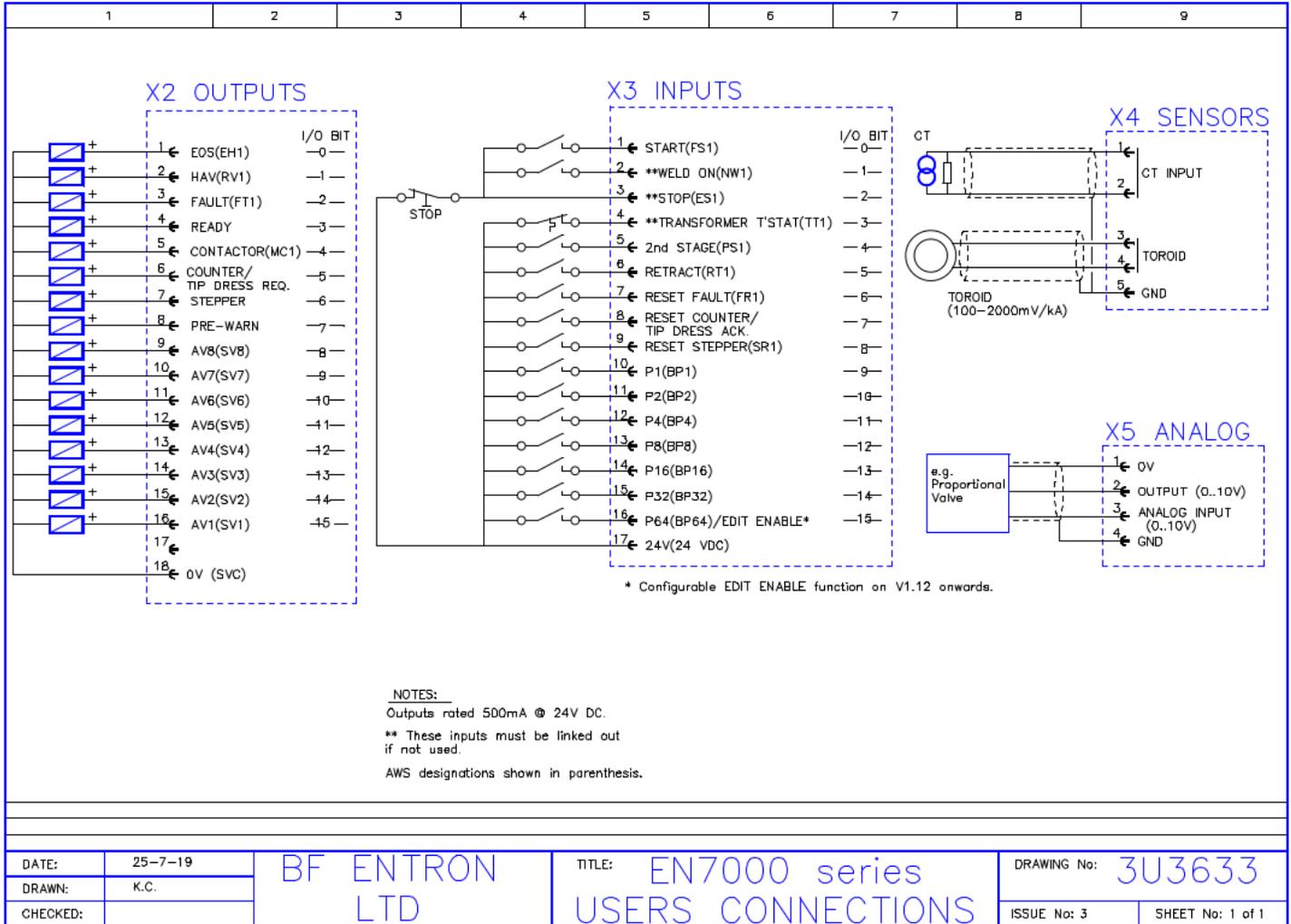


- 2) Click the **Reset Faults** icon



6.3.3 Discrete Input

A discrete input can be used to reset the faults. This requires a customer supplied switch to be wired to the EN7000v2 weld timer. For more information on the Discrete I/O refer to the **Discrete Connections** section. See drawing **Customer Connections Diagram (3U3633)**



Input	Pin number	Description
Reset fault	X3-Pin 7 (I/O Bit 6)	This input resets the Fault output and clears the status messages. Only momentary application is required (minimum time 40ms).

6.3.4 Fieldbus Input

The EtherNet/IP and MODBUS communications can also be used to reset the fault conditions and error messages. This requires a message to be sent to the EN7000v2 weld controller from the controlling device such as a PLC. For more information on the communication and data structures refer to the **READ & WRITE DATA WITH EXTERNAL DEVICES** section.

Input	Channel	Address	Description
-------	---------	---------	-------------

Reset fault	Bit 6	%QX0.6	This input resets the Fault output and clears the status messages.
-------------	-------	--------	--

7 INPUTS & OUTPUTS

The EN7000v2 uses a number of inputs and outputs to control and monitor the weld sequence. The I/O signals can be taken from multiple sources. The list of I/O Sources are:

- Discrete connections
- Modbus Messages
- EtherNet/IP

The **I/O Source** that is used by the EN7000v2 is user selectable. The I/O Source parameter is set in the EN7000v2 configuration settings. Refer to the **COMMUNICATIONS SETUP** section for more information.

7.1 Inputs

The inputs to the EN7000v2 are defined in **Table 44**. The physical location of the Pin location for the Discrete connects are defined in **Figure 43**.

WARNING!



24V DC

Discrete Connections must use 24V DC power only. Do **not** connect to 110V AC.

Input	Discrete Connection Port-Pin	AWS designation	Description
Start	X3-1	FS1	When this input is activated a weld sequence begins. If the input is removed during the Squeeze interval the sequence is aborted. If the input is maintained through the Squeeze interval but switched off subsequently, the sequence terminates normally.
Weld on ¹	X3-2	NW1	This input enables the weld current. If this input is inactive a weld sequence will not produce any current.
Stop ¹	X3-3	ES1	Sequencing is inhibited or aborted if this input is not active.
Transformer Thermostat ²	X3-4	TT1	This input is usually connected to a normally closed thermal contact attached to the weld transformer. Sequencing is inhibited if this input is not active.
2 nd stage	X3-5	PS1	If enabled, the EN7000v2 checks that the 2nd Stage signal is present before proceeding to weld. The checking is programmable to take place either before or after the Squeeze interval. If the signal is not present the 7000 waits for the signal before it proceeds. If the Start signal is removed while waiting, the sequence is aborted.
Retract	X3-6	RT1	This input is used to control the Retract function.
Reset fault	X3-7	FR1	This input resets the Fault output and clears the status messages. Only momentary application is required (minimum time 40ms).

Input	Discrete Connection Port-Pin	AWS designation	Description
Reset counter / tip dress acknowledge ³	X3-8		Used to reset the counter(s) or acknowledge a tip dress request.
Reset stepper ⁴	X3-9	SR1	Used to reset the stepper(s).
P1	X3-10	BP1	Program select inputs. Weld program selection is made by applying the binary code for the required program. Programs 0 to 127 can be selected via the discrete interface. Programs 0 to 255 can be selected internally, via Modbus or via EtherNet/IP.
P2	X3-11	BP2	
P4	X3-12	BP4	
P8	X3-13	BP8	
P16	X3-14	BP16	
P32	X3-15	BP32	
P64 / Edit enable ⁵	X3-16	BP64	
<p>1. The discrete connection for this input is always required, even when the I/O source is Modbus or EtherNet/IP.</p> <p>2. The signal from the discrete interface is always used, even when the I/O source is Modbus or EtherNet/IP where there is no equivalent signal.</p> <p>3. Momentary operation will reset all expired counters. If maintained for more than 5 seconds all counters will be reset, regardless of status.</p> <p>4. Momentary operation will reset all expired steppers. If maintained for more than 5 seconds all steppers will be reset, regardless of status.</p> <p>5. The Edit enable function is only available on the Discrete interface.</p>			

Table 44: Inputs List

7.2 Outputs

The outputs from the EN7000v2 are defined in [Table 45](#). The physical location of the Pin location for the Discrete connects are defined in [Figure 43](#).

Output	Discrete Connection Port-Pin	AWS designation	Description
EOS	X2-1	EH1	This output switches on to indicate the end of the weld sequence.
HAV	X2-2	RV1	Used in conjunction with the Retract input to control the welding head.
Fault	X2-3	FT1	This output indicates a fault condition.
Ready	X2-4		This output is active if EN7000v2 is ready to weld. The output switches off under some fault conditions.
Contactors	X2-5	MC1	This output can be used to control an isolation contactor.
Counter / tip dress request	X2-6		This output indicates that the counter has reached its limit or that a tip dressing operation is required.
Stepper	X2-7		This output indicates that the stepper has reached its limit.
Pre-warn	X2-8		This output indicates that the stepper is close to its limit.
AV8	X2-9		Additional outputs that can be used during the weld sequence to control valves etc.
AV7	X2-10		
AV6	X2-11		
AV5	X2-12		
AV4	X2-13		
AV3	X2-14		
AV2	X2-15		
AV1	X2-16		

Table 45: Outputs List

7.3 Discrete Connections

The Discrete connections are wired into the EN7000v2 weld timer. The schematic for all of the Discrete customer connections are shown in [Figure 43](#).

7.3.1 Inputs

The Inputs are current sinking. Connect input to +24v DC to activate.

Refer to the [Inputs](#) section for detailed definition of each connection.

7.3.2 Outputs

The Outputs are current sourcing. Connect the load between the output and 0V.

Refer to the [Outputs](#) section for detailed definition of each connection.

7.3.3 Analog Signals (0 to 10V)

The EN7000v2 has analog inputs and outputs. The analog connections can be used for controlling and monitoring analog signals such as an external proportional valve, or outputting a control signal to another device

The analog connection on the EN7000v2; terminal connector X5. The connections of each pin are defined in [Table 46](#).

Signal	X5 pin
0V	1
Analog Output (0...10V)	2
Analog Input Ch1 (0...10V)	3
Ground (screen)	4

Table 46: X5 Connector

7.3.3.1 Analog Input

Analog Input is located on connection X5-3. The pin reads an input ranging from 0 to 10 V. The use of the Analog Input is dependent on the configuration of the EN7000v2 parameters. The primary use of Analog Input:

- Force Monitoring

The default use of the Analog connections is control and monitor a proportional air regulator valve output or other sensor for force monitoring. The Force Measurement must be calibrated to the external sensor. Refer to the [Force Calibration](#) section for more information.

7.3.3.2 Analog Output

The Analog Output is located on connector X5-2. The pin outputs an analog signal ranging from 0 to 10 V. The Analog Output can be used for **Force Control** or to output the **Current Waveform** measurement.

For **Force Control**, the analog output of the EN7000v2 must be set to **Force Control** in the configuration. This configuration allows the EN7000v2 to drive a proportional air regulation valve. The force must be calibrated. Refer to the [Force Calibration](#) section for instructions.

For **Current Waveform**, the analog output of the EN7000v2 must be set to **Current Waveform** in the configuration. The analog output signal represents the measured current. The **Waveform 10V** = parameter in the configuration must be modified to scale the signal.

7.3.3.3 Toroid (Rogowski coil)

The connections for a toroid (Rogowski coil) are found on connector X4. This may be used for measuring the current (normally on the secondary side of the power transformer). The toroid can only be used with Spot/Seam configurations.

The toroid should be calibrated to an external meter. Refer to the **Secondary Measuring (Toroid / Rogowski coil)** section for instructions.

If the **Toroid test** configuration parameter is set to **On**, then the resistance must be in the range of 10 to 300 Ohms. Refer to the **Error! Reference source not found.** section for more information.

7.3.4 Discrete Connections Schematic

The physical location of the Discrete connections is shown in **Figure 43**. These connections are used for wiring the Inputs and Outputs to the EN7000v2 timer.

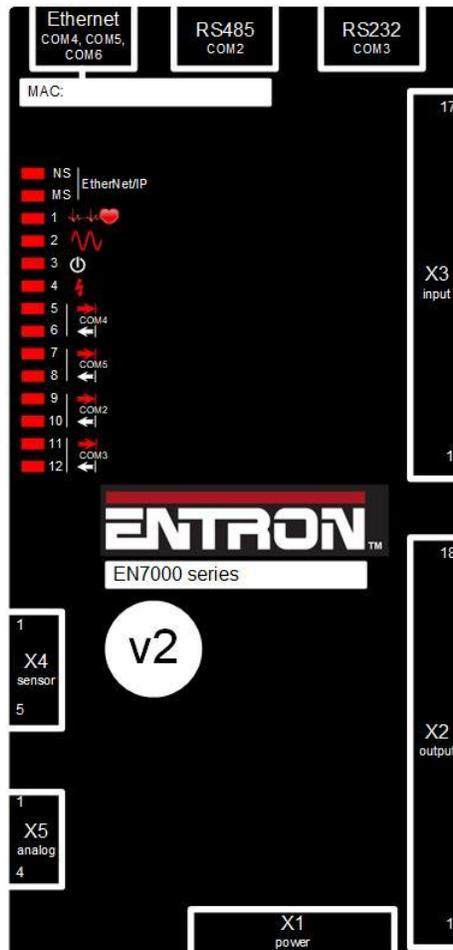


Figure 43: Discrete Connections Labeled

7.3.5 Softstart

Softstart is a feature that allows the EN7000v2 to execute a weld program through a software command from EtherNet/IP, MODBUS, NetFlash™, WSP3 Pendant or Touch Screen. Typically, this is most practical in robotic cells or with machines where a PLC controls a gun or press. It can be used during testing or calibration routines where the weld program needs to be executed remotely.

When using **SoftSTART**, the welding electrodes must be closed and under weld force by means of a PLC, or other external means.

During **SoftSTART** the EN7000v2 **will not** output the Discrete AV1-AV8 signals to operate the valves because the discrete **START** signal is not present.

Examples of items typically connected to the AV1-AV8 outputs are:

- Any air-valve including WAV

8 Modbus RTU

8.1 Modbus overview

Modbus is an open system and full details are freely available at www.modbus.org. Both MODBUS TCP/IP (Ethernet) and MODBUS RTU (RS485) protocols are supported. Modbus TCP/IP uses port 502. To activate I/O through either Modbus port: Access the control configuration parameters (using WSP3, touch- screen or NetFlash) and select an I/O source from the Com ports as defined in the [Table 47](#) below.

Protocol	Cable connected to	Port
MODBUS-TCP/IP	RJ45 on EN7000 (-TS)	COM1
	RJ45 on Ethernet/IP adapter card	COM5
	RJ45 on EN7000v2 (-TS)	COM5
MODBUS-RTU	DSUB9 (RS485)	COM2

Table 47

8.2 Using discrete outputs AV1 to AV8 in Fieldbus mode

Output signals are fed to both the fieldbus and discrete outputs. However, discrete outputs AV1 to AV8 will only pass a signal if the discrete START input is closed. To use these outputs when controlling the system via a fieldbus, **link the discrete START input to +24V**.

8.3 Using Modbus-RTU on RS485 via COM2

The COM2 port on the control is a female D-Sub 9-way connector. The control is configured as a Modbus slave I/O device and uses half-duplex RS485 signalling (2-wire topology). The table below shows the pin-out at the COM2 connector: Note that your bus master may have a different pin-out.

Pin	Signal	Note
1	0V	Connect to common wire
2		Do not connect
3		Do not connect
4		Do not connect
5	Tx+ / Rx+	Connect to Tx+ / RX+ wire
6		Do not connect
7	120R from pin 5	Connect to pin 9 if at end of cable, otherwise do not connect
8		Do not connect
9	Tx- / Rx-	Connect to Tx- / Rx- wire

Table 48

Note¹: The 120R resistor at pin 7 is provided for the purposes of line termination (LT), to prevent signal reflections on the cable. Connect pin 7 to pin 9 ONLY at the ends of the cable.

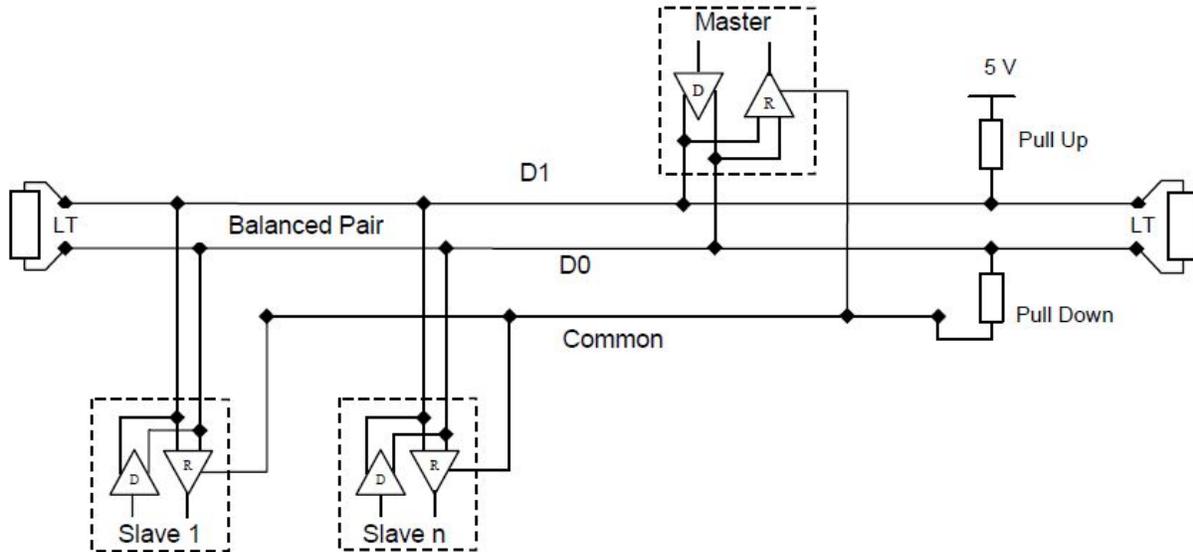


Figure 44

8.3.1 Configuring the RS485 port

For DATA Exchange Only, Other than I/O, the controls may be configured as screenshots show below.:

Address: This is the Modbus address for the control. Each control must have a unique address, in the range 1 to 247.

Baud-rate: Each control on the cable should have the same baud-rate, and this must match the setting on the bus-master. Values of 9600, 19200, 38400 and 57600 are available.

Parity is not available: This is a fixed setting in the controls. They require that **no parity** is sent. Make sure that the bus master is set for no-parity. The controls will not communicate if even-parity or odd-parity is used.

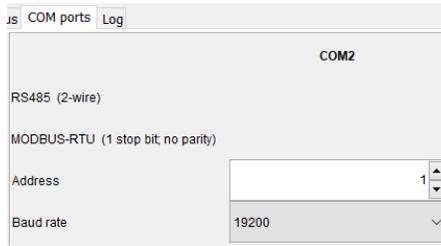
WSP3 pendant connected to COM2 on the control: Access the Configuration menu then scroll down to COM2 and press the RETURN button.

```
<<<  COM2  >>>
MODBUS RTU SLAVE
ADDRESS:  1
BAUD:  19200
```

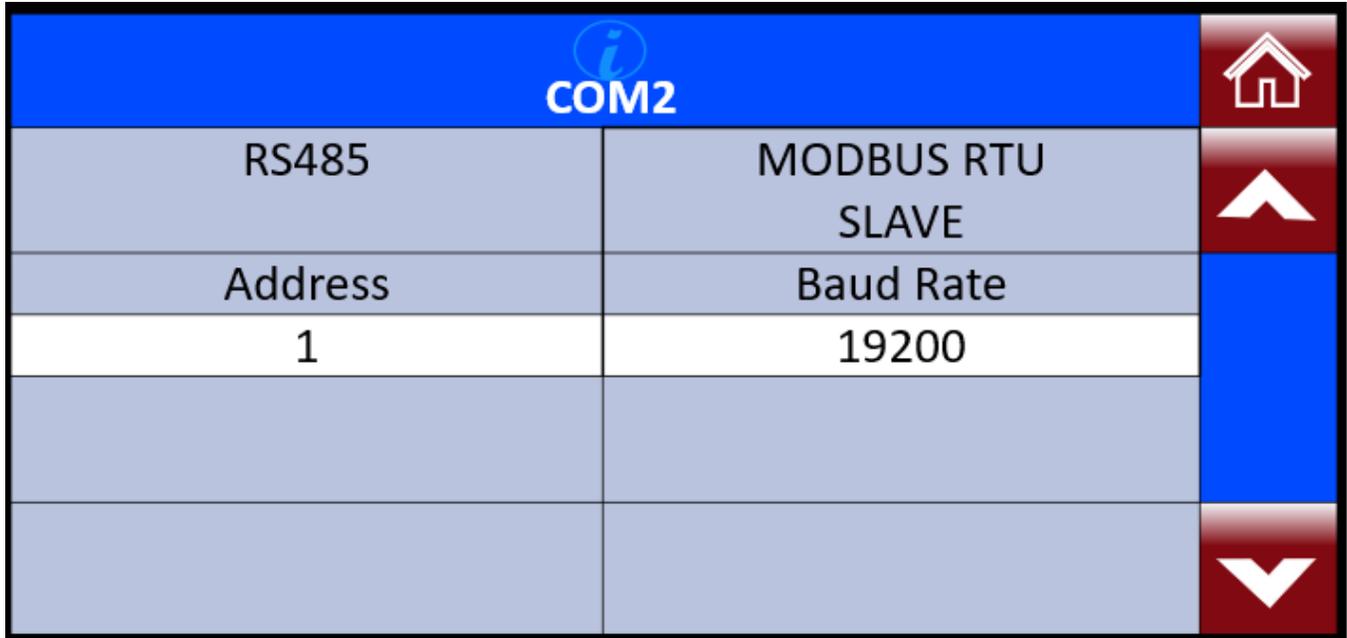
NetFlash software on a connected PC.: Connect to the control then access the Com ports tab to adjust Address and Baud Rate.

Modbus RTU

Using Modbus-RTU on RS485 via COM2



Touch-screen on the control (EN7000-TS and EN7000v2-TS only): In the configuration menu, select COM2 to change Address and Baud Rate.



Note: On EN7000v2-TS versions prior to V2.23, this option is missing.

If the Modbus channel is only for programming and monitoring purposes, and not for control, then set the *I/O source* parameter to **DISCRETE**, or any other COM interface, as appropriate to the application.

For FIELDBUS I/O: in addition to data exchange, the control may be configured as screenshots show below, to perform control functions (such as starting the control) via the Modbus connection, then set the *I/O source* parameter to COM2 (programming and monitoring is still possible with this setting).

WSP3 pendant connected to COM2 on the control: Access the Configuration menu then scroll down to I/O SOURCE, then use +/- buttons to select COM2.

SCR SELECT: DIRECT
ELECTRODES: MULTI
RETRACT: SIMPLE
I/O SOURCE: COM2

NetFlash software on a connected PC.: Connect to the control then access the Configuration tab. Set I/O source to Com2

Configuration (restart if changed)

Features	<input type="radio"/> Standard	<input checked="" type="radio"/> Extended
Weld type	Spot	
Retract	Off/Simple	
I/O source	COM2	
Line frequency	<input type="radio"/> 50 Hz	<input checked="" type="radio"/> 60 Hz

Touch-screen on the control (EN7000-TS and EN7000v2-TS only): Access the Configuration menu then scroll down and click on COM2.

Configuration	
SCR select	2nd Stage
DIRECT	OFF
2nd stage	Retract
Once	Simple
Every	
<input type="checkbox"/> Stop on fault.	<input type="checkbox"/> EOS on fault.
<input type="checkbox"/> Headlock on fault.	I/O source
	COM2

8.4 Using Modbus RTU with EN7000

See next section [READ & WRITE DATA WITH EXTERNAL DEVICES.](#)

9 READ & WRITE DATA WITH EXTERNAL DEVICES

9.1 Overview

The EN7000v2 welding control can be integrated into an industrial automation system and controlled by an external master device. This section is written for PLC programmers familiar with programming read/write messages via MODBUS and EIP protocols.

The EN7000v2 weld controller supports MODBUS communication through Ethernet or a RS-485 serial port.

The EN7000v2 Control also supports the Common Industrial Protocol (CIP™) through Ethernet/IP (EIP). With Ethernet/IP communications, the EN7000v2 control provides full data exchange with any standard EIP device.

For information on how to configure and connect the EN7000v2 control for your desired communication protocol refer to the **COMMUNICATIONS SETUP** section.

9.2 MODBUS

The EN7000v2 MODBUS communication exchanges both I/O data and the welding parameters with remote MODBUS devices.



MODBUS STANDARD

Modbus is an open system and the full details are freely available at www.modbus.org

9.2.1 Function Codes

The EN7000v2 control supports two MODBUS function codes as shown in the table below. Note: Use of any other MODBUS code will generate a MODBUS EXCEPTION. The control appears to the master as a set of I/O registers. The register addresses can be found in the user manual for the control.

Function Code	Type	Data
16	Write Multiple Registers	Inputs or parameters
3	Read Holding Registers	Outputs or parameters

Table 49: MODBUS Function Codes

9.2.2 Inputs

The EN7000v2 control accepts 2-word Input data from the Modbus Master (PLC or other Modbus devices) using Function code 16 call (**Write Multiple Registers**). The Modbus addresses for the input data are Hexadecimal number #8000 and #8001 (Decimal number 32768 and 32769).

The data structure of the Input data is shown in **Table 50**.

Variable	Channel	Address	Type	Description
	Write inputs	%QW0	WORD ARRAY [0..1]	Write multiple registers
	Write inputs [0]	%QW0	WORD	WRITE 16#8000 (= 32768)
Start	Bit 0	%QX0.0	BOOL	
Weld on	Bit 1	%QX0.1	BOOL	
Stop	Bit 2	%QX0.2	BOOL	
Transformer thermal	Bit 3	%QX0.3	BOOL	
2nd stage	Bit 4	%QX0.4	BOOL	
Retract	Bit 5	%QX0.5	BOOL	
Reset fault	Bit 6	%QX0.6	BOOL	
Reset counter	Bit 7	%QX0.7	BOOL	
Reset stepper	Bit 8	%QX1.0	BOOL	
Reserved	Bit 9	%QX1.1	BOOL	
Reserved	Bit 10	%QX1.2	BOOL	
Reserved	Bit 11	%QX1.3	BOOL	
Reserved	Bit 12	%QX1.4	BOOL	
Reserved	Bit 13	%QX1.5	BOOL	
Reserved	Bit 14	%QX1.6	BOOL	
Reserved	Bit 15	%QX1.7	BOOL	
	Write inputs [1]	%QW2	WORD	WRITE 16#8001 (= 32769)
P1	Bit 0	%QX2.0	BOOL	
P2	Bit 1	%QX2.1	BOOL	
P4	Bit 2	%QX2.2	BOOL	
P8	Bit 3	%QX2.3	BOOL	
P16	Bit 4	%QX2.4	BOOL	
P32	Bit 5	%QX2.5	BOOL	
P64	Bit 6	%QX2.6	BOOL	
P128	Bit 7	%QX2.7	BOOL	
Reserved	Bit 8	%QX3.0	BOOL	
Reserved	Bit 9	%QX3.1	BOOL	
Reserved	Bit 10	%QX3.2	BOOL	
Reserved	Bit 11	%QX3.3	BOOL	
Reserved	Bit 12	%QX3.4	BOOL	
Reserved	Bit 13	%QX3.5	BOOL	
Reserved	Bit 14	%QX3.6	BOOL	
Reserved	Bit 15	%QX3.7	BOOL	

Table 50: EN7000v2 Input Data Structure

9.2.3 Outputs

The Modbus Master (PLC or the other Modbus devices) can read the EN7000v2 control's output status data using the Function code 3 call (**Read Holding Registers**). The Modbus addresses for the output data are Hexadecimal number #9000 to #9017 (Decimal number 36864 to 36887).

NOTE: Discrete Outputs in Fieldbus Mode (Modbus, Modbus RTU, or Ethernet IP) Output signals are fed to both the fieldbus and discrete outputs. However, discrete outputs AV1 to AV8 will only pass a signal if the discrete **START** input is closed. To use these outputs when controlling the system via a fieldbus, link the discrete **START** input to +24V.

The data structure of the Output data is shown in [Table 51](#).

Variable	Channel	Address	Type	Description
	Read outputs	%IW0	WORD ARRAY [0..23]	Read holding registers
	Read outputs [0]	%IW0	WORD	READ 16#9000 (= 36864)
EOS	Bit 0	%IX0.0	BOOL	
HAV	Bit 1	%IX0.1	BOOL	
Fault	Bit 2	%IX0.2	BOOL	
Ready	Bit 3	%IX0.3	BOOL	
Contactora	Bit 4	%IX0.4	BOOL	
Counter	Bit 5	%IX0.5	BOOL	
Stepper	Bit 6	%IX0.6	BOOL	
Pre-warn	Bit 7	%IX0.7	BOOL	
AV8	Bit 8	%IX1.0	BOOL	
AV7	Bit 9	%IX1.1	BOOL	
AV6	Bit 10	%IX1.2	BOOL	
AV5	Bit 11	%IX1.3	BOOL	
AV4	Bit 12	%IX1.4	BOOL	
AV3	Bit 13	%IX1.5	BOOL	
AV2	Bit 14	%IX1.6	BOOL	
AV1	Bit 15	%IX1.7	BOOL	
	Read outputs [1]	%IW2	WORD	READ 16#9001 (= 36865)
Start	Bit 0	%IX2.0	BOOL	≡ %QX0.0
Weld on	Bit 1	%IX2.1	BOOL	≡ %QX0.1
Stop	Bit 2	%IX2.2	BOOL	≡ %QX0.2
Transformer thermal	Bit 3	%IX2.3	BOOL	≡ %QX0.3
2nd stage	Bit 4	%IX2.4	BOOL	≡ %QX0.4
Retract	Bit 5	%IX2.5	BOOL	≡ %QX0.5
Reset fault	Bit 6	%IX2.6	BOOL	≡ %QX0.6
Reset counter	Bit 7	%IX2.7	BOOL	≡ %QX0.7
Reset stepper	Bit 8	%IX3.0	BOOL	≡ %QX1.0
Reserved	Bit 9	%IX3.1	BOOL	
Reserved	Bit 10	%IX3.2	BOOL	
Reserved	Bit 11	%IX3.3	BOOL	

READ & WRITE DATA WITH EXTERNAL DEVICES

MODBUS

Variable	Channel	Address	Type	Description
Reserved	Bit 12	%IX3.4	BOOL	
Reserved	Bit 13	%IX3.5	BOOL	
Reserved	Bit 14	%IX3.6	BOOL	
Reserved	Bit 15	%IX3.7	BOOL	
	Read outputs [2]	%IW4	WORD	READ 16#9002 (= 36866)
Start	Bit 0	%IX4.0	BOOL	≡ discrete input Start
Weld on	Bit 1	%IX4.1	BOOL	≡ discrete input Weld on
Stop	Bit 2	%IX4.2	BOOL	≡ discrete input Stop
Thermal	Bit 3	%IX4.3	BOOL	≡ discrete input Thermal
2nd stage	Bit 4	%IX4.4	BOOL	≡ discrete input 2nd stage
Retract	Bit 5	%IX4.5	BOOL	≡ discrete input Retract
Reset fault	Bit 6	%IX4.6	BOOL	≡ discrete input Reset fault
Reset counter	Bit 7	%IX4.7	BOOL	≡ discrete input Reset counter
Reset stepper	Bit 8	%IX5.0	BOOL	≡ discrete input Reset stepper
Reserved	Bit 9	%IX5.1	BOOL	
Reserved	Bit 10	%IX5.2	BOOL	
Reserved	Bit 11	%IX5.3	BOOL	
Reserved	Bit 12	%IX5.4	BOOL	
Reserved	Bit 13	%IX5.5	BOOL	
Reserved	Bit 14	%IX5.6	BOOL	
Reserved	Bit 15	%IX5.7	BOOL	
Analog input (mV)	Read outputs [3]	%IW6	WORD	READ 16#9003 (= 36867)
Analog output(mV)	Read outputs [4]	%IW8	WORD	READ 16#9004 (= 36868)
% conduction	Read outputs [5]	%IW10	WORD	READ 16#9005 (= 36869)
Reserved	Read outputs [6]	%IW12	WORD	READ 16#9006 (= 36870)
Reserved	Read outputs [7]	%IW14	WORD	READ 16#9007 (= 36871)
Status register 0	Read outputs [8]	%IW16	WORD	READ 16#9008 (= 36872)
Stop	Bit 0	%IX16.0	BOOL	Bit 0
Sync. error	Bit 1	%IX16.1	BOOL	Bit 1
Retract not ready	Bit 2	%IX16.2	BOOL	Bit 2
SCR hot	Bit 3	%IX16.3	BOOL	Bit 3
Transformer hot	Bit 4	%IX16.4	BOOL	Bit 4
Pilot fault	Bit 5	%IX16.5	BOOL	Bit 5
Restart required	Bit 6	%IX16.6	BOOL	Bit 6
Headlock	Bit 7	%IX16.7	BOOL	Bit 7
Toroid short-circuit	Bit 8	%IX17.0	BOOL	Bit 8
Toroid open-circuit	Bit 9	%IX17.1	BOOL	Bit 9
Reserved	Bit 10	%IX17.2	BOOL	
Reserved	Bit 11	%IX17.3	BOOL	
Reserved	Bit 12	%IX17.4	BOOL	
Reserved	Bit 13	%IX17.5	BOOL	
Reserved	Bit 14	%IX17.6	BOOL	

Variable	Channel	Address	Type	Description
Test mode	Bit 15	%IX17.7	BOOL	Bit 15
Status register 1	Read outputs [9]	%IW18	WORD	READ 16#9009 (= 36873)
Start on	Bit 0	%IX18.0	BOOL	Bit 16
Weld off	Bit 1	%IX18.1	BOOL	Bit 17
Program inhibited	Bit 2	%IX18.2	BOOL	Bit 18
Output fault	Bit 3	%IX18.3	BOOL	Bit 19
Reserved	Bit 4	%IX18.4	BOOL	
Too many links	Bit 5	%IX18.5	BOOL	Bit 21
Bad link	Bit 6	%IX18.6	BOOL	Bit 22
Maximum current	Bit 7	%IX18.7	BOOL	Bit 23
Toroid over range	Bit 8	%IX19.0	BOOL	Bit 24
CT over range	Bit 9	%IX19.1	BOOL	Bit 25
Reserved	Bit 10	%IX19.2	BOOL	
Reserved	Bit 11	%IX19.3	BOOL	
Reserved	Bit 12	%IX19.4	BOOL	
Reserved	Bit 13	%IX19.5	BOOL	
Reserved	Bit 14	%IX19.6	BOOL	
Reserved	Bit 15	%IX19.7	BOOL	
Status register 2	Read outputs [10]	%IW20	WORD	READ 16#900A (= 36874)
Low force	Bit 0	%IX20.0	BOOL	Bit 32
High force	Bit 1	%IX20.1	BOOL	Bit 33
Low pre-current	Bit 2	%IX20.2	BOOL	Bit 34
High pre-current	Bit 3	%IX20.3	BOOL	Bit 35
Low main current	Bit 4	%IX20.4	BOOL	Bit 36
High main current	Bit 5	%IX20.5	BOOL	Bit 37
Low post-current	Bit 6	%IX20.6	BOOL	Bit 38
High post-current	Bit 7	%IX20.7	BOOL	Bit 39
No 2nd stage	Bit 8	%IX21.0	BOOL	Bit 40
No force	Bit 9	%IX21.1	BOOL	Bit 41
Low conduction(shunt)	Bit 10	%IX21.2	BOOL	Bit 42
High conduction(wear)	Bit 11	%IX21.3	BOOL	Bit 43
Reserved	Bit 12	%IX21.4	BOOL	
Reserved	Bit 13	%IX21.5	BOOL	
Reserved	Bit 14	%IX21.6	BOOL	
Reserved	Bit 15	%IX21.7	BOOL	
Status register 3	Read outputs [11]	%IW22	WORD	READ 16#900B (= 36875)
End of count 0	Bit 0	%IX22.0	BOOL	Bit 48
End of count 1	Bit 1	%IX22.1	BOOL	Bit 49
End of count 2	Bit 2	%IX22.2	BOOL	Bit 50
End of count 3	Bit 3	%IX22.3	BOOL	Bit 51
End of count 4	Bit 4	%IX22.4	BOOL	Bit 52
End of count 5	Bit 5	%IX22.5	BOOL	Bit 53

READ & WRITE DATA WITH EXTERNAL DEVICES

MODBUS

Variable	Channel	Address	Type	Description
End of count 6	Bit 6	%IX22.6	BOOL	Bit 54
End of count 7	Bit 7	%IX22.7	BOOL	Bit 55
Reserved	Bit 8	%IX23.0	BOOL	
Reserved	Bit 9	%IX23.1	BOOL	
Reserved	Bit 10	%IX23.2	BOOL	
Reserved	Bit 11	%IX23.3	BOOL	
Reserved	Bit 12	%IX23.4	BOOL	
Reserved	Bit 13	%IX23.5	BOOL	
Reserved	Bit 14	%IX23.6	BOOL	
Reserved	Bit 15	%IX23.7	BOOL	
Status register 4	Read outputs [12]	%IW24	WORD	READ 16#900C (= 36876)
End of electrode 0	Bit 0	%IX24.0	BOOL	Bit 64
End of electrode 1	Bit 1	%IX24.1	BOOL	Bit 65
End of electrode 2	Bit 2	%IX24.2	BOOL	Bit 66
End of electrode 3	Bit 3	%IX24.3	BOOL	Bit 67
End of electrode 4	Bit 4	%IX24.4	BOOL	Bit 68
End of electrode 5	Bit 5	%IX24.5	BOOL	Bit 69
End of electrode 6	Bit 6	%IX24.6	BOOL	Bit 70
End of electrode 7	Bit 7	%IX24.7	BOOL	Bit 71
Reserved	Bit 8	%IX25.0	BOOL	
Reserved	Bit 9	%IX25.1	BOOL	
Reserved	Bit 10	%IX25.2	BOOL	
Reserved	Bit 11	%IX25.3	BOOL	
Reserved	Bit 12	%IX25.4	BOOL	
Reserved	Bit 13	%IX25.5	BOOL	
Reserved	Bit 14	%IX25.6	BOOL	
Reserved	Bit 15	%IX25.7	BOOL	
Status register 5	Read outputs [13]	%IW26	WORD	READ 16#900D (= 36877)
Tip dress 0	Bit 0	%IX26.0	BOOL	Bit 80
Tip dress 1	Bit 1	%IX26.1	BOOL	Bit 81
Tip dress 2	Bit 2	%IX26.2	BOOL	Bit 82
Tip dress 3	Bit 3	%IX26.3	BOOL	Bit 83
Tip dress 4	Bit 4	%IX26.4	BOOL	Bit 84
Tip dress 5	Bit 5	%IX26.5	BOOL	Bit 85
Tip dress 6	Bit 6	%IX26.6	BOOL	Bit 86
Tip dress 7	Bit 7	%IX26.7	BOOL	Bit 87
Reserved	Bit 8	%IX27.0	BOOL	
Reserved	Bit 9	%IX27.1	BOOL	
Reserved	Bit 10	%IX27.2	BOOL	
Reserved	Bit 11	%IX27.3	BOOL	
Reserved	Bit 12	%IX27.4	BOOL	
Reserved	Bit 13	%IX27.5	BOOL	

Variable	Channel	Address	Type	Description
Reserved	Bit 14	%IX27.6	BOOL	
Reserved	Bit 15	%IX27.7	BOOL	
Status register 6	Read outputs [14]	%IW28	WORD	READ 16#900E (= 36878)
Prewarn 0	Bit 0	%IX28.0	BOOL	Bit 96
Prewarn 1	Bit 1	%IX28.1	BOOL	Bit 97
Prewarn 2	Bit 2	%IX28.2	BOOL	Bit 98
Prewarn 3	Bit 3	%IX28.3	BOOL	Bit 99
Prewarn 4	Bit 4	%IX28.4	BOOL	Bit 100
Prewarn 5	Bit 5	%IX28.5	BOOL	Bit 101
Prewarn 6	Bit 6	%IX28.6	BOOL	Bit 102
Prewarn 7	Bit 7	%IX28.7	BOOL	Bit 103
Reserved	Bit 8	%IX29.0	BOOL	
Reserved	Bit 9	%IX29.1	BOOL	
Reserved	Bit 10	%IX29.2	BOOL	
Reserved	Bit 11	%IX29.3	BOOL	
Reserved	Bit 12	%IX29.4	BOOL	
Reserved	Bit 13	%IX29.5	BOOL	
Reserved	Bit 14	%IX29.6	BOOL	
Reserved	Bit 15	%IX29.7	BOOL	
Status register 7	Read outputs [15]	%IW30	WORD	READ 16#900F (= 36879)
Reserved	Bit 0	%IX30.0	BOOL	
Reserved	Bit 1	%IX30.1	BOOL	
Reserved	Bit 2	%IX30.2	BOOL	
Reserved	Bit 3	%IX30.3	BOOL	
Reserved	Bit 4	%IX30.4	BOOL	
Reserved	Bit 5	%IX30.5	BOOL	
Reserved	Bit 6	%IX30.6	BOOL	
Reserved	Bit 7	%IX30.7	BOOL	
Reserved	Bit 8	%IX31.0	BOOL	
Reserved	Bit 9	%IX31.1	BOOL	
Reserved	Bit 10	%IX31.2	BOOL	
Reserved	Bit 11	%IX31.3	BOOL	
Reserved	Bit 12	%IX31.4	BOOL	
Reserved	Bit 13	%IX31.5	BOOL	
Reserved	Bit 14	%IX31.6	BOOL	
Reserved	Bit 15	%IX31.7	BOOL	
Pre-heat current (A)	Read outputs [16]	%IW32	DWORD	READ 16#9010 (= 36880)
Main current (A)	Read outputs [18]	%IW36	DWORD	READ 16#9012 (= 36882)
Post-heat current (A)	Read outputs [20]	%IW40	DWORD	READ 16#9014 (= 36884)
Program number	Read outputs [22]	%IW44	WORD	READ 16#9016 (= 36886)
Force ¹	Read outputs [23]	%IW46	WORD	READ 16#9017 (= 36887)

¹ value is multiplied by the scale factor (898.88 for kN or 4 for lbf)

Table 51: Output Data Structure

9.2.4 Programming Parameters

The EN7000v2 control can exchange program parameter data with Modbus master devices. The Modbus Master devices read the program data from the control through Modbus Function code 3 call and write the program data to the control through Modbus Function code 16 call.

The program data includes 256 Welding programs, Parameter data for 8 Electrodes and Calibration data for 8 welding electrodes, as well as the Control Configuration data. The Modbus addresses of the program data are shown on the following [Table 52](#).

Variable	Address	Type	Description
Weld programs			256 x 64 WORDS
Weld program 0	16#0000 (= 0)	WORD ARRAY [0..63]	
Weld program 1	16#0040 (= 64)	WORD ARRAY [0..63]	
Weld program 2	16#0080 (= 128)	WORD ARRAY [0..63]	
Weld program 3	16#00C0 (= 192)	WORD ARRAY [0..63]	
...	
Weld program 254	16#3F80 (= 16256)	WORD ARRAY [0..63]	
Weld program 255	16#3FC0 (= 16320)	WORD ARRAY [0..63]	
Weld program extensions			256 x 16 WORDS
Weld program 0 extension	16#7000 (= 28672)	WORD ARRAY [0..15]	
Weld program 1 extension	16#7010 (= 28688)	WORD ARRAY [0..15]	
Weld program 2 extension	16#7020 (= 28704)	WORD ARRAY [0..15]	
Weld program 3 extension	16#7030 (= 28720)	WORD ARRAY [0..15]	
...	
Weld program 254 extension	16#7FE0 (= 32736)	WORD ARRAY [0..15]	
Weld program 255 extension	16#7FF0 (= 32752)	WORD ARRAY [0..15]	
Electrodes			8 x 64 WORDS
Electrode 0	16#4000 (= 16384)	WORD ARRAY [0..63]	
Electrode 1	16#4040 (= 16448)	WORD ARRAY [0..63]	
Electrode 2	16#4080 (= 16512)	WORD ARRAY [0..63]	
Electrode 3	16#40C0 (= 16576)	WORD ARRAY [0..63]	
Electrode 4	16#4100 (= 16640)	WORD ARRAY [0..63]	
Electrode 5	16#4140 (= 16704)	WORD ARRAY [0..63]	
Electrode 6	16#4180 (= 16768)	WORD ARRAY [0..63]	
Electrode 7	16#41C0 (= 16834)	WORD ARRAY [0..63]	
Calibration			8 x 64 WORDS
Calibration 0	16#5000 (= 20480)	WORD ARRAY [0..63]	
Calibration 1	16#5040 (= 20544)	WORD ARRAY [0..63]	
Calibration 2	16#5080 (= 20608)	WORD ARRAY [0..63]	
Calibration 3	16#50C0 (= 20672)	WORD ARRAY [0..63]	
Calibration 4	16#5100 (= 20736)	WORD ARRAY [0..63]	

Variable	Address	Type	Description
Calibration 5	16#5140 (= 20800)	WORD ARRAY [0..63]	
Calibration 6	16#5180 (= 20864)	WORD ARRAY [0..63]	
Calibration 7	16#51C0 (= 20928)	WORD ARRAY [0..63]	
Configuration			1 x 64 WORDS
Configuration	16#6000 (= 24576)	WORD ARRAY [0..63]	

Table 52: Modbus Programming Parameters

CAUTION!



CAUTION!

Modbus users updating firmware from version 2.09 to 2.10 will need to review the RAM registers now used by the Weld Program Extensions. The new registers are 16#FFF to 16#7FF0 as defined in the Weld Program Extensions section of Table 51: Modbus Programming parameters.

9.2.4.1 Weld Program Parameters

The EN7000v2 control has 256 weld programs. As Table 53 shows, Parameters for weld programs 0 through 255 are mapped to addresses (Hexadecimal number) 16#0000–3FFF. Each weld program (schedule) occupies 64 words of data. Weld program 0 starts at address 16#0000 and ends at address 16#003F, then each subsequent schedule uses the next 64-word addresses, with the last schedule using address 16#3FC0–3FFF. The address offset of each parameter in the weld programs can be found in Table 53.

Based on the above description, the following equation (Equation 1) is used to calculate a parameter’s address:

Equation 1:

$$\text{Parameter's address} = \text{Start address (0000)} + [\text{Weld program number} \times 64] + \text{Parameter address offset in Weld program}$$

For example, to obtain the address of Main current of weld program 5, calculation will be:

$$\text{Start address} = 0000$$

$$\text{Weld program number} = 5$$

$$\text{Main current address offset in schedule} = 12$$

$$\text{Address of Main current of Weld program 5} = 0000 + [5 \times 64] + 12 = 332 \text{ (Hexadecimal number address is } 16\#014C)$$

Variable	Channel	Address offset	Type	Description
Weld program	%IW0	WORD ARRAY [0..63]		
Attributes	Weld program [0]	%IW0	WORD	
Pre heat	Bit 0	%IX0.0	BOOL	0 = off, 1 = on
Post heat	Bit 1	%IX0.1	BOOL	0 = off, 1 = on
Pre-mode	Bit 2	%IX0.2	BOOL	00 = PHA mode 01 = CCR mode
	Bit 3	%IX0.3	BOOL	
Main mode	Bit 4	%IX0.4	BOOL	00 = PHA mode 01 = CCR mode
	Bit 5	%IX0.5	BOOL	
Post-mode	Bit 6	%IX0.6	BOOL	00 = PHA mode 01 = CCR mode
	Bit 7	%IX0.7	BOOL	
Link mode	Bit 8	%IX1.0	BOOL	0 = off, 1 = on
Repeat / Roll-spot mode	Bit 9	%IX1.1	BOOL	0 = off, 1 = on
Wait force	Bit 10	%IX1.2	BOOL	0 = off, 1 = on
Force profile	Bit 11	%IX1.3	BOOL	0 = off, 1 = on
Test force	Bit 12	%IX1.4	BOOL	0 = off, 1 = on

Variable	Channel	Address offset	Type	Description
Test pre-current	Bit 13	%IX1.5	BOOL	0 = off, 1 = on
Test main current	Bit 14	%IX1.6	BOOL	0 = off, 1 = on
Test post-current	Bit 15	%IX1.7	BOOL	0 = off, 1 = on
Presqueeze time	Weld program [1]	%IW1	WORD	0 – 99
Squeeze time	Weld program [2]	%IW2	WORD	0 – 99
Pre-heat time	Weld program [3]	%IW3	WORD	0 – 99
Pre-heat (PHA)	Weld program [4]	%IW4	WORD	0 – 999 (x10)
Pre-heat (CCR) ³	Weld program [5]	%IW5	WORD	0 – 999 (x10)
Pre-current	Weld program [6]	%IW6	DWORD	0 – 500000
Cool1 time	Weld program [8]	%IW8	WORD	0 – 99
Main heat time	Weld program [9]	%IW9	WORD	0 – 99
Main heat (PHA)	Weld program [10]	%IW10	WORD	0 – 999 (x10)
Main heat (CCR) ³	Weld program [11]	%IW11	WORD	0 – 999 (x10)
Main current	Weld program [12]	%IW12	DWORD	0 – 500000
Cool2 time	Weld program [14]	%IW14	WORD	0 – 99
Pulsations	Weld program [15]	%IW15	WORD	1 – 99
Post-heat time	Weld program [16]	%IW16	WORD	0 – 99
Post-heat (PHA)	Weld program [17]	%IW17	WORD	0 – 999 (x10)
Post-heat (CCR) ³	Weld program [18]	%IW18	WORD	0 – 999 (x10)
Post-current	Weld program [19]	%IW19	DWORD	0 – 500000
Hold time	Weld program [21]	%IW21	WORD	0 – 99
Off time	Weld program [22]	%IW22	WORD	0 – 99
Upslope time	Weld program [23]	%IW23	WORD	0 – 99
Downslope time	Weld program [24]	%IW24	WORD	0 – 99
Squeeze valves ¹	Weld program [25]	%IW25	WORD	
Pre-heat valves ¹	Weld program [26]	%IW26	WORD	
Cool1 valves ¹	Weld program [27]	%IW27	WORD	
Upslope valves ¹	Weld program [28]	%IW28	WORD	
Main heat valves ¹	Weld program [29]	%IW29	WORD	
Cool2 valves ¹	Weld program [30]	%IW30	WORD	
Downslope valves ¹	Weld program [31]	%IW31	WORD	
Post-heat valves ¹	Weld program [32]	%IW32	WORD	
Hold valves ¹	Weld program [33]	%IW33	WORD	
Off valves ¹	Weld program [34]	%IW34	WORD	
	Weld program [nn]	%IXnn.0.0	BOOL	AV1 state 1 = ON
	Weld program [nn]	%IXnn.0.1	BOOL	AV2 state 1 = ON
	Weld program [nn]	%IXnn.0.2	BOOL	AV3 state 1 = ON
	Weld program [nn]	%IXnn.0.3	BOOL	AV4 state 1 = ON
	Weld program [nn]	%IXnn.0.4	BOOL	AV5 state 1 = ON
	Weld program [nn]	%IXnn.0.5	BOOL	AV6 state 1 = ON
	Weld program [nn]	%IXnn.0.6	BOOL	AV7 state 1 = ON

Variable	Channel	Address offset	Type	Description
	Weld program [nn]	%IXnn.0.7	BOOL	AV8 state 1 = ON
Squeeze force	Weld program [35]	%IW35	WORD	0 – 32767 ²
Pre-heat force	Weld program [36]	%IW36	WORD	0 – 32767 ²
Cool ¹ force	Weld program [37]	%IW37	WORD	0 – 32767 ²
Upslope force	Weld program [38]	%IW38	WORD	0 – 32767 ²
Main heat force	Weld program [39]	%IW39	WORD	0 – 32767 ²
Cool2 force	Weld program [40]	%IW40	WORD	0 – 32767 ²
Downslope force	Weld program [41]	%IW41	WORD	0 – 32767 ²
Post-heat force	Weld program [42]	%IW42	WORD	0 – 32767 ²
Hold force	Weld program [43]	%IW43	WORD	0 – 32767 ²
Off force	Weld program [44]	%IW44	WORD	0 – 32767 ²
Force low limit	Weld program [45]	%IW45	WORD	0 – 99
Force high limit	Weld program [46]	%IW46	WORD	0 – 99
Selected WAV	Weld program [47]	%IW47	WORD	0 – 7
Current low limit	Weld program [48]	%IW48	WORD	0 – 99
Current high limit	Weld program [49]	%IW49	WORD	0 – 99
Selected electrode	Weld program [50]	%IW50	WORD	0 – 7
Linked program	Weld program [51]	%IW51	WORD	0 – 255
Reserved	Weld program [52]	%IW52	WORD	
Reserved	Weld program [53]	%IW53	WORD	
Reserved	Weld program [54]	%IW54	WORD	
Reserved	Weld program [55]	%IW55	WORD	
Reserved	Weld program [56]	%IW56	WORD	
Reserved	Weld program [57]	%IW57	WORD	
C-Monitor Shunt limit	Weld program [58]	%IW58	WORD	0 – 99 %
C-Monitor Wear limit	Weld program [59]	%IW59	WORD	0 – 99 %
Reserved	Weld program [60]	%IW60	WORD	
Attributes ²	Weld program [61]	%IW61	WORD	
Inhibited	Bit 0	%IX61.0	BOOL	0 = enable, 1 = inhibit
C-Monitor Shunt enable	Bit 1	%IX61.1	BOOL	0 = off, 1 = on
C-Monitor Wear enable	Bit 2	%IX61.2	BOOL	0 = off, 1 = on
Retry	Bit 3	%IX61.3	BOOL	0 = off, 1 = on
Motor valves ¹	Weld program [62]	%IW62	WORD	
Seam balance	Weld program [63]	%IW63	WORD	0 – 200 (0 – 20.0%)
¹ AUX Valve Access Turn ON starting on any timed interval after Pre-Squeeze. ² Divide value by 898.99 for kN. Divide value by 4 for lbf ³ Controls the initial heat at the start of weld. CCR regulation will then adjust the heat based on measured current.				

Table 53: Weld Program Parameter Data Structure

9.2.4.2 Weld Program Extension (Forge Delay) Valve Parameters

A Valve ON delay (Forge delay) may be applied to any of the AUX valves. The delay begins at the interval on which the valve is assigned. The actual turn-on time is delayed by the time value in cycles entered in the delay parameter for any valve. For example: AUX3 valve is set to turn on at the START of Main Heat, and Delay time is set to 3 cycles. The valve will turn ON 3 cycles after Main Heat begins.

Variable	Channel	Address offset	Type	Description
Weld program extension		%IW0	WORD ARRAY [0..15]	
AV1 delay time	Weld program extension[0]	%IW0	WORD	0 – 999
AV2 delay time	Weld program extension[1]	%IW1	WORD	0 – 999
AV3 delay time	Weld program extension[2]	%IW2	WORD	0 – 999
AV4 delay time	Weld program extension[3]	%IW3	WORD	0 – 999
AV5 delay time	Weld program extension[4]	%IW4	WORD	0 – 999
AV6 delay time	Weld program extension[5]	%IW5	WORD	0 – 999
AV7 delay time	Weld program extension[6]	%IW6	WORD	0 – 999
AV8 delay time	Weld program extension[7]	%IW7	WORD	0 – 999
Reserved	Weld program extension[8]-[15]			

Table 54: Weld Program Forge Valve Delay Time Parameters

9.2.4.3 Electrode Management Parameters

The EN7000v2 control supports up to 8 electrodes and each electrode has its own parameters. As Table 55 shows, Parameters for Electrodes 0 through 7 are mapped to addresses 16384—16895 (Hexadecimal number 16#4000–41FF). The parameter data for each electrode occupies 64 words. Electrode 0's data starts at address 16384 (16#4000) and ends at address 16447 (16#403F), then each subsequent electrode uses the next 64-word bank, with electrode 7's data using address 16832--16895 (16#41C0–41FF). The address offset of each parameter in Electrode parameter set can be found in Table 55.

The following equation (Equation 2) is used to calculate a parameter's address:

Equation 2:

$$\begin{aligned} \text{Parameter's address} &= \text{Start address (16384)} + [\text{Electrode number} \times 64] \\ &\quad + \text{Parameter address offset in Electrode parameter set} \end{aligned}$$

For example, to obtain the address of **Counter** of Electrode 5, the calculation will be:

$$\text{Start address} = 16384$$

$$\text{Electrode number} = 5$$

$$\text{Counter address offset in Electrode parameter set} = 2$$

$$\begin{aligned} \text{Address of Counter of Electrode 5} &= 16384 + [5 \times 64] + 2 \\ &= 16706 \text{ (Hexadecimal number address is 16\#4142)} \end{aligned}$$

Variable	Channel	Address offset	Type	Description
Electrode		%IW0	WORD ARRAY [0..63]	
Attributes	Electrode [0]	%IX0	WORD	
Enable counter	Bit 0	%IX0.0	BOOL	0 = off, 1 = on
Enable tipdress	Bit 1	%IX0.1	BOOL	0 = off, 1 = on
Enable stepper	Bit 2	%IX0.2	BOOL	0 = off, 1 = on
Stop at endcount	Bit 3	%IX0.3	BOOL	0 = off, 1 = on
Stop at endstep	Bit 4	%IX0.4	BOOL	0 = off, 1 = on
Transformer	Electrode [1]	%IW1	WORD	0 – 7
Counter	Electrode [2]	%IW2	WORD	0 – 9999
Endcount	Electrode [3]	%IW3	WORD	0 – 9999
Dressings done	Electrode [4]	%IW4	WORD	0 – 9999
Max dressings	Electrode [5]	%IW5	WORD	0 – 9999
Stepper spots done	Electrode [6]	%IW6	DWORD	Read only
Stepper % done	Electrode [8]	%IW8	WORD	Read only
Stepper reset to	Electrode [9]	%IW9	WORD	0 – 9999
Stepper spots	Electrode [10..19]	%IW10..19	WORD	0 – 9999
Stepper delta H	Electrode [20..29]	%IW20..29	WORD	0 – 500 (% x 10)
Stepper delta I	Electrode [30..39]	%IW30..39	WORD	0 – 500 (% x 10)
Reserved	Electrode [40]-[63]			

Table 55: Electrode Parameters Data Structure

9.2.4.4 Calibration Parameters

The EN7000v2 control supports a set of calibration parameters for up to 8 transformers associated with up to 8 electrodes.

Similar to Electrode management data, Calibration parameters for Electrode 0 through 7 are mapped to addresses 20480—20991 (Hexadecimal number 16#5000–51FF). The Calibration parameters for each electrode includes 64 words data. Electrode 0's parameters start at address 20480 (16#5000) and end at address 20543 (16#503F), then each subsequent Calibration parameter set uses next 64-word block, with electrode 7's data using address 20928---20991 (16#51C0–51FF). The address offset of each parameter in Calibration parameter set can be found in [Table 56](#).

The equation (Equation 3) is used to calculate a parameter's address:

Equation 3:

$$\begin{aligned} \text{Parameter's address} &= \text{Start address (20480)} + [\text{Electrode number} \times 64] \\ &+ \text{Parameter address offset in Calibration parameter set} \end{aligned}$$

For example, to obtain the address of Toroid (Rogowski coil) sensitivity of Electrode 5, calculation will be:

$$\begin{aligned} \text{Start address} &= 20480 \\ \text{Electrode number} &= 5 \\ \text{Toroid sensitivity address offset in Calibration parameter set} &= 10 \\ \text{Address of Toroid sensitivity of Electrode 5} &= 20480 + [5 \times 64] + 10 \\ &= 20810 \text{ (Hexadecimal number address is } 16\#514A) \end{aligned}$$

Variable	Channel	Address offset	Type	Description
Calibration		%IW0	WORD ARRAY [0..63]	
Power Factor	Calibration [0]	%IW0	WORD	0 – 86 (x100)
A out X1	Calibration [1]	%IW1	WORD	0 – 10000 mV
A out Y1	Calibration [2]	%IW2	WORD	0 – 32767
A out X2	Calibration [3]	%IW3	WORD	0 – 10000 mV
A out Y2	Calibration [4]	%IW4	WORD	0 – 32767
A in X1	Calibration [5]	%IW5	WORD	0 – 10000 mV
A in Y1	Calibration [6]	%IW6	WORD	0 – 32767
A in X2	Calibration [7]	%IW7	WORD	0 – 10000 mV
A in Y2	Calibration [8]	%IW8	WORD	0 – 32767
CT sensitivity	Calibration [9]	%IW9	WORD	1 – 60000 mV/kA
Toroid sensitivity	Calibration [10]	%IW10	WORD	1 – 60000 mV/kA
Convert CT	Calibration [11]	%IW11	WORD	0 = off 1 = use 2-points 2 = use turns ratio
CT X1	Calibration [12]	%IW12	DWORD	0 – 32000
CT Y1	Calibration [14]	%IW14	DWORD	0 – 500000
CT X2	Calibration [16]	%IW16	DWORD	0 – 32000
CT Y2	Calibration [18]	%IW18	DWORD	0 – 500000
CT max	Calibration [20]	%IW20	DWORD	Read only
Turns ratio	Calibration [22]	%IW22	WORD	1 – 999
CCR gain	Calibration [23]	%IW23	WORD	1 – 10
Phase B adjust	Calibration [24]	%IW24	WORD	-99 – 99%
Phase C adjust	Calibration [25]	%IW25	WORD	-99 – 99%
Analog control mode max current (for 10V input)	Calibration [26]	%IW26	DWORD	0-500000
Toroid factor	Calibration [28]	%IW28	WORD	1 – 10
Analog control mode min current (for 0V input)	Calibration [29]	%IW29	DWORD	0-500000
Reserved	Calibration [31]-[63]			

Table 56: Calibration Parameters Data Structure

9.2.4.5 Configuration Parameters

Configuration data of the EN7000v2 control includes 64 parameters. Each parameter takes 1-word. The data are mapped to addresses 24576—25087 (Hexadecimal number 16#6000–61FF). The description of each Configuration parameter can be found in [Table 57](#).

Variable	Channel	Address offset	Type	Description
Configuration		%IW0	WORD ARRAY [0..63]	
Weld type	Configuration[0]	%IW0	WORD	0 = spot 1 = seam
Second stage	Configuration[1]	%IW1	WORD	
	Bit 0 Bit 1	%IX1.0 %IX1.1	BOOL BOOL	00 = none 01 =before Squeeze 10 = after Squeeze
	Bit 2	%IX1.2	BOOL	Reserved
	Bit 3	%IX1.3	BOOL	0 = check first program 1 = check every program
Retract	Configuration[2]	%IW2	WORD	0 = simple 1 = hilift plus 2 = hilift minus 3 = maintained
Sensor	Configuration[3]	%IW3	WORD	0 = CT 1 = toroid
Frequency	Configuration[4]	%IW4	WORD	0 = 50 Hz 1 = 60 Hz
Units	Configuration[5]	%IW5	WORD	0 = metric 1 = imperial
Electrodes	Configuration[6]	%IW6	WORD	0 = single 1 = multi
Fault	Configuration[7]	%IW7	WORD	
Stop	Bit 0	%IX7.0	BOOL	1 = stop on fault
EOS	Bit 1	%IX7.1	BOOL	1 = EOS on fault
Headlock	Bit 2	%IX7.2	BOOL	1 = headlock on fault
Contactora	Configuration[8]	%IW8	WORD	1 - 99 seconds 0 = off
Program select	Configuration[9]	%IW9	WORD	0 = external 1 = internal
Internal prog	Configuration[10]	%IW10	WORD	0 - 255
I/O source	Configuration[11]	%IW11	WORD	0 = discrete 1 = MODBUS COM0 2 = MODBUS COM1 3 = MODBUS COM2 4 = n/a 5 = MODBUS COM4 6 = MODBUS COM5 7 = EtherNet/IP COM7

Variable	Channel	Address offset	Type	Description
SCR select	Configuration[12]	%IW12	WORD	0 = direct (1 - 4 SCRs) 1 = encoded (5 - 8 SCRs) 2 = 3-phase
COM2 address	Configuration[13]	%IW13	WORD	1 - 247
COM2 baud rate	Configuration[14]	%IW14	WORD	0 = 9600 1 = 19200 2 = 38400 3 = 57600
Touch-screen display	Configuration[15]	%IW15	WORD	0 = fitted 1 = not fitted
Adapter code	Configuration[16]	%IW16	WORD	
Analog output function	Configuration[17]	%IW17	WORD	0 = force 1 = waveform
Analog output scale (10 V =)	Configuration[18]	%IW18	DWORD	0 - 500 kA
Security ²	Configuration[20]	%IW20	WORD	0 = off 1 = key-switch 2 = PIN on WSP3 3 = PIN on touchscreen 4 = PIN on both
Security timeout ²	Configuration[21]	%IW21	WORD	0 - 10 minutes
Security PIN0 ²	Configuration[22]	%IW22	WORD	1000 - 9999
Security PIN1 ²	Configuration[23]	%IW23	WORD	1000 - 9999
Security PIN2 ²	Configuration[24]	%IW24	WORD	1000 - 9999
Security PIN3 ²	Configuration[25]	%IW25	WORD	1000 - 9999
Security PIN4 ²	Configuration[26]	%IW26	WORD	1000 - 9999
IP address (msb) ¹	Configuration[27]	%IW27	WORD	0 - 255
IP address ¹	Configuration[28]	%IW28	WORD	0 - 255
IP address ¹	Configuration[29]	%IW29	WORD	0 - 255
IP address (lsb) ¹	Configuration[30]	%IW30	WORD	0 - 255
Sub-net mask(msb) ¹	Configuration[31]	%IW31	WORD	0 - 255
Sub-net mask ¹	Configuration[32]	%IW32	WORD	0 - 255
Sub-net mask ¹	Configuration[33]	%IW33	WORD	0 - 255
Sub-net mask (lsb)	Configuration[34]	%IW34	WORD	0 - 255
Gateway (msb) ¹	Configuration[35]	%IW35	WORD	0 - 255
Gateway ¹	Configuration[36]	%IW36	WORD	0 - 255
Gateway ¹	Configuration[37]	%IW37	WORD	0 - 255
Gateway (lsb) ¹	Configuration[38]	%IW38	WORD	0 - 255
Features	Configuration[39]	%IW39	WORD	0 = standard 1 = extended
Toroid test	Configuration[40]	%IW40	WORD	0 = off, 1 = on
Analog control	Configuration[41]	%IW41	WORD	0 = off, 1 = on
Reserved	Configuration[42]- [63]			
1 Applies to COM4, COM5 and COM6 only.				
2 Not accessible on WSP3 or touch-screen.				

Table 57: Configuration Parameters Data Structure

9.3 Ethernet/IP (EIP)

The EN7000v2 control's EtherNet/IP has the ability to exchange control parameters, control Inputs and Outputs (Plus Status data) with a PLC, HMI or computer. Both Implicit messaging and Explicit messaging are offered by the EN7000v2 control.

9.3.1 Implicit Messaging

The EN7000v2 control uses Implicit messaging for Inputs/outputs (plus status data) exchange with other EtherNet/IP devices.

To communicate with the EN7000v2 control through Implicit messages, the controlling device (usually a PLC) must work as an Originator to initiate a class 1 connection. The following **Figure 45** shows the required parameters to setup the Originator.

The screenshot shows the 'Add Class1 Connection' dialog box with the following parameters:

- Originator->Target (O->T) Connection Parameters:**
 - Connection Point: 150
 - Connection Tag: (empty)
 - Data Size (bytes): 4
 - Run/Idle Header:
- Target->Originator (T->O) Connection Parameters:**
 - Connection Point: 100
 - Connection Tag: (empty)
 - Data Size (bytes): 48
 - Run/Idle Header:
- Redundant Owner Connection:**
 - Redundant Owner:
 - COO value: 0
 - ROO value: 0
- Configuration:**
 - Configuration Instance: 1
 - Module Configuration Data - Each byte is a 2 char hex value, separated by a space (i.e. 0a 26 f9): (empty text box)
- Connection Rate:**
 - O->T Packet Rate (ms): 100
 - T->O Packet Rate (ms): 100
 - O->T Production Inhibit Timeout (ms): 0
 - T->O Production Inhibit Timeout (ms): 0
- Connection Type:**
 - O->T Transport Type: Point To Point
 - T->O Transport Type: Point To Point
 - Transport Trigger: Cyclic
 - Timeout Multiplier: 16
 - T->O Priority: Scheduled
 - O->T Priority: Scheduled
- Keep TCP connection active during connection

Buttons: OK, Cancel

Figure 45: Parameters for Class 1 Connection - Implicit Messaging

9.3.1.1 Input Data Structure

The EN7000v2 control accepts 4 bytes of input information from a PLC or any EtherNet/IP device using an Originator->Target (O->T) message. This should be interpreted as 2 16-bit word inputs. See **Table 50: EN7000v2 Input Data Structure** for variable names.

9.3.1.2 Output Data Structure

The EN7000v2 control outputs 24 16-bit words to EtherNet/IP devices through Target ->Originator (T->O) message; the structure of these Output data is shown in the [Table 51: Output Data Structure](#).

9.3.2 Explicit Messaging

The EN7000v2 control uses Explicit messaging to exchange parameter data with other EtherNet/IP devices. The same as Modbus communication, the parameters include settings for 256 Welding programs, settings for Electrodes and Calibration data for 8 welding electrodes, and Control Configuration data.

A PLC, HMI or any EIP devices can send an Explicit Message to the iPAK2 control to get/set the data in the control. The parameters of an Explicit Message should include:

- Service Code
- Class Code
- Instance Code
- Attribute Code

Standard EtherNet/IP protocol offers many Service codes for different Explicit messages.

9.3.2.1 Service Codes 0x0e and 0x10

Although Standard EtherNet/IP protocol offers many Service codes for explicit messages, the EN7000v2 **only** supports Service codes 0x0e and 0x10.

The Service Code 0x0e **gets** single Attribute data. It is used to read the parameter settings from the control.

The Service code 0x10 **sets** single Attribute data. It is used to write the parameter settings to the control.

9.3.2.2 Instance Code

Instance Code will be 1 for setting parameters exchange with the EN7000v2 control.

9.3.2.3 Class and Attribute Codes

The Class Codes and Attribute Codes settings define different parameters in the EN7000v2 to get or set by the external EtherNet/IP device. The table below shows the Class Code and Attribute message settings that the EN7000v2 supports.

Class (Hex)	Attribute (Hex)	Control Parameter block		Definition of Data Structure
95 hex	0 to FF	Valve Delay Parameters (weld program extension)	32 bytes	Table 54
96 hex	0 to FF	Weld program 0 to 255	128 bytes	Table 53
97 hex	0 to 7	Electrode parameters for electrode 0 to 7	128 bytes	Table 55
98 hex	0 to 7	Calibration parameters for electrode 0 to 7	128 bytes	Table 56
99 hex	0	Configuration parameters	128 bytes	Table 57

9.3.2.4 Example Explicit Message

Below is an example of how to get, modify and set weld program *p* where *p* is the number of the weld program ranging from 0 to 255.

Refer to [Table 53](#) to [Table 57](#) for the Data Structure definitions.

- 1) Get the weld program parameter in *p* by send the explicit message below:

Service Code	=	0E (hex)
Class Code	=	96 (hex)
Instance	=	1
Attribute Code	=	<i>p</i>
Data	:	None

This returns the 64-word (128 bytes) parameters of welding program *p*.

- 2) Modify the parameter(s) as required:
- 3) Send the modified program back to the control with the explicit message below:

Service Code	=	10 (hex)
Class Code	=	96 (hex)
Instance	=	1
Attribute Code	=	<i>p</i>
Data	:	64-word parameters of Welding program <i>p</i>

10 ADVANCED FEATURES

The EN7000v2 is a flexible welding solution that can be configured to meet your specific welding application. This section provides information on advanced features or configurations that the EN7000v2 weld control supports.

10.1 History Log

The EN7000v2 has the ability to store the results of up to 6,000 spot welds. The weld data is stored in the history log is shown in [Table 58](#).

Parameter	Field Name	Description
Weld Number	#ID	
Time and date	Date Time	The time and date when the weld was made
Program	Prog	The weld program used
Pre-current	I1	The current measured during the Pre-heat interval
Main current	I2	The current measured during the Main heat interval
Post-current	I3	The current measured during the Post-heat interval
Force	Force	The force measured during the weld
Pulse width	Conduction	The conduction measured during the weld

Table 58: History Log Data Structure

The configuration of the EN7000v2 determines which value current value stored in the weld log.

10.1.1 Currents

When the EN7000v2 is configured to **Measure Secondary**, the output is the **secondary current**. This requires a Toroid (Rogowski coil) to be connected and calibrated. Refer to the [Secondary Measuring \(Toroid / Rogowski coil\)](#) section for more information.

When the EN7000v2 is configured to **Measure Primary**, the output is the **primary current**. This can be displayed in units of Kilo-Amps. This requires the Primary Current to be calibrated via the turns-ratio or the 1 & 2 point procedure. Refer to the [Points 1&2 Method](#) section for more information.

10.1.2 Force

The Force Value in the history log is the value from **Input Measured Force** on the Analog Input. This allows the analog signal from a proportional air valve or external sensor to be input to the EN7000v2. The **Input Measured Force** value must be calibrated. Refer to the [Force Calibration](#) section for more information.

10.1.3 Viewing the Log

The History Log can be viewed in the NetFlash™ software by connecting to the target control and navigate to the **Log** tab.

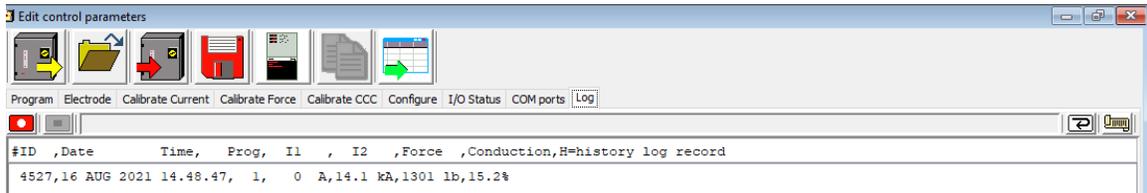


Figure 46: NetFlash Log Tab

The History Log can also be viewed on the WSP3 Pendant by navigating to the **History log** menu and selecting **View Log**.

Step	Description	Screen / Parameters	Key Inputs
1	From the Status Screen press the F key to go to the <<MAIN MENU>>		
2	Scroll to the HISTORY LOG option using the Down arrow and press the RETURN key		To Scroll Down To Enter Menu
3	Scroll to the VIEW LOG option using the arrows and press the RETURN key		To view log press To Enter Menu
4	To view another LOG number, scroll to the LOG # and use the +/- keys		To Scroll Down <p>When on the << LOG# >> line use the +/- keys to change the Log number.</p>

Step	Description	Screen / Parameters	Key Inputs
5	Press RETURN to the Status Screen.		

10.1.4 Exporting History Log

The History Log can be downloaded from the EN7000v2 using the NetFlash™ software. The data is exported as a text file.

To download the History Log:

- 1) Connect to the target control via **NetFlash™**
- 2) Navigate to the **Log** tab
- 3) Click the **Get History** log from control icon.



- 4) The Windows Explorer window will appear. Name the file and select the folder to save the file.

For MODBUS and EtherNet/IP users the weld data can read from the Output after each weld. Refer to the **Outputs** section for information.

Variable	Channel	Address	Type	Description
Pre-heat current (A)	Read outputs [16]	%IW32	DWORD	READ 16#9010 (= 36880)
Main current (A)	Read outputs [18]	%IW36	DWORD	READ 16#9012 (= 36882)
Post-heat current (A)	Read outputs [20]	%IW40	DWORD	READ 16#9014 (= 36884)
Program number	Read outputs [22]	%IW44	WORD	READ 16#9016 (= 36886)
Force	Read outputs [23]	%IW46	WORD	READ 16#9017 (= 36887)

Figure 47: History Log Outputs Data Structure

10.1.5 Resetting History Log

The History Log can be reset or cleared using the **NetFlash™** software or the **WSP3 Pendant**.

To reset the History Log using **NetFlash™**, connect to the target control and navigate to the **Log** tab. Then click the **Clear** icon.



To reset the History Log using the **WSP3 Pendant** follow the instructions below.

Step	Description	Screen / Parameters	Key Inputs
1	From the Status Screen press the F key to go to the <<MAIN MENU>>		
2	Scroll to the HISTORY LOG option using the Down arrow and press the RETURN key		To Scroll Down To Enter Menu
3	Scroll to the CLEAR LOG option using the Down arrow and press the RETURN key		To Scroll Down To Enter Menu
4	Prese F to abort clear log. Pres + to confirm clear log.		to Abort OR To Confrim

10.2 Security Settings

The EN7000v2 has security settings that can be enabled to prevent unauthorized users from updating parameters on the EN7000v2. There two primary methods of security for the EN7000v2. Both of these methods are configured using the NetFlash™ Software.

- PIN Codes
- Edit Switch

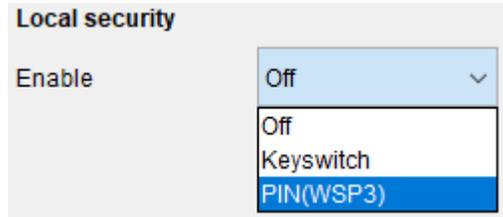
The NetFlash™ software can also be configured with security that allows usernames and passwords to be established with unique security settings.

10.2.1 PIN Codes

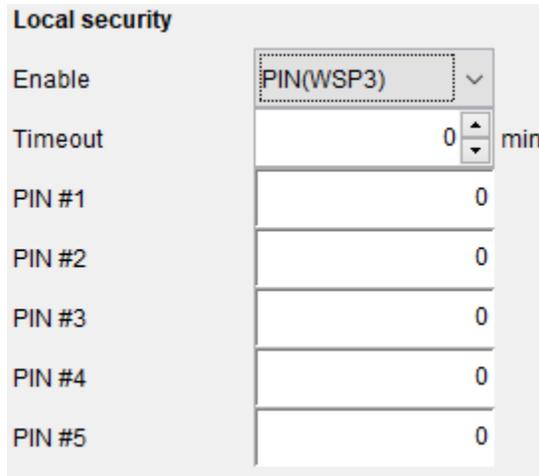
The EN7000v2 can be configured to require a PIN Code to be entered on the **WSP3 Pendant or Touch Screen** before parameters can be updated. Without the PIN code, all parameters are read-only. Up to 5 PIN codes can be stored in each control. After initially gaining access, edit permissions remain for a configurable timeout period.

To configure the PIN Codes, follow the steps below:

- 1) Connect to the target control via **NetFlash™**
- 2) Navigate to the **Configure** tab
- 3) In the Local Security section, open the dropdown for the Enable parameter and select PIN (WSP3)



- 4) The **Timeout** and **PIN#** fields will appear. Populate these as desired



10.2.2 Edit Switch

An external Edit Switch can be connected to the EN7000v2 control. This is typically a key switch which requires the user to have a key to allow a user to edit parameters. The external switch is connected to the P64 connection (Pin 16 on Connector X3).



Program Select

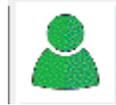
If Edit Switch is used, then P64 (program select bit 64) is no longer available on the discrete signal interface and thus external selection of programs is restricted to the range 0 to 63. This is not normally a problem on manual installations which is typically where security features are required. The full range of programs (0 to 255) is still available through manual selection or via a network connection.

10.2.3 NetFlash™ User Security

NetFlash™ has a security feature which can be used to tailor access rights. Users can be allocated usernames, passwords, and access levels which restrict users to editing none, some or all of the parameters as required. Thus, an administrator can setup security in their installation of NetFlash and then can distribute copies of NetFlash to various personnel, each having individual permissions.

To add user security to NetFlash, follow the steps below:

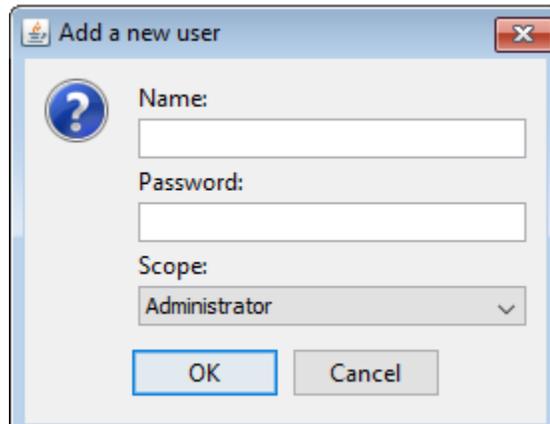
- 1) Open NetFlash™
- 2) Click the **Set up NetFlash users/security icon** on the main menu bar



- 3) Click **Add a new user** icon



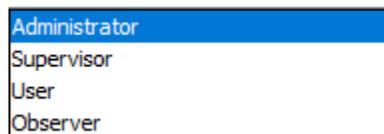
- 4) Create an Administrator account



- 5) Click the **Enable Security** checkbox



- 6) Create additional users as required with the desired profile type:



- 7) The NetFlash™ security has now been enabled.



NetFlash Security

If users will be executing the NetFlash™ software from a folder local to their PC, then the administrator should zip the secure NetFlash™ folder and distribute the version with the security enabled to users. By default, NetFlash™ is provided without security.

10.3 Updating the Firmware

The EN7000v2 is designed to have three memories. The A and B memory allows the user to retain two versions of firmware in the control. The user can toggle between the two memories without having to reprogram the firmware. The BIOS memory stores the factory defaults.

Memory	Description
A	Memory A
B	Memory B
BIOS	BIOS memory

Table 59: EN7000v2 Firmware Memories

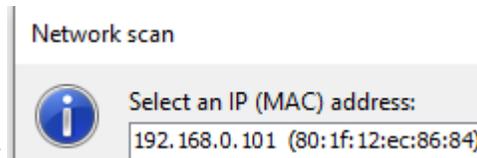
A new version of firmware may be released from time to time as new features are added to the EN7000v2.

To update the firmware locally, follow the instructions below:

- 1) Open NetFlash™
- 2) Click **Scan network for controls** icon, then select the target control to update



and Select



- 3) Click the **Flash Programming Tool** icon



- 4) Click the **Select Flash File** icon and then select the file to upload. The file will be a .hex file provided by ENTRON



- 5) Click the **Connect with control** icon. NetFlash™ will connect to the target control and report the current firmware status



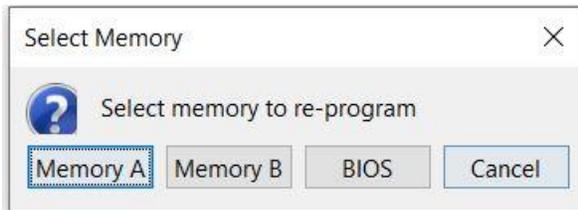
Connection established

```
Preparing control...  
Connected  
Getting control status...  
Control type iPAK2v2  
HW: V1.01  
RAM: 256k  
BOOT BIOS: BBIOSV1.03  
BOOT BIOS update file: (File not found error)  
Memory A: iP2V2.08  
Memory B: iP2V2.08  
Active firmware: Memory A
```

6) Click the **Start transfer to control** icon and select a memory to reprogram



Select Memory to update



You should then see



Followed by



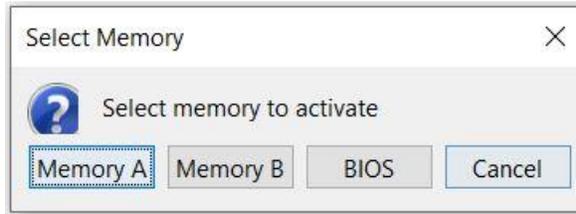
When complete you will see the following message

```
Active firmware: Memory A  
Erasing memory A...  
Sending file to memory A...  
Done.
```

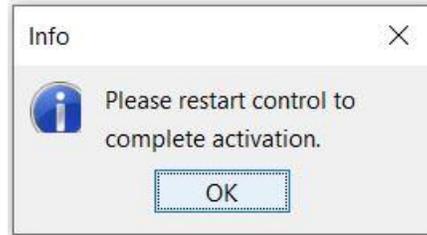
7) If required, click the change **Active Memory Icon** to change the active memory to the desired firmware.



Select the Memory you want the timer to use (**A** or **B**)



Then click OK



- 8) **Restart** the EN7000v2 by clicking the **Restart control** icon. The selected firmware will be used during reboot.



CAUTION!



CAUTION – Do Not Turn Off Power while Updating Firmware

Removing power from the weld control while updating or flashing firmware may corrupt the firmware and the control may not be able to boot.

10.4 Backup & Restoring

The data from one EN7000v2 can be transferred to another using either the WSP3 Pendant or the NetFlash™ software. The backup file contains the configuration and all weld programs stored on the EN7000v2.

CAUTION!



CAUTION – Unique IP Addresses Required

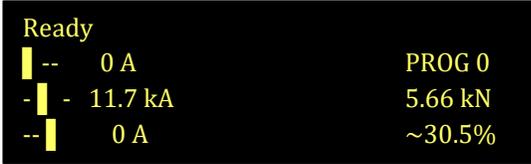
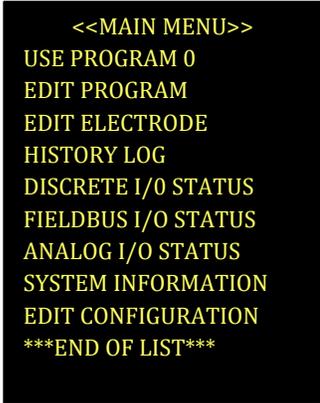
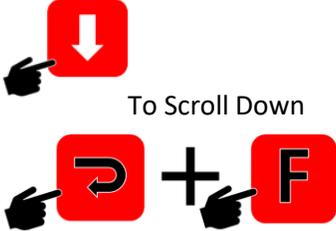
The Backup & Restoration features copy the IP Address parameters. When restoring a backup to a different control on the same network, the IP Address parameters must be changed to be unique.

10.4.1 WSP3 Pendant

The WSP3 pendant can be used to store a backup to the WSP3. The WSP3 can then also be used to restore the backup to another EN7000v2 (including IP address) from the backup physically stored on the WSP3. Please make sure the EN7000v2 has the correct IP address after restoring the data from the WSP3. It is recommended to power cycle the control to make sure the IP address has updated correctly.

10.4.1.1 Backup

To store a copy of all the settings on an EN7000v2 to the WSP3 Pendant follow the steps below. Once backup has been created it can be uploaded to any EN7000v2 control via the WSP3.

Step	Description	Screen / Parameters	Key Inputs
1	From the Status Screen press the F key to go to the <<MAIN MENU>>		
2	Scroll to the EDIT CONFIGURATION option using the Down arrow and press the RETURN and F key simultaneously to enter the CONFIGURATION menu		 <p>To Scroll Down</p>

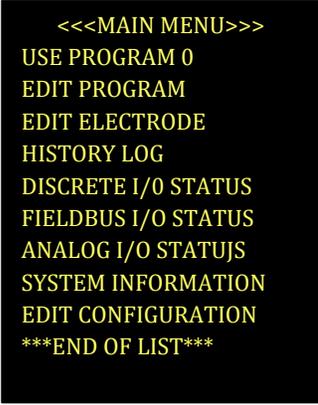
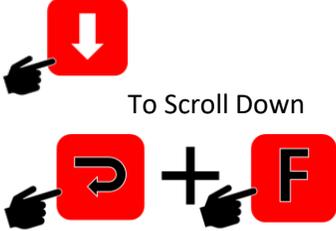
ADVANCED FEATURES

Backup & Restoring

Step	Description	Screen / Parameters	Key Inputs
3	Scroll to the BACKUP TO WSP3 option using the Down arrow and press the RETURN key	<pre> <<<CONFIGURE>>> 25 NOV 2021 11.23.19 FEATURES: EXTENDED WELD TYPE: SPOT 2nd STAGE: OFF 2nd STAGE: ONCE SENSOR C.T. FREQUENCY 60Hz TOROID TEST: OFF UNITS: IMPERIAL STOP ON FAULT: NO EOS ON FAULT: NO HEADLOCK: NO PROG SELECT: INTERNAL SCR SELECT: DIRECT ELECTRODES: SINGLE RETRACT: SIMPLE I/O SOURCE: DISCRETE ANALOG CONTROL: OFF ANALOG OUT: FORCE WAVEFORM 10V=30 kA CONTACTOR: 0 s COM2 (R2485) COM3 (RS232) ETHERNET BACKUP TO WSP3 RESTORE FROM WSP3 INITIALISE DATA RESTART SYSTEM ***END OF LIST*** </pre>	 To Scroll Down To BACKUP TO WSP3  To Enter Menu
4	Press + key to start backup.	<pre> WARNING! All data in WSP3 Will be overwritten. F Abort, + Confirm </pre>	 To start backup
5	When backup is complete, press the F key to return to the CONFIGURE menu	<pre> <<< BACKUP >>> 100%  COMPLETED. PRESS F </pre>	

10.4.1.2 Restore

The backup stored on a WSP3 can be uploaded to any EN7000v2. This allows you to clone controls or restore a control to a known good state during development. To restore a control with a the WSP3, follow the steps defined below:

Step	Description	Screen / Parameters	Key Inputs
1	From the Status Screen press the F key to go to the <<MAIN MENU>>		
2	Scroll to the EDIT CONFIGURATION option using the Down arrow and press the RETURN and F key simultaneously to enter the CONFIGURATION menu		 <p>To Scroll Down</p>

ADVANCED FEATURES

Backup & Restoring

Step	Description	Screen / Parameters	Key Inputs
3	Scroll to the RESTORE FROM WSP3 line using the Down arrow and press the RETURN key	<pre> <<<CONFIGURE>>> 25 NOV 2021 11.23.19 FEATURES: EXTENDED WELD TYPE: SPOT 2nd STAGE: OFF 2nd STAGE: ONCE SENSOR C.T. FREQUENCY 60Hz TOROID TEST: OFF UNITS: IMPERIAL STOP ON FAULT: NO EOS ON FAULT: NO HEADLOCK: NO PROG SELECT: INTERNAL SCR SELECT: DIRECT ELECTRODES: SINGLE RETRACT: SIMPLE I/O SOURCE: DISCRETE ANALOG CONTROL: OFF ANALOG OUT: FORCE WAVEFORM 10V=30 kA CONTACTOR: 0 s COM2 (R2485) COM3 (RS232) ETHERNET BACKUP TO WSP3 RESTORE FROM WSP3 INITIALISE DATA RESTART SYSTEM ***END OF LIST*** </pre>	 To Scroll Down To RESTORE FROM WSP3  To Enter Menu
4	Press + key to start backup.	<pre> WARNING! All data in WSP3 Will be overwritten. F Abort, + Confirm </pre>	 To start backup
5	When backup is complete, press the F key to return to the CONFIGURE menu	<pre> <<< RESTORE >>> 100%  COMPLETED. PRESS F </pre>	

10.4.2 NetFlash

The NetFlash™ software can also be used to save a backup of an EN7000v2's current settings and upload those settings to any EN7000v2.

10.4.2.1 Save Backup File

The settings and configuration of an EN7000v2 can be saved to a PC using NetFlash. This file can be used to restore a control or to upload the settings to any control. To save a backup file follow the steps below:

- 1) Connect to the target control with the NetFlash™ software
- 2) Click the **Load from control** icon



- 3) Click the **Save** icon to open the Windows Explorer window



- 4) Save the file to your desired location



Offline Development

NetFlash can be used to edit configuration and setting file offline. The edits can be changed and uploaded to the control at a later time. Refer to the [NetFlash™](#) section for more information on the upload process.

10.4.2.2 Restore from File

A configuration and setting file can be uploaded to any EN7000v2 control using NetFlash. This allows you to clone a control or restore a control to a known good state during development.

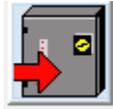
- 1) Open the NetFlash™ application
- 2) Click the **Load from control** icon to connect to the target control



- 3) Click the **Load from File** icon and then select the file to upload to the control



- 4) Click the **Save to Control** icon to upload the file to the control



10.5 Electrode Management

Electrode Management is a feature that allows a user to control a specific electrode with a combination of the stepper function, a counter, and calibration. The stepper provides a means of gradually increasing the current to compensate for electrode wear. The counter counts the number of welds that the electrode has done and allows the electrode to be dressed a number of times before it is replaced.

The EN7000v2 Features parameter must be set to **Extended** for the EN7000v2 to be capable of being configured for Multi-Welder Machine set-up. The stepper and counter can be assigned to eight transformers. When a program is run, the EN7000v2 will automatically trigger the correct transformer by referencing the electrode/transformer assignment. In addition, the electrode number is also used to access the appropriate stepper, counter and calibration information.

10.5.1 Steppers

A stepper is programmed by means of a curve which will provide values of heat and current increments related to the number of spots done. The curve is defined by a set of 10 points. The stepper profile must be defined based on empirical data about electrode wear in your specific application.

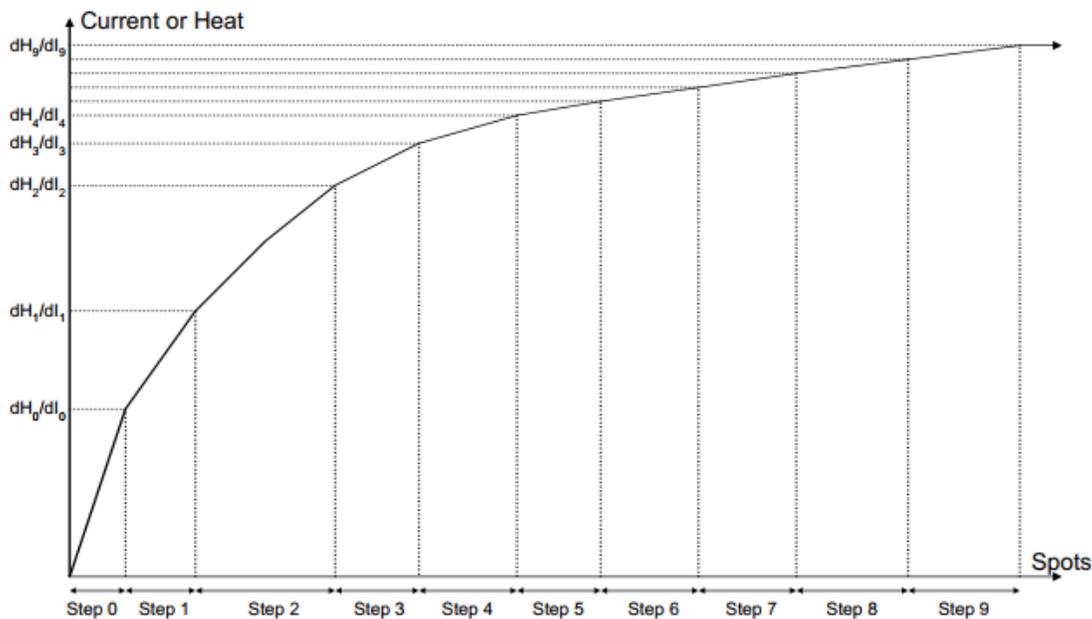


Figure 48: Electrode Stepper Curve

The parameters for programming the stepper can be found on the **Electrode** tab in NetFlash™. A list of the parameters for the stepper function are defined in [Table 60](#).

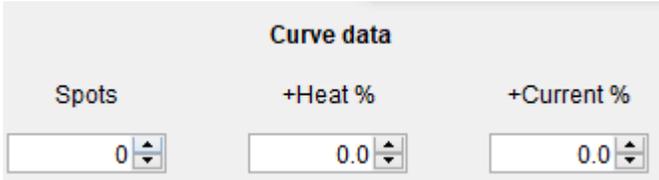
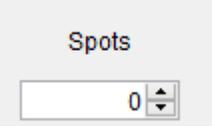
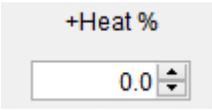
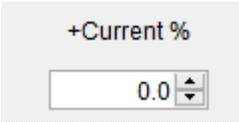
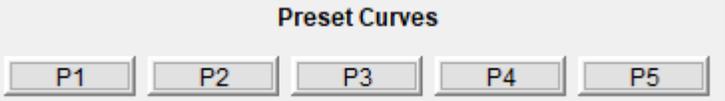
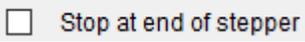
Parameter	Units	Range	Description	NetFlash Screenshot
Curve Data		0 - 9	The steps are a predefined table in NetFlash. The steps 0-9 are displayed vertically. The Spots, +%Heat, and +%Current are programmed for each step.	
Spots	Number of welds	0 - 9999	The number of welds in the step	
+Heat ¹	%	0.0 - 50.0	The increase in heat during the step	
+Current ²	%	0.0 - 50.0	The increase in current during the step	
Preset	1 - 5		Apply predefined values to the stepper curve	
Enable stepper	on/off		Enables or disables the stepper	
Stop at end of stepper	on/off		EN7000v2 can inhibit welding at the end of the last step	
Spots done	welds	0 - 99999	The number of welds that have been done since the last reset	
1. +Heat value only applies to % HEAT mode				
2. +Current parameter only applies to CCR current mode				

Table 60: Electrode Stepper Parameters in NetFlash

The parameters for Electrode Stepper are found on the **Electrode** tab of **NetFlash™** as shown in **Figure 49**.

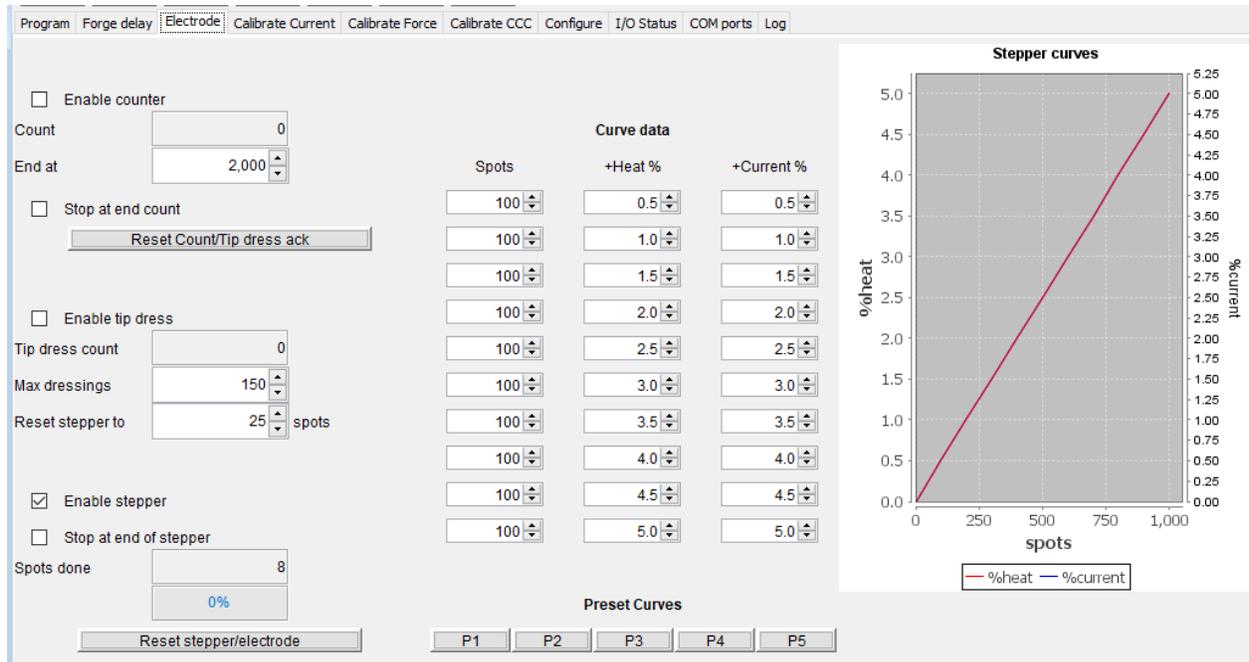


Figure 49: Electrode Stepper Parameters in Netflash

It should be noted that the terminology in the WSP3 may vary from **NetFlash™** due to character limits. Table 61 shows the Electrode Stepper parameter as shown on the WSP3.

Parameter	Units	Range	Description
Step		0 - 9	The step number, vertically arranged in NetFlash
Spots	welds	0 - 9999	The number of welds in the step
+Heat ¹	%	0.0 - 50.0	The increase in heat during the step
+Current ²	%	0.0 - 50.0	The increase in current during the step
Preset	1 - 5		Apply predefined values to the stepper curve
Enable stepper	on/off		Enables or disables the stepper
Stop at end	on/off		EN7000v2 can inhibit welding at the end of the last step
Spots done	welds	0 - 99999	The number of welds that have been done since the last reset
1. +Heat value only applies to CCu and P/W current mode			
2. +Current parameter only applies to CCC current mode			

Table 61: Electrode Stepper Parameters

When programming the stepper, make sure the proper electrode and transformer is selected. For Multi-Welder configurations, up to eight electrodes and transformers can have a unique counter. The stepper is used for all weld programs. Since the +Heat and +Current is applied in terms of percent, it can be applied to all weld programs.

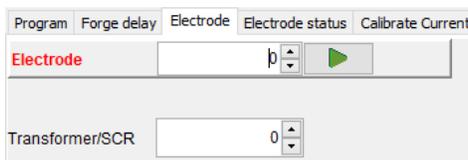


Figure 50: Stepper Electrode and Transformer Numbers

10.5.1.1 Stepper Outputs

For MODBUS and Ethernet/IP communications, the stepper status information is output by the EN7000v2.

Prewarn – the Prewarn output is active when the stepper function is 90% complete and on the last step.

Stepper – The End Stepper output is active at the end of the last step.

10.5.1.2 Preset Values

To expedite programming, the NetFlash™ software has preset values to populate the stepper table with initial values.

In the Electrode Tab on NetFlash, Click on the P1, P2, P3, P4 or P5 icons to load the preset stepper tables.

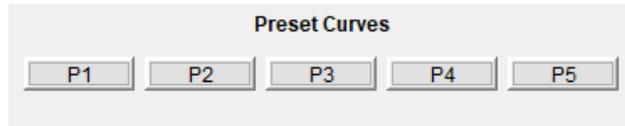


Figure 51: Preset Stepper Curve Action Buttons

10.5.2 Counters

Each electrode can have the counter programmed to track the number of welds on an electrode and create stops to allow for electrode maintenance. The parameters for the Counter are shown in [Table 63](#).

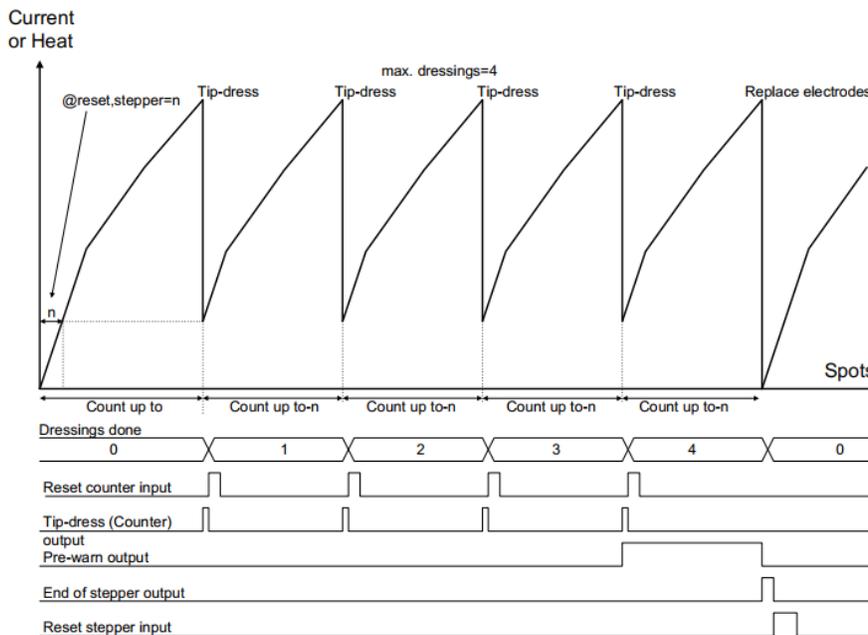


Figure 52: Weld Stepper Timing Diagram

For Multi-Welder configurations, up to eight electrodes and transformers can have a unique counter. The counter is used by all weld programs.

ADVANCED FEATURES

Electrode Management

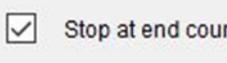
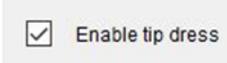
Parameter	Units	Range	Description	NetFlash Screenshot
Enable counter		on/off	Enables or disables the counter	
Count	welds	0 - 9999	The number of welds that have been done since the last reset	
End count	welds	0 - 99999	The maximum number of welds that can be done if Stop at end count is ON. Note: This is also the Tip Redress Count	
Stop at end		on/off	EN7000v2 can inhibit welding until the counter is reset	
Enable tip dress		on/off	Enables or disables the tip dressing feature	
Dressings done		0 - 9999	The number of times the electrodes have been dressed	
Max dressings		0 - 9999	The maximum number of times the electrodes can be dressed	
Reset to	welds	0 - 9999	The weld count following a tip dress operation	

Table 62: Electrode Counter Parameters in NetFlash

Parameter	Units	Range	Description
Enable counter		NO/YES	Enables or disables the counter
[RESET COUNTER]			User can reset count by selecting this line
Count	welds	0 - 9999	The number of welds that have been done since the last reset. Note: This can be overwritten via the WSP3
End count	welds	0 - 99999	The maximum number of welds that can be done
Stop at end		NO/YES	EN7000v2 can inhibit welding until the counter is reset
Enable tip dress		NO/YES	Enables or disables the tip dressing feature
Dressings done		0 - 9999	The number of times the electrodes have been dressed
Max dressings		0 - 9999	The maximum number of times the electrodes can be dressed
Reset to	welds	0 - 9999	The weld count following a tip dress operation

Table 63: Electrode Counter Parameters in WSP3

10.5.2.1 Counter Outputs

When Tip Dressing is enabled the EN7000v2 will activate the Tip Dress Request output when the End Count value is reached.

10.5.3 Calibration

For multi-welder or multi-head configurations where a single control drives multiple valves and/or transformers, the calibration procedures may need to be done for each electrode. Refer [CT Turns-Ratio](#) – Not matched to external meter. or [Points 1&2 Method](#). Match a calibrated current meter. section for calibration procedure.

10.5.3.1 CCR Calibration

For a **multi-welder configuration** used for spot welding, the CCR Calibration procedure must be done for each individual electrode. Refer to the [Current Calibration](#) section for calibration procedure.



Toroid (Rogowski coil) on Multi-Electrode System

For a **multi-welder or multi-head configuration**, it is *not recommended* that secondary measuring be performed using a toroid (Rogowski coil). Toroids need to be switched in and out of the circuit at the appropriate moment in the sequence or errors will occur. The CT method of secondary measurement is recommended.

10.5.3.2 Force Calibration

For a **multi-welder or multi-head configuration**, the Force must be calibrated independently for each electrode. Refer to the Force Calibration section for calibration procedure.

10.5.3.3 Current Measurement

For a **multi-welder or multi-head configuration**, it is *not recommended* that secondary measuring be performed using a toroid (Rogowski coil). Toroids need to be switched in and out of the circuit at the appropriate moment in the sequence or errors will occur. **In Multi type configurations, the CT method is recommended for current measuring** as it does not require an external toroid (Rogowski coil). Refer to the [Points 1&2 Method](#). Match a calibrated current meter. section for calibration procedure.

10.6 Seam Welding

A typical seam weld is a continuous weld to where two weld wheels pass weld current and rotate to roll the material through the throat of the machine.

The EN7000v2 has the necessary inputs and outputs to control a seam welding system in a variety of modes. The EN7000v2 can drive the wheels. The EN7000v2 can also control the current with discrete targets in PHA % Heat or CCR mode. The EN7000v2’s **analog mode** allows the EN7000v2 current profile to be set by an analog input signal to make unique weld profiles.



Continuous Seam Welds

For continuous Seam welds we would recommend using a Primary CT.

10.6.1 Programming a Seam Weld with NetFlash

This section provides an overview of how to program a simple seam weld program using the NetFlash™ software. This example provides an overview of the process for programming a weld program (schedule). The skills learned in this section can be built upon to create a weld program for your unique resistance welding application.

This section assumes that the control has been installed, calibrated, and the connected to the control via the NetFlash™ software. If this has not been completed refer to the [Installation Instructions](#) section.

The weld program (schedule) to be programmed will follow the Seam Weld timing diagram shown in [Figure 53](#). This example is based on a machine with the configuration defined below:

- Seam Welding Machine with a single air valve controlled by the EN7000v2
- A drive motor driven by the MOTOR signal
- A **Second Stage** input configured to activate **Before Squeeze**
- The unit has been configured and calibrated for Primary Regulation and Primary Monitoring

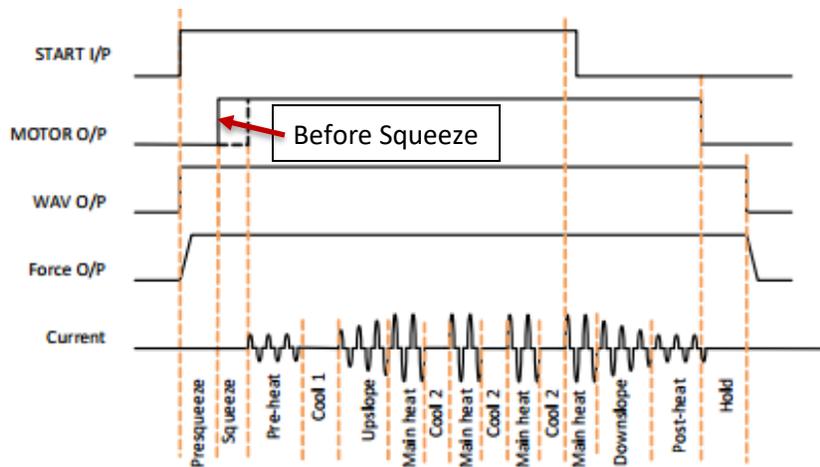


Figure 53: Seam Weld Timing Diagram – Second Stage Before Squeeze

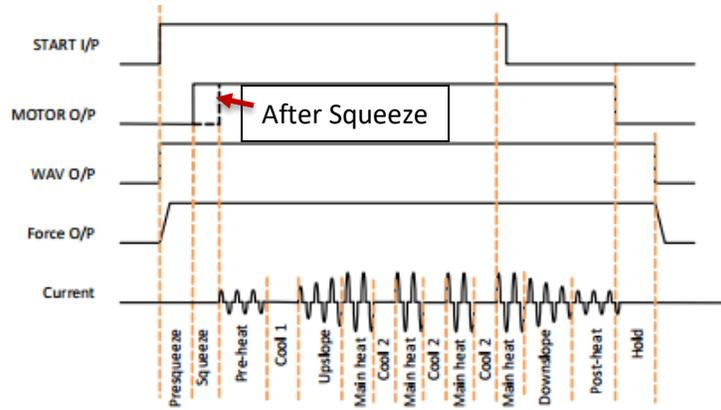


Figure 54: Seam Weld Timing Diagram – Second Stage After Squeeze



Live Data Update

When connected to a control, updates to control parameters occur on a field change in NetFlash™. For checkboxes and arrows, the change is written to the control on a mouse click. For text fields updated with a keyboard entry, the user must press `Enter` or `Tab` after a field change to push the data to the control.

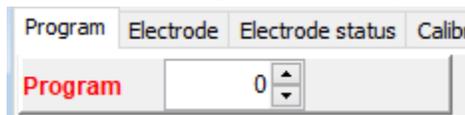
The steps to program the Weld Program in [Figure 53](#) are as follows:

- 1) Open the NetFlash™ application and connect to the target control by clicking the **Load from Control** icon
- 2) Navigate to the **Configuration** tab to verify the EN7000v2 is configured for a seam weld:

Configuration Parameter	Value
Features	Extended
Weld Type	Seam
Retract	Off/Simple
I/O Source	Discrete
Line Frequency	50 Hz or 60 Hz
2 nd Stage	Before Squeeze
2 nd Stage	Every
Regulation (Sensor)	CT (Recommended)
SCR Selected	Direct / 3 Phase depending on application
Electrodes	Single
Program Selection	Internal
Use Program	0
Analog Control	Off
Analog Out	Force Control

Table 64: Configuration Parameters for Seam Weld Example

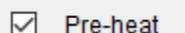
- 3) Navigate to the **Program** Tab
- 4) Enter the **weld program number** to edit in the Program field and press ENTER.



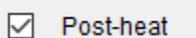
- 5) Set the **Pulses** valve to 1 for a single Main Heat current pulse, then press ENTER



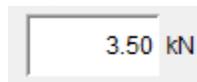
- 6) Enable the **Pre-heat** function by clicking the checkbox



- 7) Enable the **Post-heat** function by clicking the checkbox



- 8) Set the **Force** value to your desired value, then press ENTER



- 23) Set the **Presqueeze** value to the desired values in terms of cycles, then press ENTER



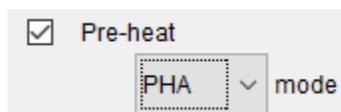
- 9) Set the **Squeeze** value to the desired values in terms of cycles, then press ENTER



- 10) Set the **Pre-Heat** time in terms of cycles, then press ENTER



- 11) Set the **Pre-heat Mode** to PHA.



- 12) Since we are controlling the heat in **PHA** mode, the magnitude of the weld pulse is set in terms of **% Heat**. Set this value to your desired **% Heat**, then press ENTER

Heat %

13) Set the duration of the **Cool1** pulse in terms of Cycles, then press ENTER

Cool1 ~

14) Set the **Upslope** parameter in terms of cycles. This defines the time it will take for the control to ramp up to the Main Heat/Current, then press ENTER

Upslope ~

15) Set the **Main Heat Mode** to **PHA** mode where the current is programmed in terms of % **Heat**, then press ENTER

Main heat
PHA mode

16) Set the **Main Heat** value in term of percent, then press ENTER

Heat %

17) Set the **Main heat** parameter in cycles to define the duration of the pulse, then press ENTER

Main heat ~

18) *If required* Set the **Post-heat Mode** to **PHA**

Post-heat
PHA mode

19) Since we are controlling the heat in **PHA mode**, the magnitude of the weld pulse is set in terms of % **Heat**. Set this value to your desired % **Heat**, then press ENTER

Heat %

20) Set the **Downslope** value in terms of cycles. This defines the time the control will take to ramp down from the Main Heat/Current to the Post-heat current, then press ENTER

Downslope ~

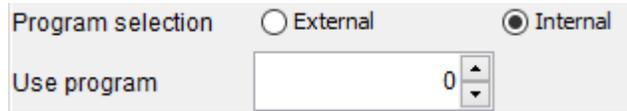
21) Set the duration of the **Post-heat** pulse in terms of cycles, then press ENTER



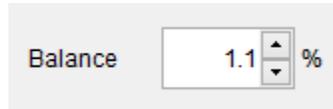
22) Set the **Hold** time to allow the weld nugget to solidify, then press ENTER



23) Navigate to the Configure tab and verify the **Use Program** field is to the weld program that you edited.



24) **Balance** This parameter adjusts the conduction angle of first Half Cycle of Main Weld Time.



25) The weld program corresponding to the seam welding timing diagram in **Figure 53** has now been stored in the EN7000v2 weld control and it is ready for use.

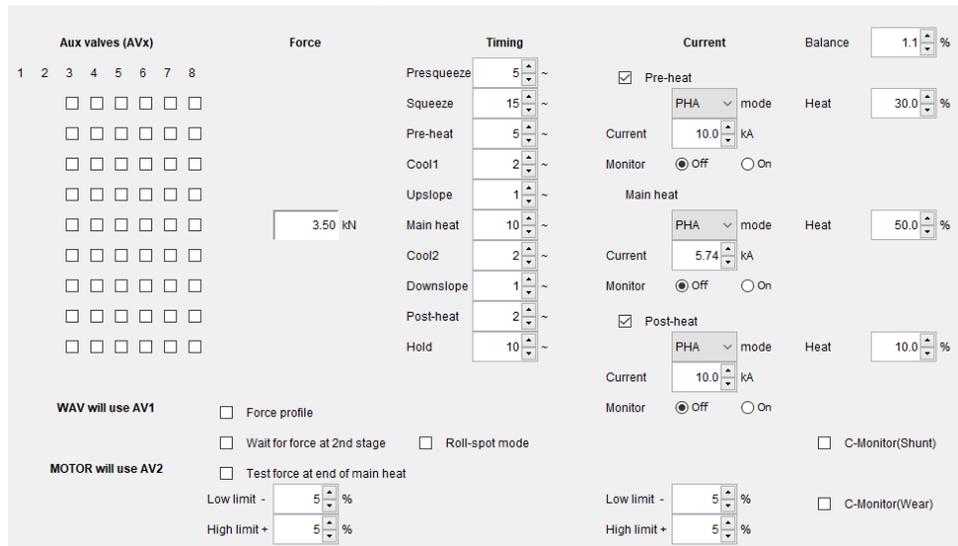


Figure 55: Example Seam Welding Program in NetFlash

10.7 Multi-weld Operations

The EN7000v2 supports multi-weld operations where the weld control is used to control multiple electrodes. There are two configurations available for multi-welding.

- **Multi-Electrode (Multi-Gun) operation** allows for each welding program to be triggered independently and allows for selection of a transformer via the electrode parameter. This mode is typically used with a Multi-Electrode Machine (Refer to the **Multi-Welding Machine** section). Multi-Electrode mode allows the user to do the following:
 - Independently control up to 8 transformers from a single weld control
 - Uniquely calibrate up to 8 Electrode – Transformer pairs
 - Command up to 8 Weld Air Valves [WAV1 – WAV8] to close during a weld program
- **Cascade operation** allows the welding programs to be linked together and triggered from a single start command. The programs ripple through with minimal time between them, selecting transformers and electrodes on the fly. The linked programs are known as a cascade. This mode is typically used on a Multi-Welder or Cascade (Refer to the **Multi-Welding Machine** section).



Cascade / MUX

The EN7000v2 Cascade type weld controls can be identified by the part description.

UK built controls the description must contain **e.g 150M or 300Mx2,3-8** which means additional SCRs have been installed in the cabinet to fire additional transformers.

USA built controls the description must contain **e.g 1200 or 1800 (2,3-8)** which means additional SCRs have been installed in the cabinet to fire additional transformers.

10.7.1 Electrode & Transformer Assignment

Up to 8 electrodes and transformers can be connected to the EN7000v2. The electrodes and transformers must be associated in the **Electrode** menu for the EN7000v2 weld controller to know which ones to fire during a weld program.

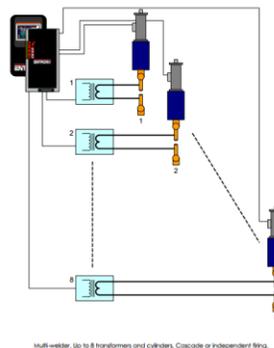


Figure 56: Multi-Weld Overview

10.7.1.1 Transformer Assignment

The Features configuration parameter must be set to **Extended** for the **Transformer** parameter to be programmable. **Figure 57** shows the location of the Features parameter in NetFlash™. Refer to the Configure the Control section for configuration instructions.

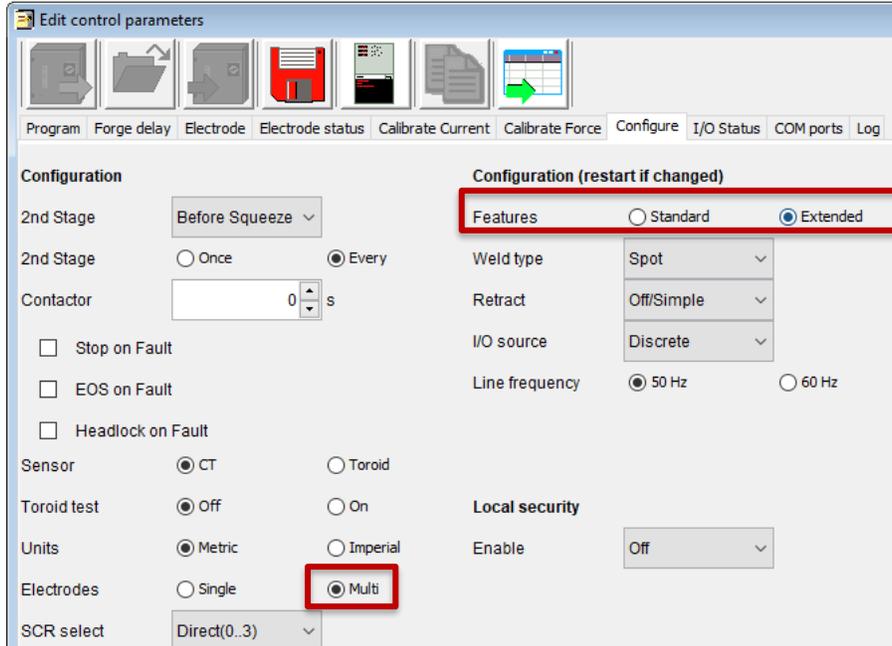


Figure 57: Location of Features Parameter in NetFlash

Each **Electrode** must be assigned to a **Transformer**. In other words, a one-to-one relationship must be defined between the electrode and transformer.

Electrode Parameter	Range	Description	NetFlash Screenshot
Transformer	0 - 7	The transformer that the electrode is connected to	

Table 65: Transformer Parameter in Electrode Settings

In NetFlash™, the **Transformer** parameter is located on the **Electrode** tab. The transformer must be defined with each electrode. The transformer-electrode assignment can also be set via WSP3, MODBUS, or EtherNet/IP.

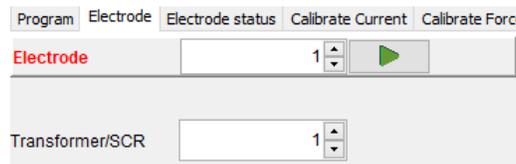


Figure 58: Transformer Parameter in Electrode Settings



Multi-Electrode Machine

For Multi-Electrode configurations with a *single transformer*, the Transformer number should be the same for all electrodes. Refer to the Configure the Control section for more information on configuration.

The schematic in Figure 59 shows how the electrodes can be assigned to transformers/SCRs.

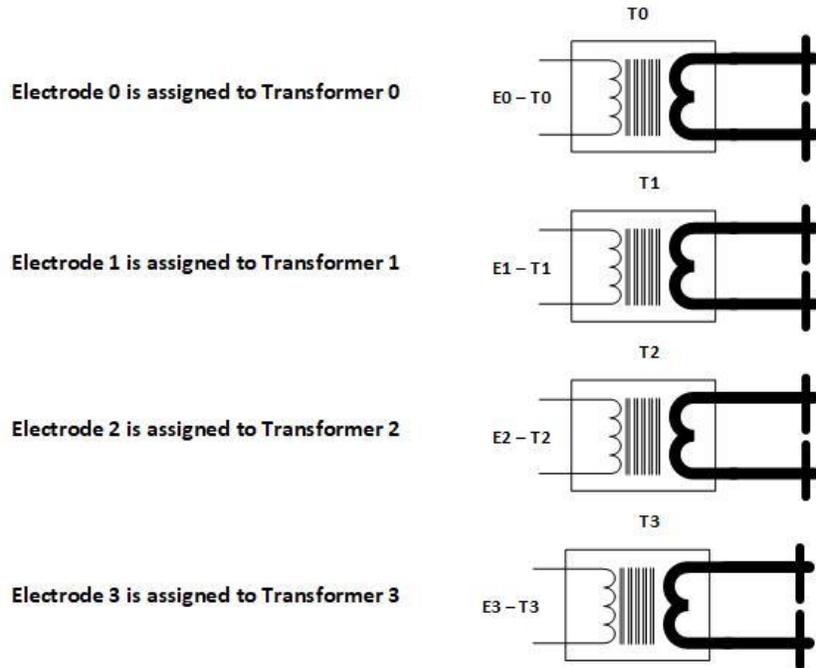


Figure 59: Electrode and Transformer Assignment

10.7.1.2 Electrode Assignment

The *Electrode* number must be assigned in the weld program. The *Transformer* linked to the *Electrode* number will be fired during the weld program.

Weld program parameter	Range	Description	NetFlash Screenshot
Electrode	0 - 7	The electrode number	

Table 66: Electrode Parameter in Weld Program

In NetFlash™, the *Electrode* parameter is located on the *Program* tab. The electrode must be defined with each weld program (schedule). The electrode assignment per weld program can also be set via WSP3, Touch Screen, MODBUS or EtherNet/IP.

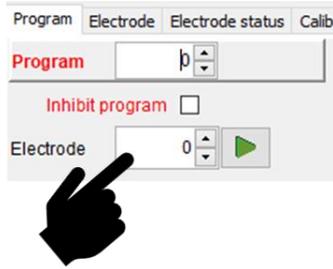


Figure 60: Electrode Parameter in NetFlash

10.7.2 Linking Programs

The weld programs may be linked together to create cascade sequences of programs, each using a different SCR/Transformer/Electrode combination. The parameters for linking weld programs are defined in the weld program.

Weld program parameter	Units	Range	Description	NetFlash Screenshot
to Program		0 - 255	The next program in the cascade sequence	
Link/Cascade	Off/On		Flag in weld program to enable the Linked Program parameter	

Table 67: Linking Parameters in Weld Program

The schematic in **Figure 59** shows how the electrodes can be assigned to transformers/SCRs.

10.7.3 Multi-Electrode Operation

Multi-Electrode operation is used for Multi-Electrode (Multi-gun) machines. Up to 8 Weld Air Valves [WAV1-WAV8] can be assigned to each weld program in a Multi-Electrode operation to run complete independent weld sequences. **Figure 61** shows a timing diagram of a multi-electrode weld timing sequence. A different weld program can be actuated on a different electrode or weld gun using a single transformer. The WAV signal can use a different output for each program. The START signal must be closed and re-opened for the next program to execute. In other words, the previous electrode must have completed its weld program and be opened before the next electrode can be closed to start the next weld program.

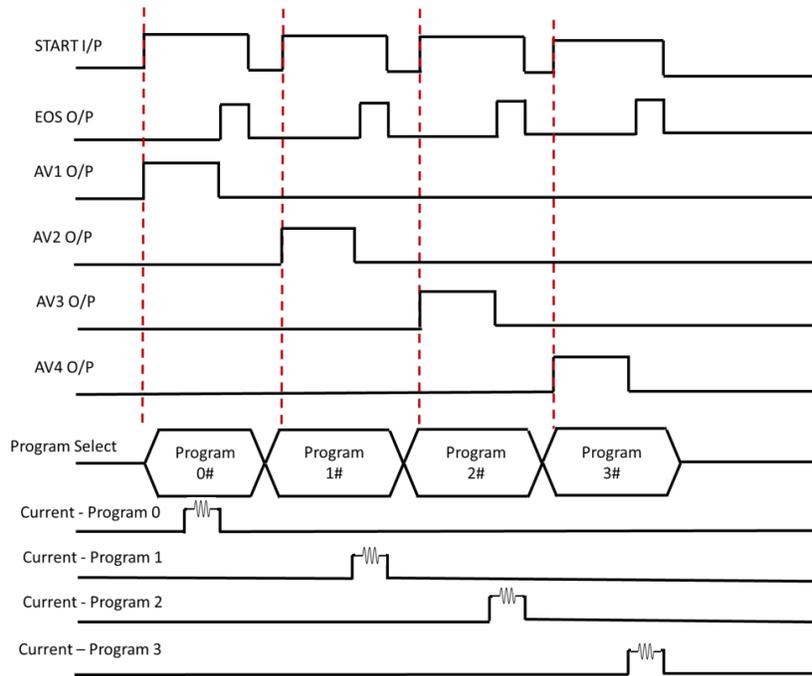


Figure 61: Multi-Electrode Weld Timing Diagram

To program a multi-weld electrode program, the user should familiarize themselves with electrode assignment, transformer assignment, valve control, linking programs, and programming a weld program (schedule).

Although Multi-Electrode programs can be programmed when the EN7000v2 features configuration parameter is set to **standard**, it is recommended that Multi-Electrodes be programmed in the **extended** configuration. Refer to the **Configure the Control** section for configuration instructions.

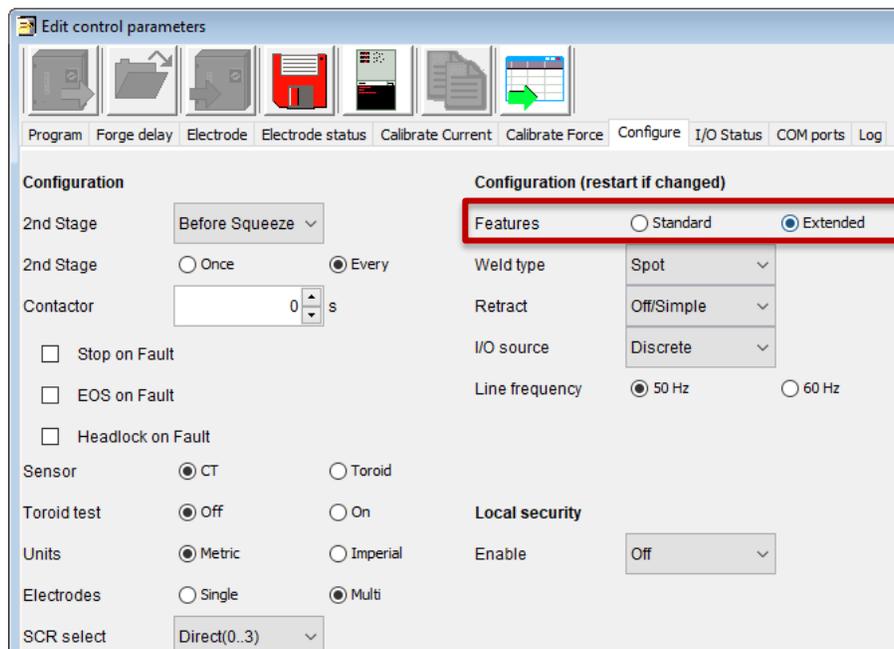


Figure 62: Location of Features Parameter in NetFlash

10.7.3.1 Multi-Electrode in Extended Mode

For Multi-Electrode operation in Extended mode, the **Electrodes** configuration parameter must be set to **Multi** as shown in Figure 63.

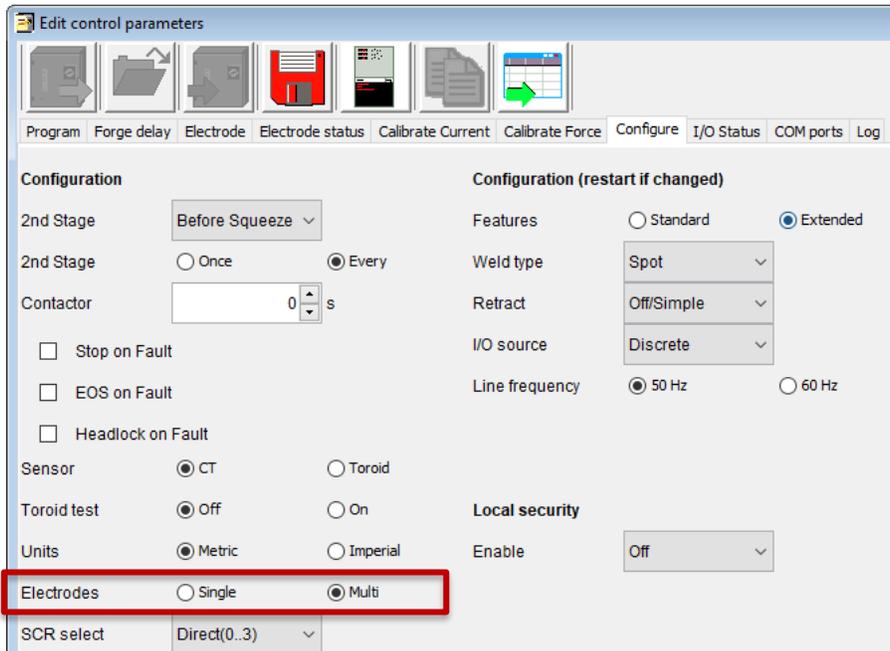


Figure 63: Location of Electrodes Configuration Parameter in NetFlash



Using One or More Weld Air Valves

Extended mode is required when using one or more Weld Air Valves on a Multi-Electrode (Multi-Gun) machine.

Extended configuration allows a user to output the WAV signal on any of the discrete outputs ranging from AV1 to AV8. In **NetFlash™**, check the **AVx** and **WAVx** box corresponding to the desired valve and timing parameter to execute during the weld sequence. The selected **WAVx** output will **automatically stay ON** throughout the entire weld sequence.

When the **WAVx** checkbox is checked, the **AVx** outputs in the column shown in Figure 64 does not need to be checked. The **AVx** output will execute for all events.

When the **WAVx** checkbox is unchecked, the **AVx** outputs for each event must be individually set by checking the box.

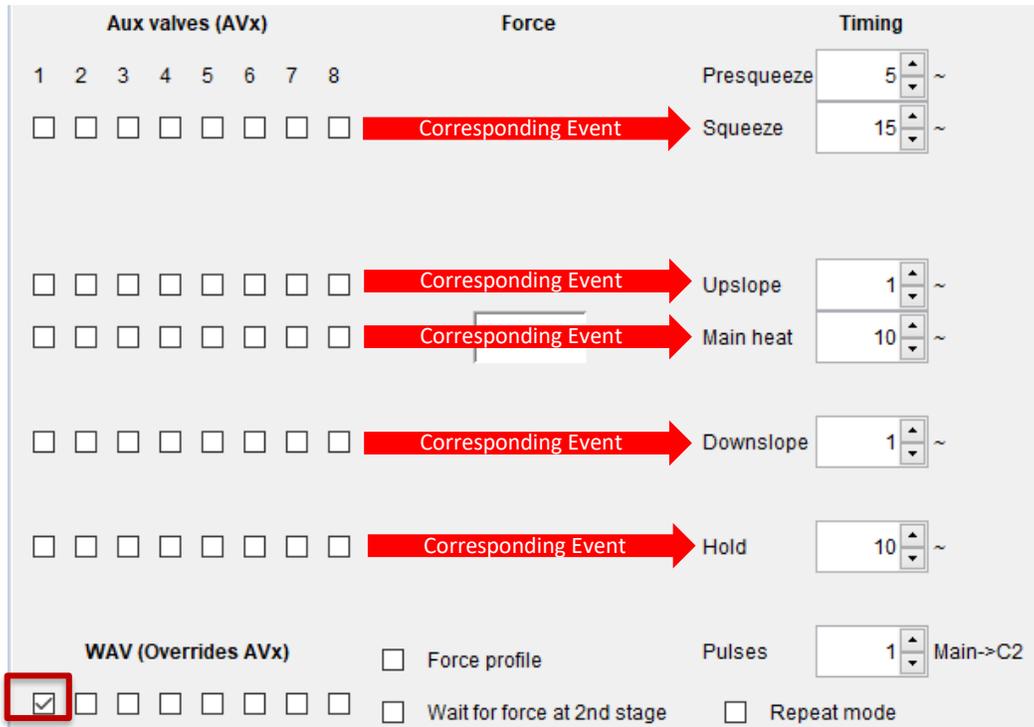


Figure 64: NetFlash Valve Selection with Extended Features Configuration

10.7.3.2 Mutli-Electrode in Standard Mode

Standard configuration always outputs the WAV signal on AV1 which limits the flexibility in programming a Multi-Electrode weld program. In **NetFlash™**, check the **AVx** box corresponding to the desired valve and timing parameter to execute during the weld sequence.

In the **Standard** mode, only a **WAV** output can be used. Auxiliary outputs can be used as Event-Outputs, such as turning ON a Dump-Valve during post heat for a forge operation. **Figure 65** shows how to enable Auxiliary Output 2 [**AV2**] during the Post-Heat and Hold interval of a weld program. The **WAV** signal is automatically assigned and stays ON throughout the entire weld sequence.

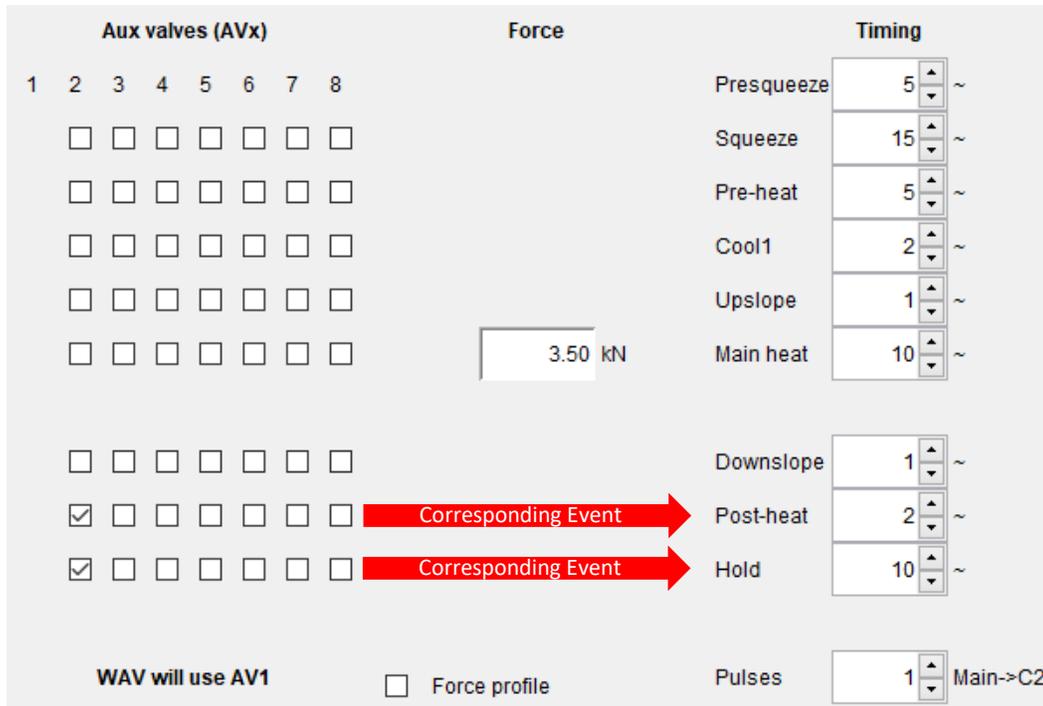


Figure 65: NetFlash Valve Selection with Standard Features Configuration

10.7.4 Cascade Operation

The Cascade operation is typically used with Multi-Welder (Cascade) Machines where multiple transformers are controlled from a single EN7000v2 weld controller. Refer to the **Multi-Welding Machine** section for more information.

Different weld guns and transformers can be selected for each weld program, and the welding programs can be linked together and started by a single Start command. Cancelling the Start command at any time will abort the cascade sequence.

To program a Cascade weld program, the EN7000v2 features configuration parameter must be set to **Extended**. Refer to the Configure the Control section for configuration instructions.

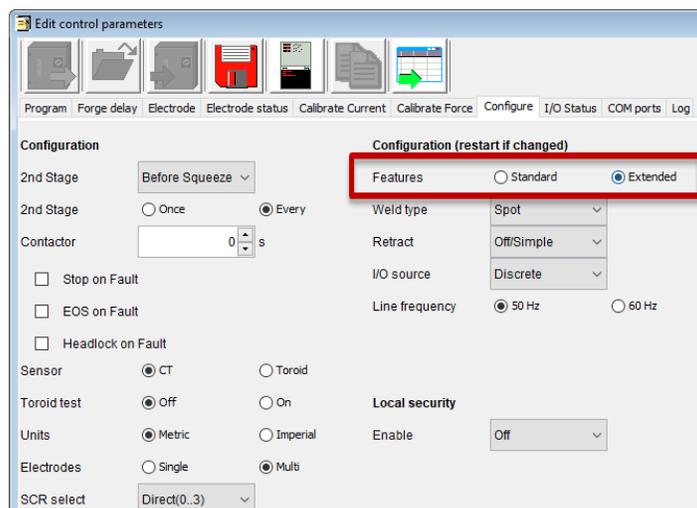


Figure 66: Location of Features Parameter in NetFlash

To program a cascade program, the user should familiarize themselves with electrode assignment, transformer assignment, valve control, linking programs, and programming a weld program (schedule).

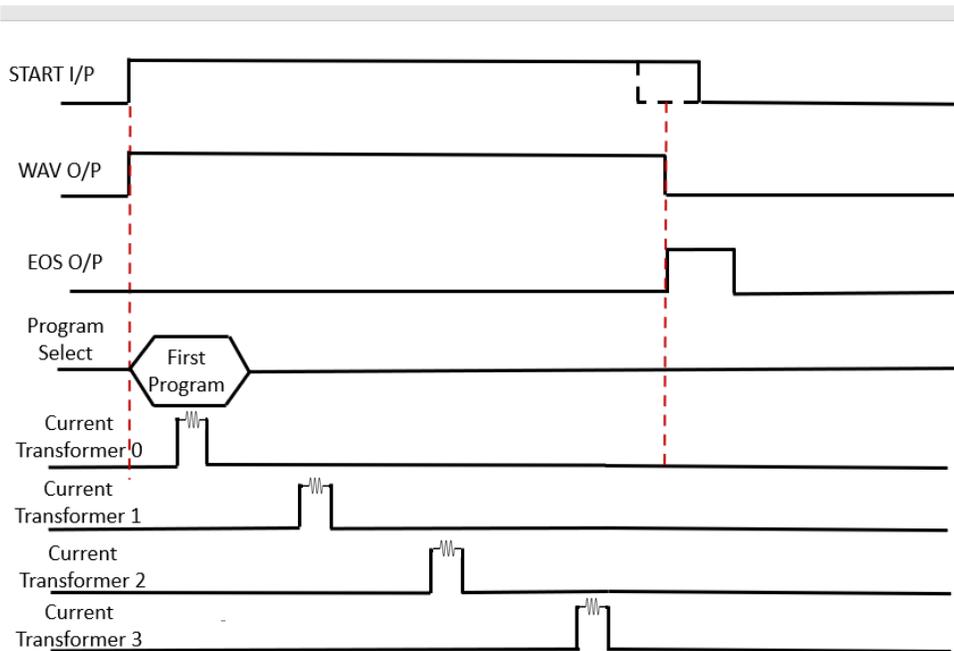


Figure 67: Cascade Weld Timing Diagram

In cascade operation, the program select input determines the first program in the cascade. The **Link To Program** parameter specifies the next program in the cascade sequence. The cascade ends when a program runs with the **Link/Cascade Option** set to Off. **Figure 68** shows the Program, Link/Cascade option, and the Link To parameters in NetFlash™.

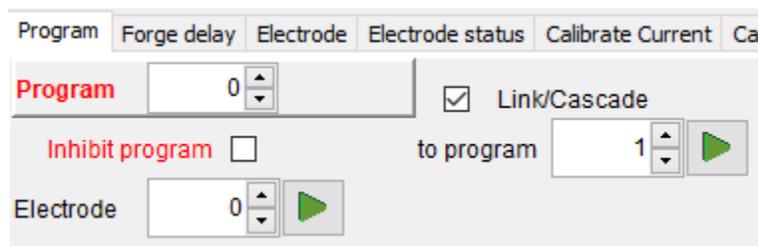


Figure 68: NetFlash Cascade Parameters

The fault response during a Cascade program can be configured by changing the Stop On Fault configuration parameter as shown in **Table 68**.

Configuration parameter 'Stop on fault'	Description
Off	Cascade will continue. Fault output will remain on only until next weld.
On	Cascade will pause. Cascade will continue when the fault is reset.

Table 68: Stop on Fault Configuration Parameter

10.8 Analog Control Mode

The EN7000v2 supports analog control which allows the output of the inverter to be controlled via an analog input ranging from 0 to 10 V. The control output will track the analog input, allowing the user to create dynamic current profiles.



Figure 69: Select Analog Control

Note the following features are **not available** in Analog Control Mode:

- Pre-heat and post heat
- Force feedback

To use Analog Control Mode, the feature parameter must be set to **Extended** and the Weld Type parameter must be set to **(Analog)** in the configuration settings. See the Configure the Control section for more information.

The analog input must be wired to P4 pins 1(+) and 2(-).

Analog Control Mode allows the user to control current in all two available modes. The current control mode must be set on the weld program.

Main mode	0 to 10 V input signal controls
PHA	0 to 100% Heat
CCR	0 to 100% calibrated current.

Table 69: Current Control Modes Available with Analog Control

Figure 70 shows an example of a seam welding timing diagram using Analog Control mode.

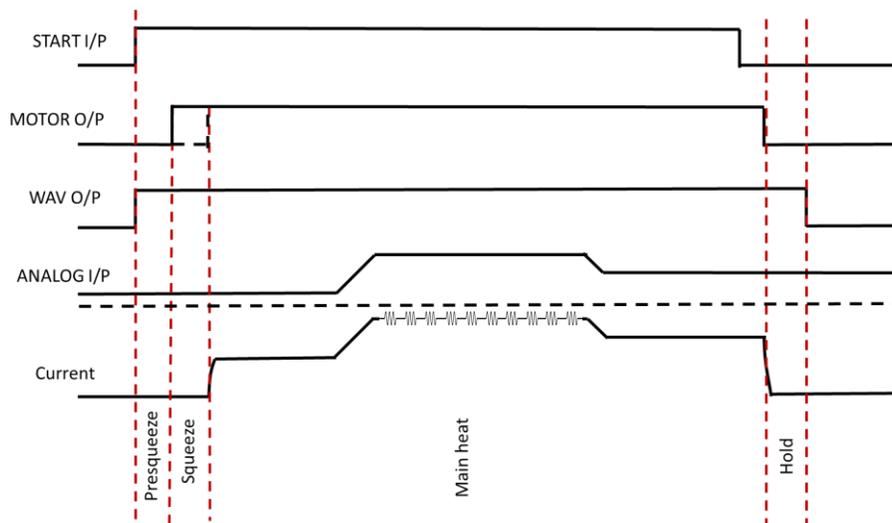


Figure 70: Seam Welding Timing Diagram using Analog Control

10.9 Valve Control

The EN7000v2 has eight discrete outputs (AV1-AV8) that can be operated independently during a weld sequence. The valves are categorized as WAV, MOTOR¹, and AUX.

- A **WAV** valve turns on at start of sequence and turns off at the end of the Hold interval
- A **MOTOR** valve turns on after the 2nd stage test and turns off at the start of the Hold interval (see the Configure the Control section for more information on the configuration)
- An **AUX** valve may be programmed to come on during any interval of the weld sequence, including the Off time in repeat or roll-spot mode.

The summary of the configurations settings and valve outputs are shown in [Table 70](#).

Features Parameter	Weld Type Parameter	Configuration	WAV function	MOTOR function	Description
Standard	N/A	All	AV1	n/a	AV1 is automatically selected
Extended	Spot	Single electrode	AV1	n/a	AV1 is automatically selected
	Spot	Multi-electrode	AV1 – AV8	n/a	Any combination of AV1 to AV8 may be selected
	Seam	Single electrode	AV1	AV2	AV1 and AV2 are automatically selected
	Seam	Multi-electrode	AV1 – AV8	AV1 – AV8	Any combination of AV1 to AV8 may be selected

Table 70: Configuration Parameters for Valve Outputs

Valves not being used for the WAV or MOTOR function may be used as AUX valves. WAV/MOTOR settings always override any corresponding AUX settings.

The weld programs contain the valve parameters defined in [Table 71](#).

Parameter	Units	Range	Description
WAV		AV1 – AV8	WAV output
Motor 1		AV1 – AV8	Motor output
Squeeze	AV1 – AV8	on/off	Valve state during the Squeeze interval
Pre-heat	AV1 – AV8	on/off	Valve state during the Pre-heat interval
Cool1	AV1 – AV8	on/off	Valve state during the Cool1 interval
Upslope	AV1 – AV8	on/off	Valve state during the Upslope interval
Main heat	AV1 – AV8	on/off	Valve state during the Main heat interval
Cool2	AV1 – AV8	on/off	Valve state during the Cool2 interval
Downslope	AV1 – AV8	on/off	Valve state during the Downslope interval
Post-heat	AV1 – AV8	on/off	Valve state during the Post-heat interval
Hold	AV1 – AV8	on/off	Valve state during the Hold interval
Off 2	AV1 – AV8	on/off	Valve state during the Off interval
1. Seam mode only			
2. Repeat mode or Roll-Spot program option must be enabled to use this feature.			

Table 71: Valve Control Parameters

10.10 Valve Delays

A forge operation is simply the application of additional force during the weld process.



HELPFUL TIP

Some materials, such as Aluminium, Titanium, and some exotic alloys, may need a forging force applied during the weld in order to remove heat induced cracks and form a more homogeneous nugget.

The timing of the application of additional force is critical. If the additional force is applied too soon, the current may be insufficient to form a good nugget with the resulting drop in contact resistance. If the additional force is applied too late, the nugget may have already started to solidify making it difficult to obtain the result needed.

Forge delay provides a precise timing method to trigger an AUX valve assigned to the function.

An on-delay may be applied to any of the AUX valves. The delay is triggered when a valve is programmed to turn on at the start of any interval. The actual turn-on time is delayed by the time value entered in the appropriate delay parameter.

- If a valve is programmed to turn off, then the delay is reset.
- All delays are reset at the end of the HOLD time.
- If a valve has been selected to operate as a WAV or MOTOR function, then the delay for that valve is not used.

See section [Programming Valve Delay Parameters using NetFlash](#) and [Programming Valve Delay Parameters using WSP3](#) for programming examples.

Each weld program has a corresponding extension. Each weld program extension contains the following parameters:

Parameter	Units	Range	Description
AV1 Delay	cycles	0 - 999	Delay on for AV1
AV2 Delay	cycles	0 - 999	Delay on for AV2
AV3 Delay	cycles	0 - 999	Delay on for AV3
AV4 Delay	cycles	0 - 999	Delay on for AV4
AV5 Delay	cycles	0 - 999	Delay on for AV5
AV6 Delay	cycles	0 - 999	Delay on for AV6
AV7 Delay	cycles	0 - 999	Delay on for AV7
AV8 Delay	cycles	0 - 999	Delay on for AV8

Table 72: Weld Program Forge Valve Delay Time Parameters

10.10.1 Programming Valve Delay Parameters using NetFlash

Example 1:

The AUX valve outputs can be programmed to activate after the start of any interval. In this example, NetFlash is used to program AV8 to come on 5 cycles after the start of the main heat interval:

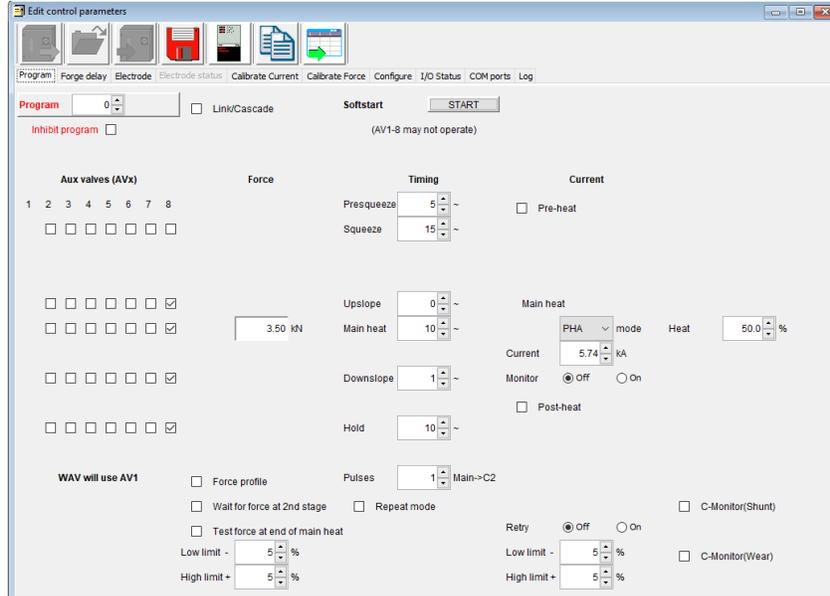


Figure 71: Example 1 NetFlash Program Valve Delay Selection Parameters

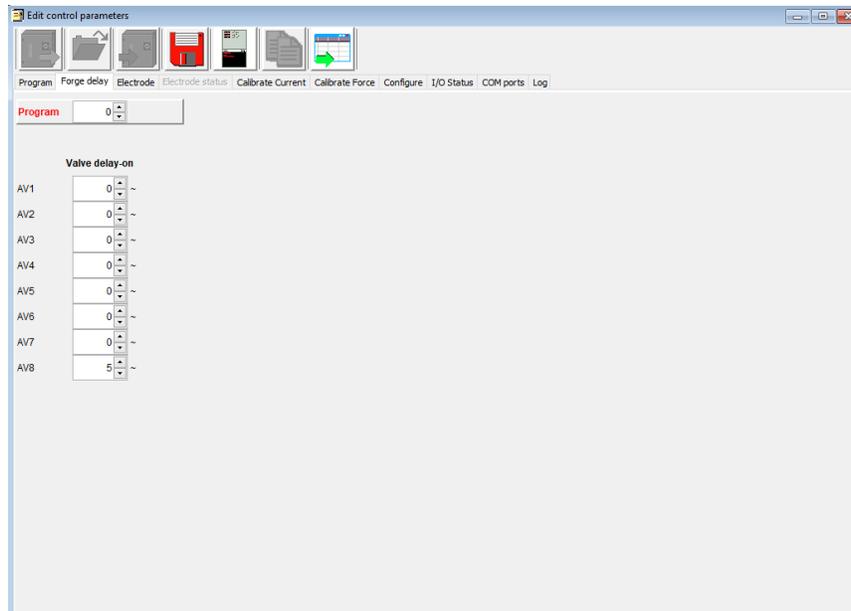


Figure 72: Example 1 Weld Program Forge Valve Delay Time Parameters

The resulting output is shown below in Figure 73.

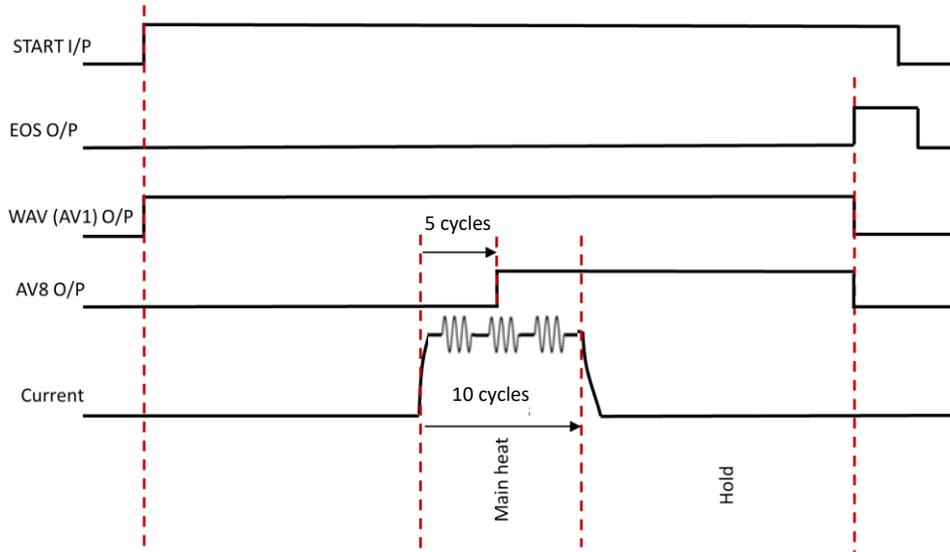


Figure 73: Example 1 Timing Diagram with Valve Delay in use

Example 2:

Extra care should be taken when using pulsation welding, as the program schedule contains a loop (Main-heat->Cool2->Main heat-> Cool2 etc). If the valve turn-on point lies within the loop, be sure to select all intervals in the loop and trigger the delay at the start of the Main heat interval.

In this example, AV8 is turned on in the first COOL2 period:

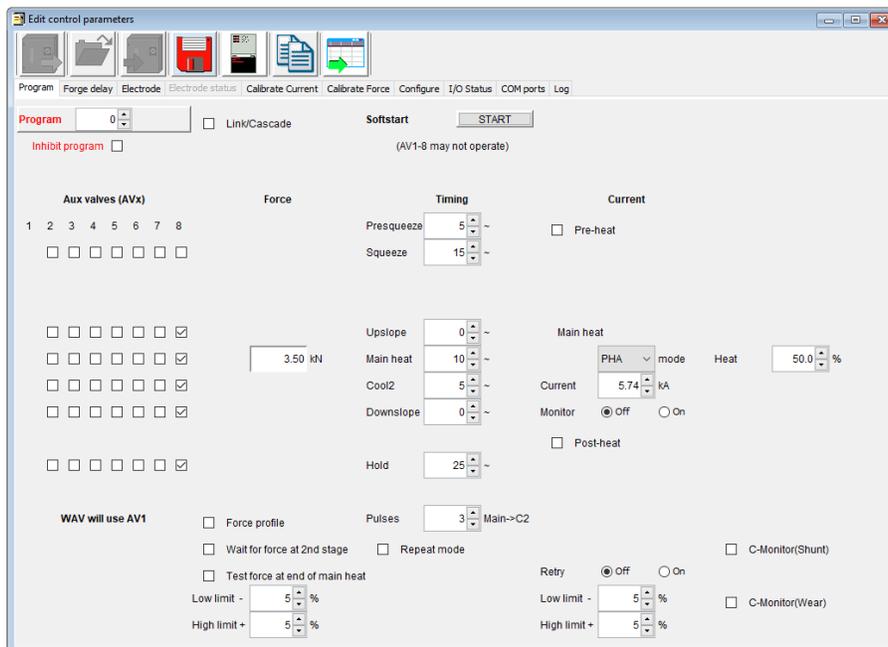


Figure 74: Example 2 NetFlash Program Valve Delay Selection Parameters

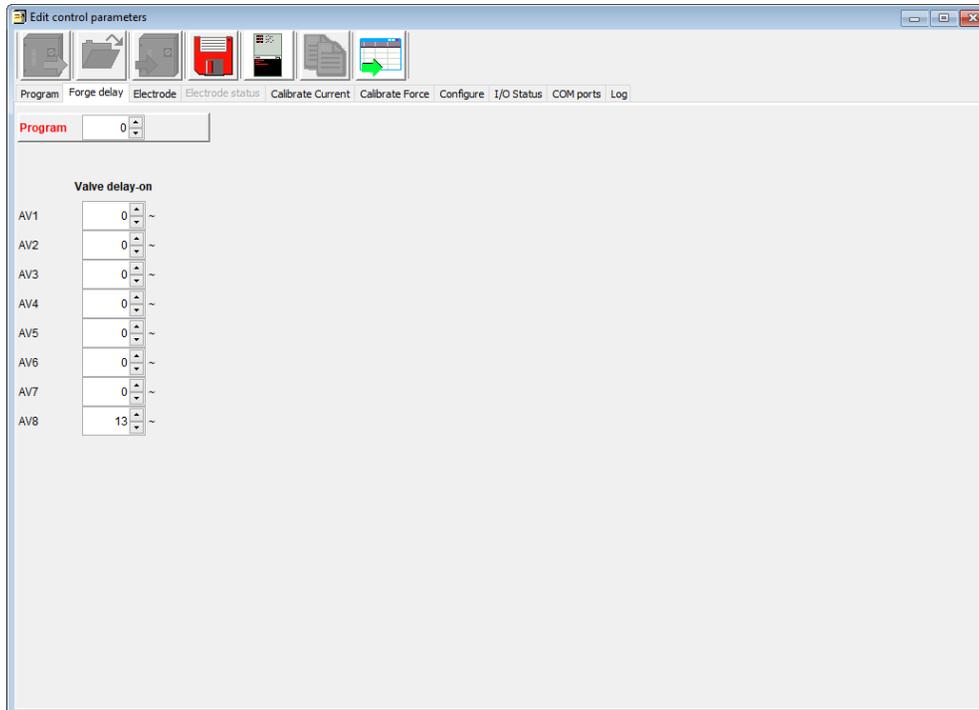


Figure 75: Example 2 Weld Program Forge Valve Delay Time Parameters

The resulting output is shown below in Figure 76.

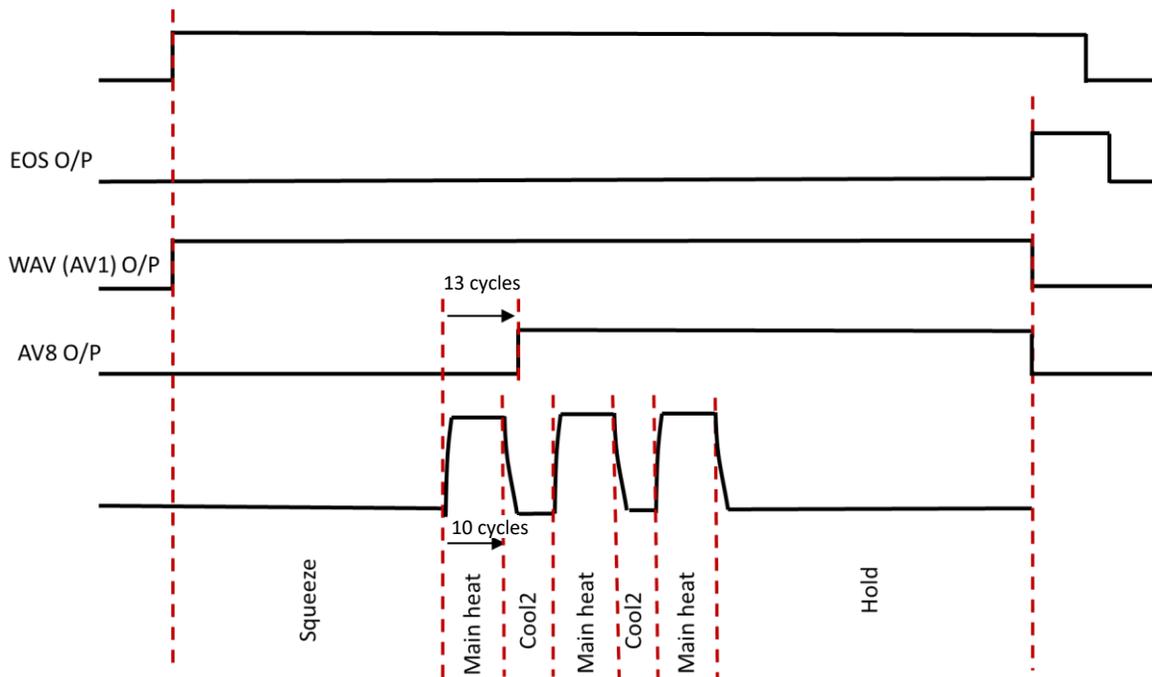


Figure 76: Example 2 Timing Diagram with Valve Delay in use

10.10.2 Programming Valve Delay Parameters using WSP3

The example step-by-step instructions for programming forge delay using the WSP3 in [Table 73](#).

Program data as per [Example 1](#) NetFlash programming screens.

Step	Description	Screen / Parameters	Key Inputs
1	The Status Screen will be displayed on the WSP3		
2	Press the F key to navigate to the <<<Main Menu>>>		To Enter Menu
3	Scroll down to the Edit Program line using the Down arrow then press RETURN key		To scroll Down To Enter Menu
4	Select correct Program number using + and - keys		Use the +/- keys to alter a selected parameter.
5	Scroll down to Edit Valves line and press RETURN key		To scroll Down To Enter Menu
6	Use the down arrow to select when the valve output comes on in sequence. Use the right arrow to select the valve number to come on eg valve 8.		To scroll Down To go Right

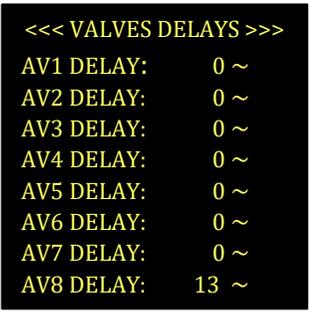
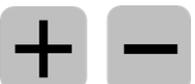
Step	Description	Screen / Parameters	Key Inputs
	<p>Use the + key to turn the valve on</p>  <p>This step needs to be done prior to programming the forge delay</p>		 <p>Use the +/- keys to alter a selected parameter.</p>
7	Press the F key to return to Program Menu		 <p>To Enter Menu</p>
8	Scroll using down arrow to Edit Valve Delays and Press RETURN key		 <p>To scroll Down</p>  <p>To Enter Menu</p>
9	<p>Scroll using down arrow to AV8 DELAY. Use + and – key to enter desired delay value eg 13 cycles.</p>  <p>The AV8 valve will be turned on 100 ms after the start of the upslope time and will turn off automatically after the end of the weld sequence.</p>		 <p>To scroll Down</p>  <p>Use the +/- keys to alter a selected parameter</p>

Table 74: WSP3 Weld Program Forge Valve Delay Time Parameters

10.11 Current Limits

The EN7000v2 has the ability to set a high and low limit on each weld program in terms of percentage. This allows a user to set a tolerance around the weld target current. When the upper and lower limits are violated, a fault will be latched to notify the user of the error.

Typically, the upper and lower limit are defined based on the weld lobe for the material. The weld lobe defines the acceptable range of currents that will make a satisfactory weld nugget at a defined force for a specific weld stack up. Currents outside the weld lobe will have quality defects such as expulsion or the weld nugget is below the minimum weld size. **Figure 77** shows an example of a weld lobe diagram.

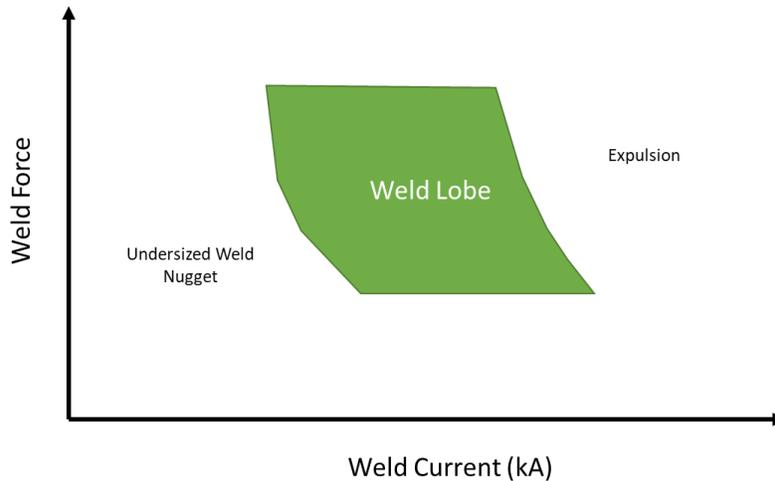


Figure 77: Weld Lobe

The **Measure** setting in the configuration defines which current is used for the monitoring function. Primary measuring will use the current measurement from a CT sensor to test against the limits. Secondary measuring will use the current measurement from the toroid (Rogowski coil) to test against the limits.



Calibration Required
 The EN7000v2 control must be calibrated prior to using the Current Limit function. Refer to the [Current Calibration](#) section for calibration procedure.

The current limits can be defined for each of the current types controlled by the EN7000v2:

- Pre-Heat/Current
- Main Heat/Current
- Post-Heat/Current

Figure 78 shows visual representation of the current limit function.

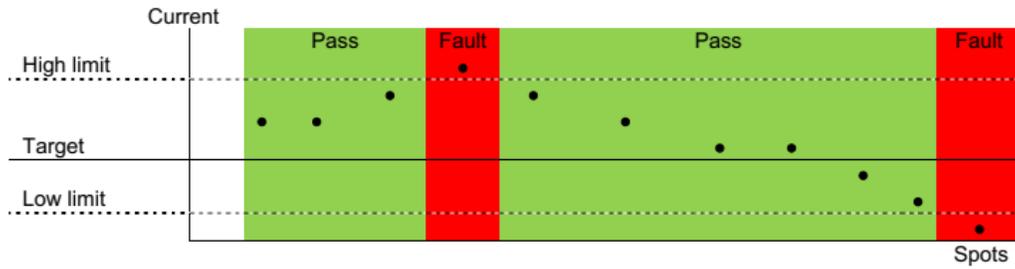


Figure 78: Current Limit Diagram

The **Current Limit** function can be set via NetFlash™, WSP3, MODBUS, and Ethernet/IP. Unique limits can be defined for each weld program and current type.

The **Monitor** setting must be enabled for each current type for the limits to be tested by the control. This is set for each of the current types (Pre, Main, and Post). **Figure 79** shows the location of the Monitor checkbox for the Main heat/current in the NetFlash™ program tab.

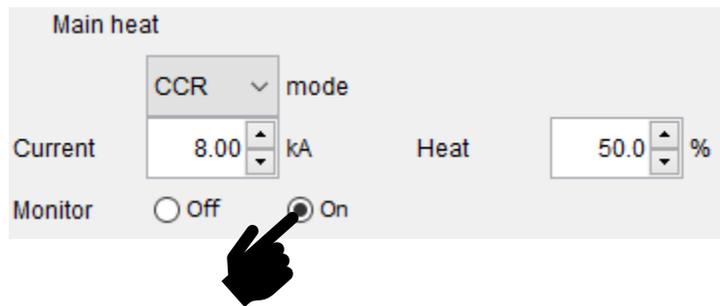


Figure 79: Current Limit Monitor Flag in Netflash

Once the Monitor function has been enabled for the current type, the high and low limit can be set in terms of percent. This is found at the bottom of the Program tab in NetFlash™.

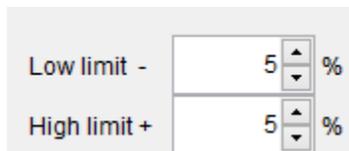


Figure 80: Current Limit Settings in NetFlash

11 TUTORIALS

11.1 Controlling an Air over Oil System

An Air over Oil System (also referred to as OHMA) uses compressed air to open and close the electrodes plus a hydraulic intensifier to apply the weld force. This type of system can easily be controlled by the EN7000v2 by making use of the programmable AUX valves feature.

Figure 81 shows a weld timing diagram where the Intensify signal is output during the Squeeze, Main Heat and Hold events. Table 75 defines step by step instructions to program a weld program (schedule) using **NetFlash™** with the Intensify signal output on AV2.

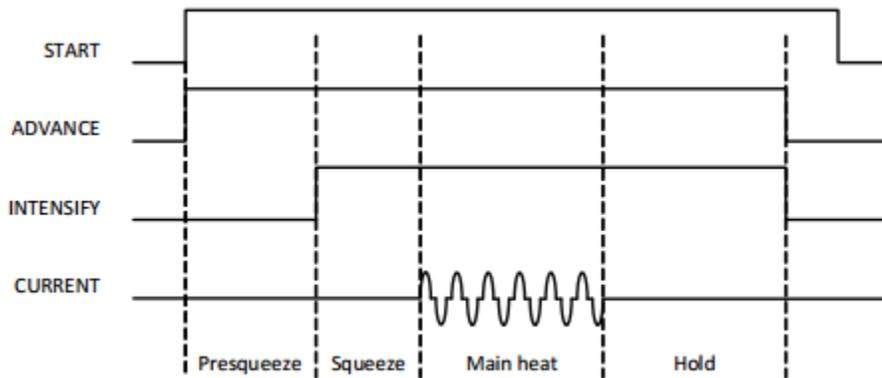


Figure 81: Weld Sequence Timing Diagram for Air Over Oil System

Step	Instruction	NetFlash Tab	Description
1	Connect WAV output to Advance valve on the EN7000v2 Weld Timer		<p>X2 OUTPUTS</p>
2	Connect AV2 output to Intensify valve on the EN7000v2 Weld Timer		<p>X2 OUTPUTS</p>

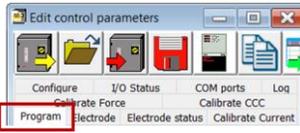
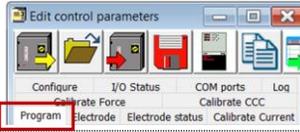
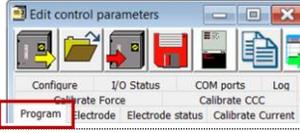
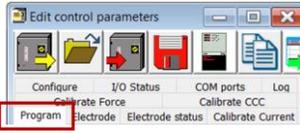
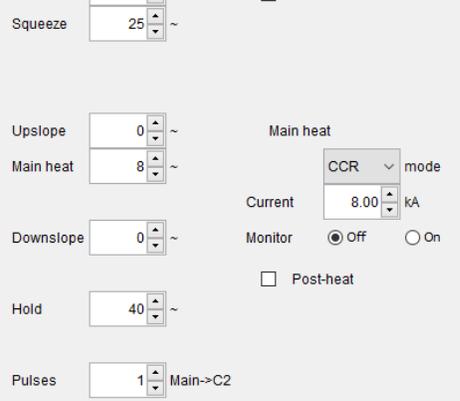
<p>3</p>	<p>On the Netflash Program Tab, select the desired Weld Program and then check all of the AV2 checkboxes in the column.</p> <p>Note: The checkboxes must be checked for all events used by the weld program (Squeeze, Upslope, Main heat, Downslope, Hold)</p>		
<p>4</p>	<p>Program the Presqueeze time with a value sufficient to allow the electrode advance to the work</p>		
<p>5</p>	<p>Program Squeeze time with a value sufficient to allow the cylinder to build to the Intensify pressure or Weld Force</p>		
<p>6</p>	<p>Program remaining weld parameters to suit weld schedule.</p> <p>Review step 3 to confirm the AV2 column is checked for each event of the weld program in use (Squeeze, Upslope, Main heat, Downslope, Hold).</p>		

Table 75: Instructions to program a Weld Program for an Air-Over-Oil System

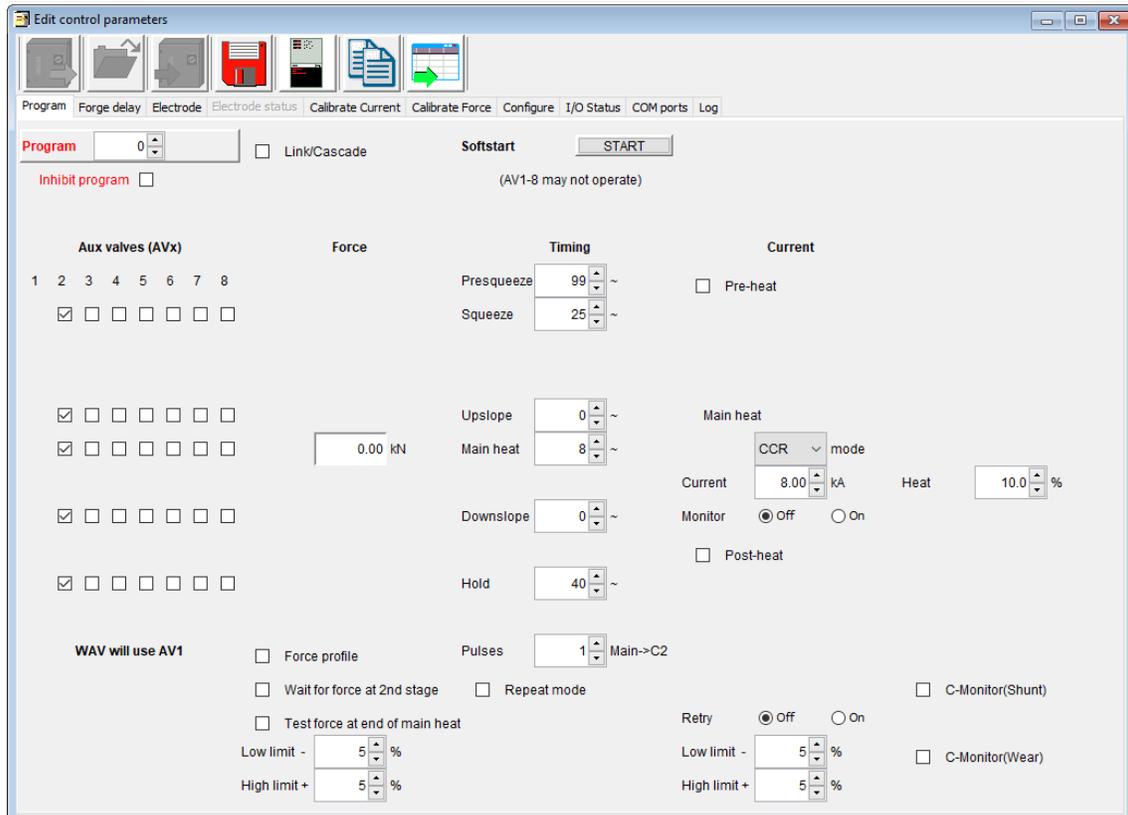
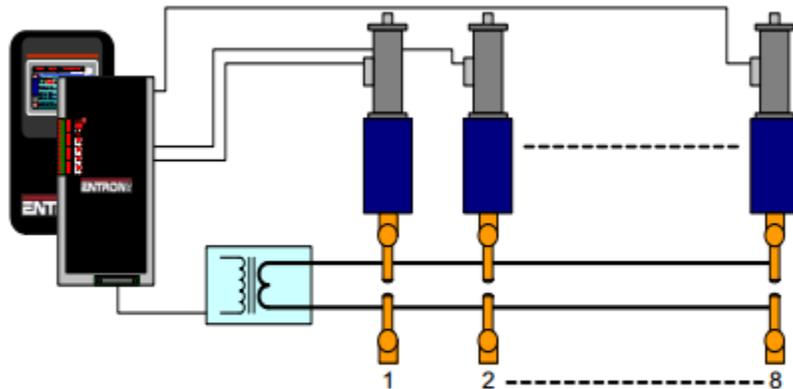


Figure 82: Example Weld Program for Air-Over Oil System using AV2 for Intensify Output

11.2 Using Valves to Control a Multi-Head Machine

The EN7000v2 can be used with welding machines that have multiple welding heads. By assigning one of the EN7000v2 AVx outputs, each head can be operated individually.



Multi-head machine. Up to eight cylinders. Cascade or independent firing.

The weld air valve or WAV output is determined by the weld program. The **WAV** will become active when the **START** input is active and will remain active until the end of the weld sequence.

11.2.1 Configure Control for Extended Mode

Multi-Welder/Cascades require the user to program the **WAV** outputs. To program the **WAV** Outputs, the control **Features** parameter must be set to **Extended**. The steps for setting the **Features** parameter to **Extended** in **NetFlash™** are defined in **Table 76**.

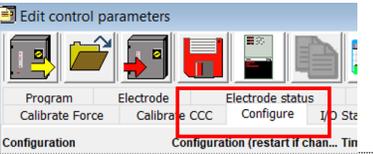
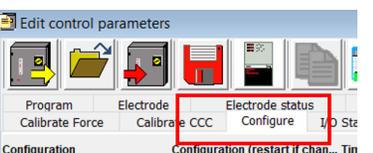
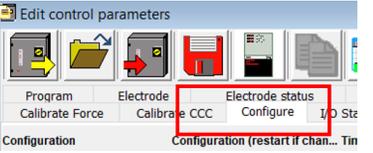
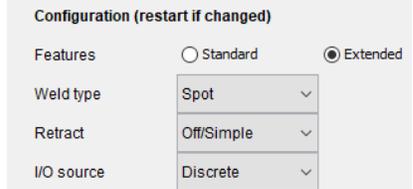
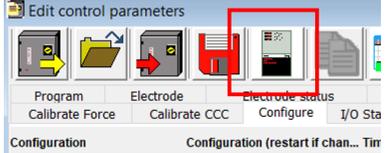
Step	Directions	NetFlash Tab	Netflash tools
1	Go to Configure Tab		
2	Change features to Extended by checking the checkbox.		
3	Note, the “Configuration (restart if changed)” header changes require control to be restarted		
4	To confirm if a Restart is required after any change. Click Open/Close Metrics icon		
5	Look at the Error/Message window. If you see “RESTART REQUIRED”, then the control must be restarted.		
6	Close the “Edit Control Parameters” window by clicking the  symbol.		
7	Press the Restart Button to cycle power to the control		

Table 76: Configure EN7000v2 for Extended Mode

11.2.2 Configure the Control for Multi-Electrodes

Once the control has been set to **Extended** mode, the Electrodes configuration parameter must be set to **Multi**. This change is required to allow the user to program the **WAVx** outputs. The instructions to set the Electrodes parameter to **Multi** in **NetFlash™** are defined in **Table 77**.

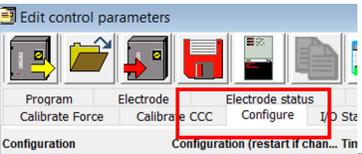
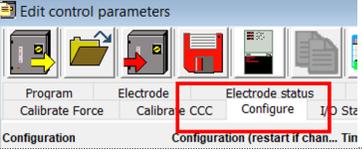
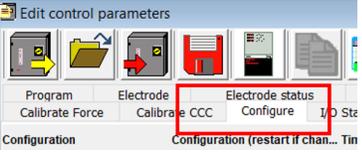
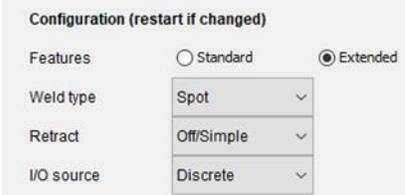
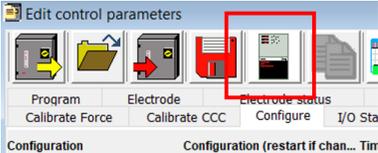
Step	Directions	NetFlash Tab	Netflash tools
1	Go to Configure Tab		
2	Change features to Multi by checking the checkbox.		
3	Note, the "Configuration (restart if changed)" header changes require control to be restarted		
4	To confirm if a Restart is required after any change. Click Open/Close Metrics icon		
5	Look at the Error/Message window. If you see "RESTART REQUIRED", then the control must be restarted.		
6	Close the "Edit Control Parameters" window by clicking the  symbol.		
7	Press the Restart Button to cycle power to the control		

Table 77: Configure EN7000v2 for Multi-Electrodes

11.2.3 Program the WAV Output for Each Weld Program in the Weld Sequence

The **WAVx** output will be selected with each weld program to select which Weld Air Valve will close during the execution of the weld program. **Figure 83** provides an example of setting the **WAVx** output on four different weld programs in **NetFlash™**. All four programs are assigned to **Transformer/SCR 0** which means the weld current will be output through the same weld transformer.

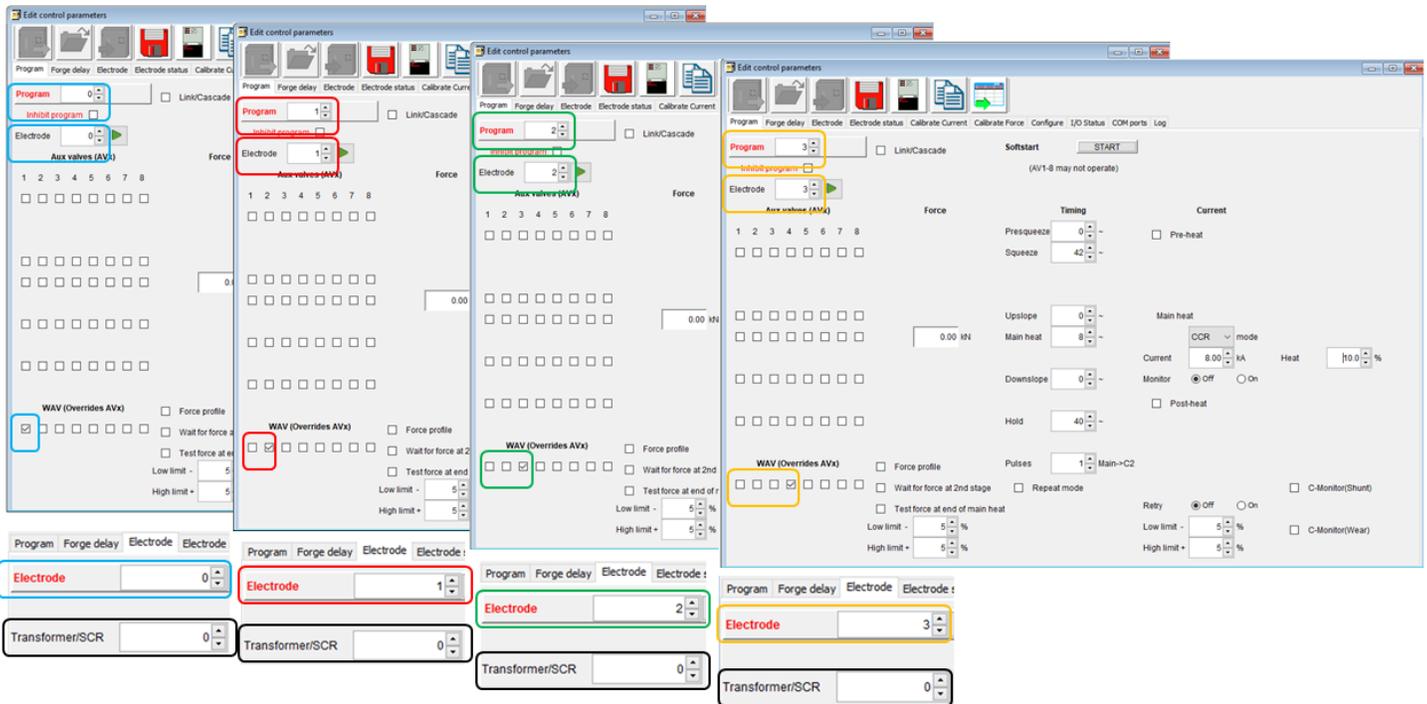


Figure 83: Example of WAV Settings on Weld Program for Multi-Head Machine - 1 Transformer

The step-by-step instructions program the sequence shown in Figure 83 using **NetFlash™** are defined in Table 78.

Step	Instruction	NetFlash Tab	Program/Electrode/TX-SCR	WAV Check Selection
1	Select Program 0 Set Electrode to 0 Check the WAV1 checkbox Set Transformer/SCR to 0	 		
2	Select Program 1 Set Electrode to 1 Check the WAV2 checkbox Set Transformer/SCR to 0	 		

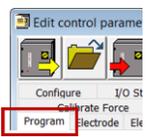
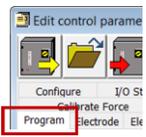
<p>3</p>	<p>Select Program 2 Set Electrode to 2 Check the WAV3 checkbox Set Transformer/SCR to 0</p>	 	<p>Program 2</p> <p>Inhibit program <input type="checkbox"/></p> <p>Electrode 2</p> <p>Program Forge delay Electrode Electrode :</p> <p>Electrode 2</p> <p>Transformer/SCR 0</p>	<p>WAV (Overrides AVx)</p> <p><input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p>
<p>4</p>	<p>Select Program 3 Set Electrode to 3 Check the WAV4 checkbox Set Transformer/SCR to 0</p>	 	<p>Program 3</p> <p>Inhibit program <input type="checkbox"/></p> <p>Electrode 3</p> <p>Program Forge delay Electrode Electrode :</p> <p>Electrode 3</p> <p>Transformer/SCR 0</p>	<p>WAV (Overrides AVx)</p> <p><input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p>

Table 78: Instructions to Program the WAV Output Per Weld Program on Multi-Head Machine

In the example, each program must be selected individually, then initiated. Programs can be run in any order.

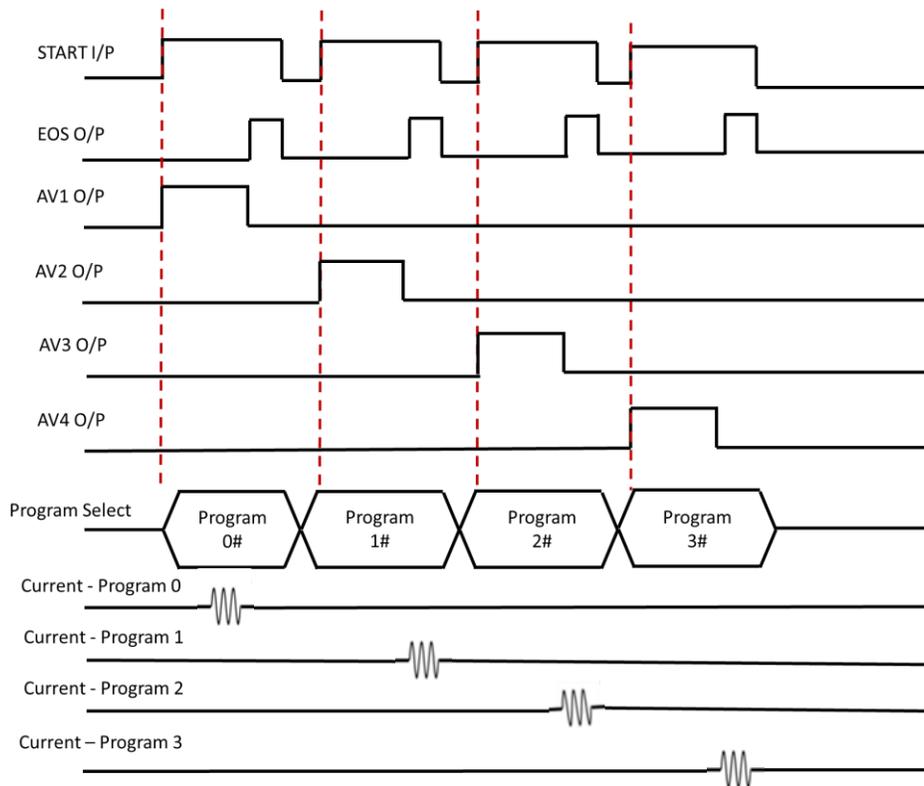


Figure 84: Weld Timing Diagram for Multi-Head Machine with Independent Initiation of Each Weld Program

11.2.4 Link Programs Together (Cascade)

The programs can also be linked together using the Link/Cascade parameter. In this example the Multi-weld sequence can be completed with one initiation after selecting the first program as shown in

Figure 85.

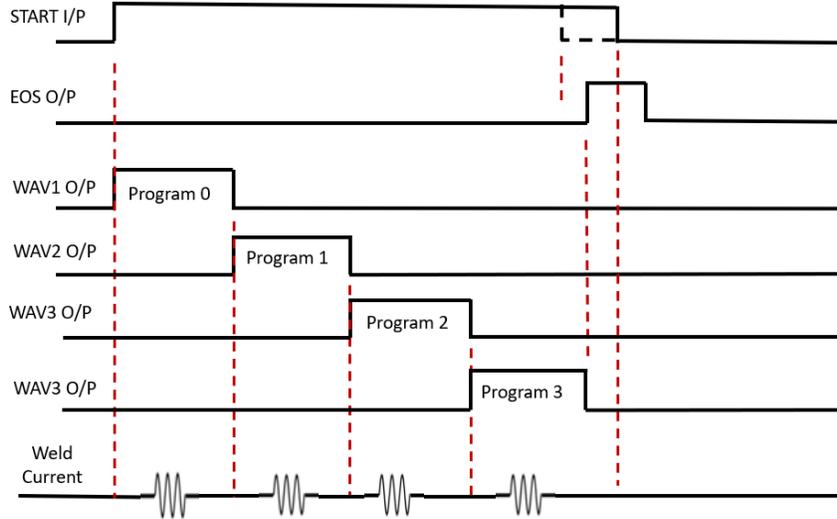


Figure 85: Weld Timing Diagram for Linked/Cascade Program on Multi-Head Machine

To link the programs together using NetFlash™, you will use the **Link/Cascade** checkbox. When the **Link/Cascade** checkbox is checked, the **to program** parameter will appear. The **to program** parameter defines the program to run after the current program executes. Figure 86 shows a visual representation of four weld programs linked together. Each weld program is open in a separate **Edit control parameters** window.

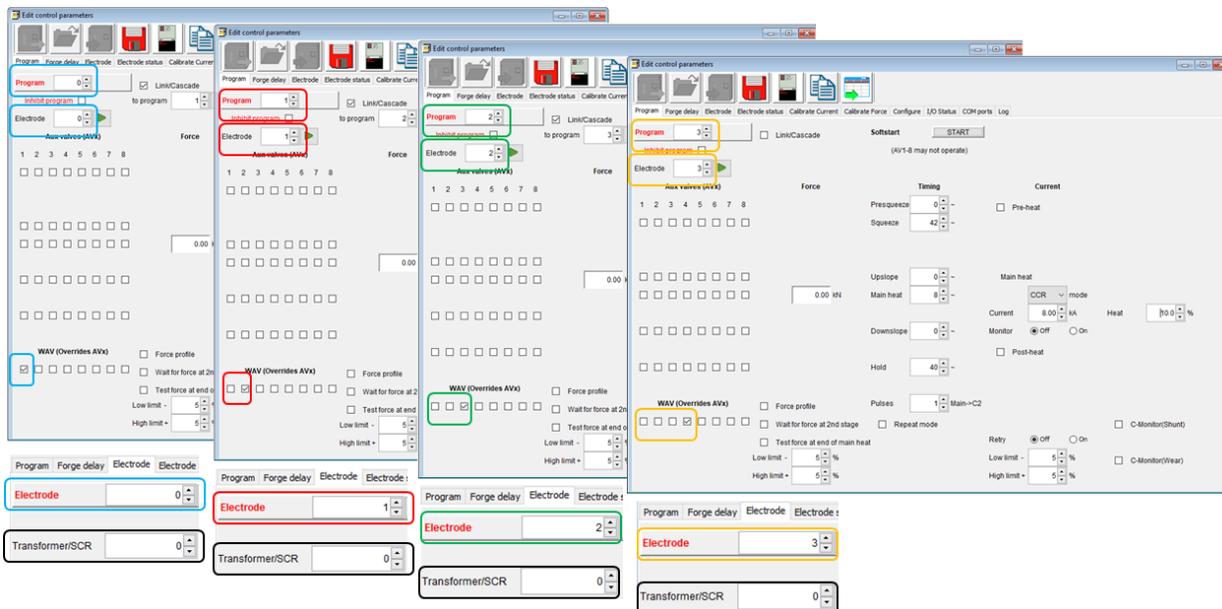


Figure 86: Linking Programs on a Multi-Head Machine Example - 1 Transformer

The step-by-step instructions to link four weld programs together as shown in Figure 86 are defined in Table 79. The example also includes setting the WAVx output with each weld program.

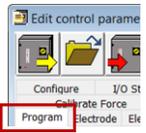
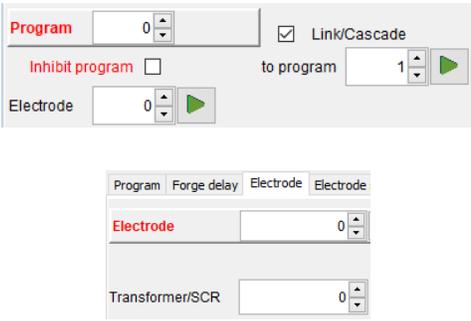
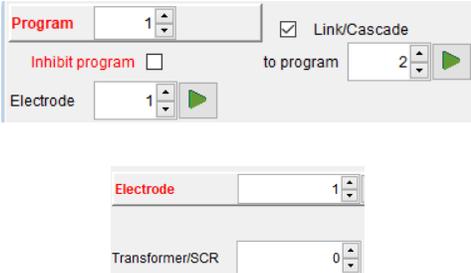
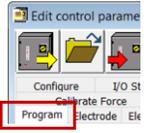
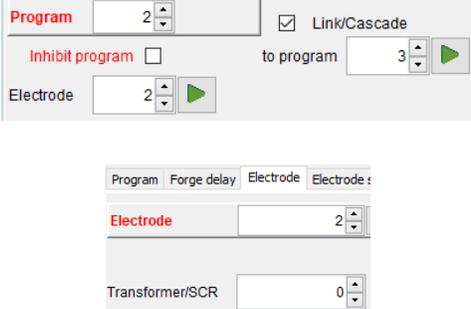
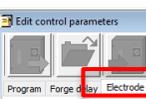
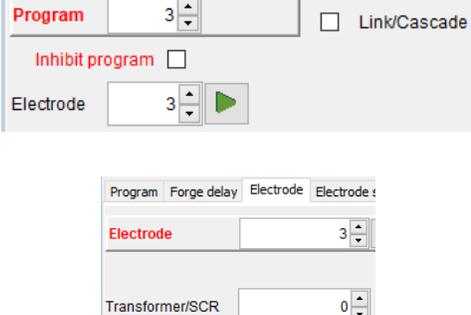
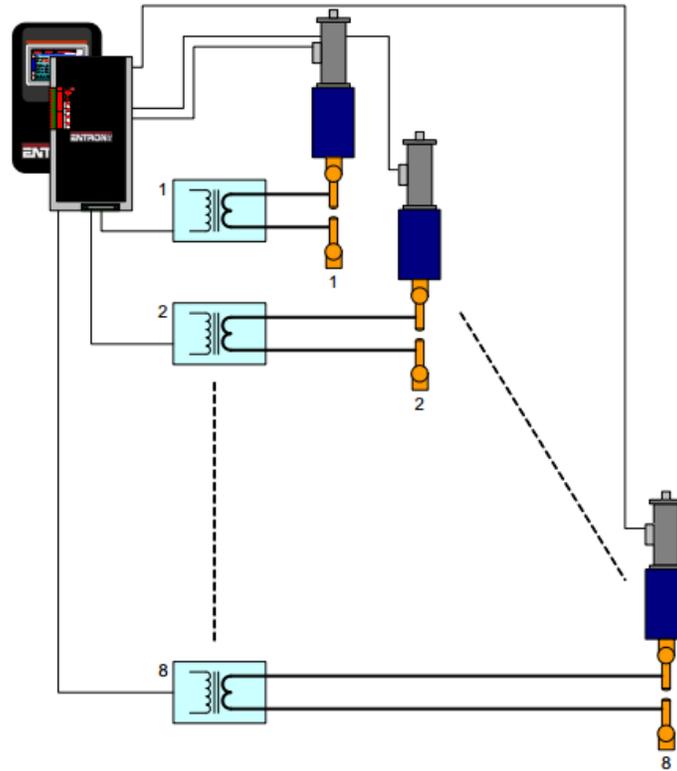
Step	Instruction	NetFlash Tab	Program/Electrode/Link	WAV Check Selection
1	Select Program 0 Set Electrode to 0 Check the Link/Cascade checkbox Set to program to 1 Check the WAV1 checkbox Set Transformer/SCR to 0	 		WAV (Overrides AVx) <input checked="" type="checkbox"/> <input type="checkbox"/>
2	Select Program 1 Set Electrode to 1 Check the Link/Cascade checkbox Set to program to 2 Check the WAV2 checkbox Set Transformer/SCR to 0	 		WAV (Overrides AVx) <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3	Select Program 2 Set Electrode to 2 Check the Link/Cascade checkbox Set to program to 3 Check the WAV3 checkbox Set Transformer/SCR to 0	 		WAV (Overrides AVx) <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
4	Select Program 3 Set Electrode to 3 Uncheck the Link/Cascade checkbox to define end of sequence. Check the WAV4 checkbox Set Transformer/SCR to 0	 		WAV (Overrides AVx) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Table 79: Instructions to Link/Cascade Programs on a Multi-Head Machine – 1 Transformer

11.3 Controlling a Multi-Welder/Cascade

A machine with multiple transformers, used in a Cascade Sequence, can reduce cycle time while making up to 8 welds in rapid succession. In this instance, since each secondary circuit is controlled independently, all guns can close simultaneously. The longest part of the sequence will be the Squeeze time during the first program and the Hold time at the end of the last program. The welds fire with minimal delay between each firing.



Multi-welder. Up to 8 transformers and cylinders. Cascade or independent firing.

Figure 87: Multi-Welder / Cascade Diagram – Multiple Transformers

In a cascade sequence, all **WAV** output's are programmed to operate at the start of the first weld program as shown in [Figure 88](#). The **WAV's** will become active when the **START** input is active and will remain active until all the weld programs have completed.

11.3.1 Configure Control for Extended Mode

Multi-Welder/Cascades require the user to program the **WAV** outputs. To program the **WAV** Outputs, the control **Features** parameter must be set to **Extended**. The steps for setting the **Features** parameter to **Extended** in **NetFlash™** are defined in [Table 76](#).

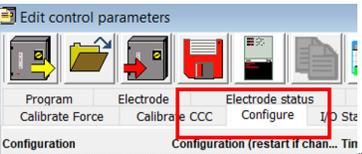
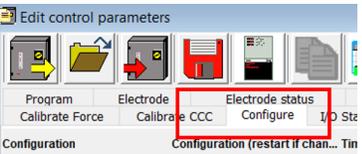
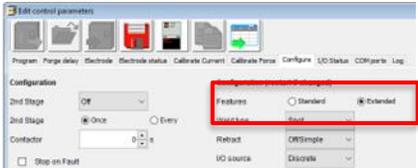
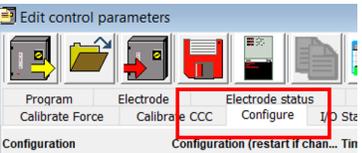
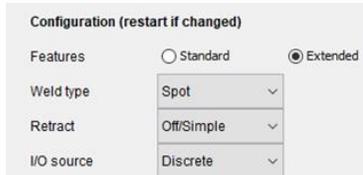
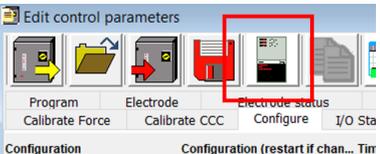
Step	Directions	NetFlash Tab	Netflash tools
1	Go to Configure Tab		
2	Change features to Extended by checking the checkbox.		
3	Note, the "Configuration (restart if changed)" header changes require control to be restarted		
4	To confirm if a Restart is required after any change. Click Open/Close Metrics icon		
5	Look at the Error/Message window. If you see "RESTART REQUIRED", then the control must be restarted.		
6	Close the "Edit Control Parameters" window by clicking the [X] symbol.		
7	Press the Restart Button to cycle power to the control		

Table 80: Configure EN7000v2 for Extended Mode

11.3.2 Assign Electrode to a Transformer

The relationship between an electrode and the transformer must be defined. Once **Transformers** have been assigned to **Electrodes**, **Electrodes** can be assigned to weld programs.

Table 81 shows how to define the Transformer/Electrode relationship in the **Electrode** tab of **NetFlash™**. The **Electrode** can then be defined for the Weld Program in the **Program** tab of **NetFlash™**.

PROGRAM	PROGRAM PARAMETERS	ELECTRODE PARAMETERS	Firing assignment
0			PROGRAM 0 (Link Prg 1) ELECTRODE 0 TRANSFORMER 0
1			PROGRAM 1(Link Prg 2) ELECTRODE 1 TRANSFORMER 1
2			PROGRAM 2 (Link Prg 3) ELECTRODE 2 TRANSFORMER 2
3			PROGRAM 3 ELECTRODE 3 TRANSFORMER 3

Table 81: Defining Electrode/Transformer Relationship

11.3.3 Programming a Multi-Welder/Cascade Sequence

A Multi-Welder/Cascade weld timing sequence is shown in Figure 88. The sequence has a single start input and then a defined series of weld programs are executed one after the other using different transformers. The WAV output can be the same or different for each weld program. The step-by-step instructions to program this sequence using NetFlash™ are defined in Table 80: Configure EN7000v2 for Extended Mode.

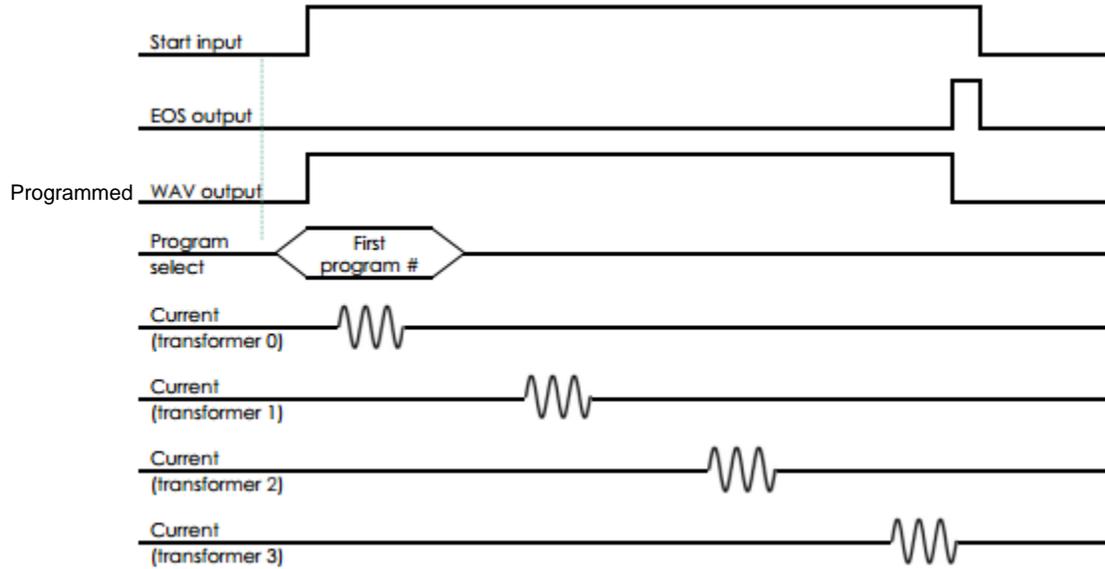


Figure 88: Cascade Weld Timing Diagram

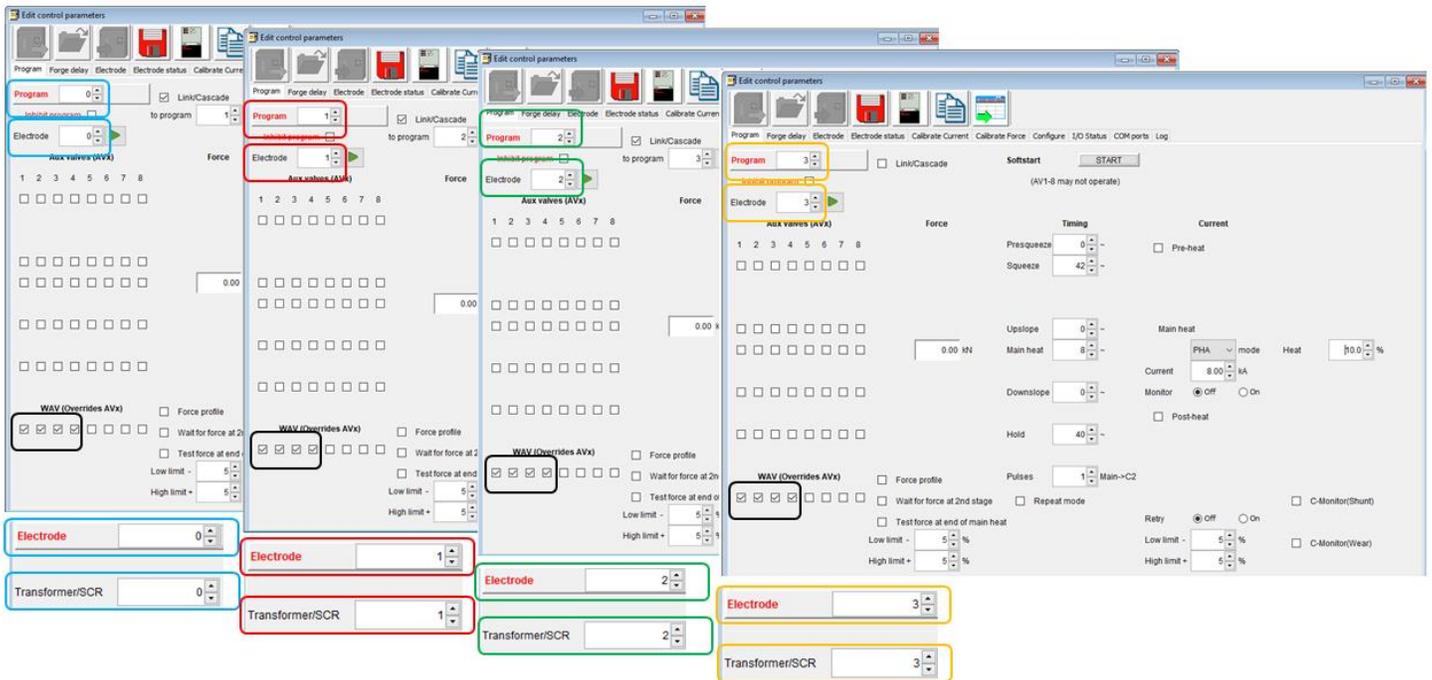
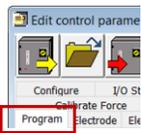
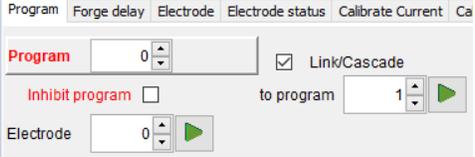
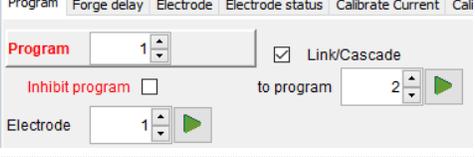
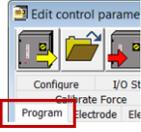
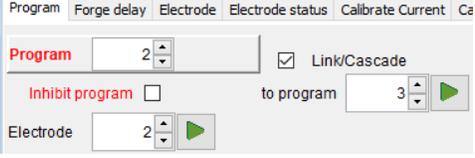
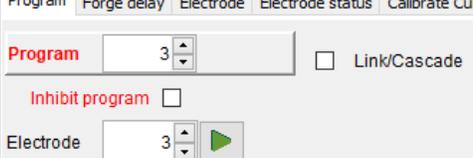


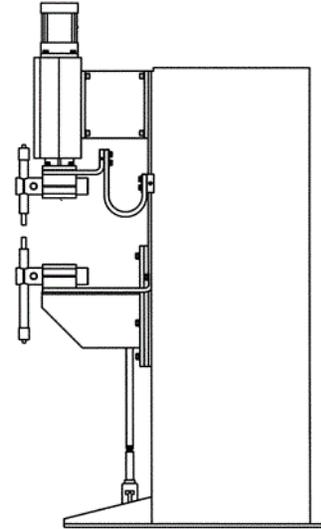
Figure 89: Linking Programs on a Multi-Head Machine Example - 4 Transformer's

Step	Instruction	NetFlash Tab	Program/Electrode/Link	WAV Check Selection
1	Select Program 0 Set Electrode to 0 Check the Link/Cascade checkbox Set to program to 1 Check the WAV1,2,3 & 4 checkbox			
2	Select Program 1 Set Electrode to 1 Check the Link/Cascade checkbox Set to program to 2 Check the WAV1,2,3 & 4 checkbox			
3	Select Program 2 Set Electrode to 2 Check the Link/Cascade checkbox Set to program to 3 Check the WAV1,2,3 & 4 checkbox			
4	Select Program 3 Set Electrode to 3 Uncheck the Link/Cascade checkbox to define end of sequence. Check the WAV1,2,3 & 4 checkbox			

11.4 Configuring & Calibrating EN7000v2 with the WSP3 Pendant

This tutorial provides step-by-step instructions to configure and calibrate an EN7000v2 weld control using the WSP3 pendant. This procedure is based on the following assumptions:

Component	Type
Machine Type	Standard
Transformer	100 KVA AC Welding transformer with a 50:1 turns ratio
Actuator	Weld Air Valve (no retract system)
Measurement	Secondary (requires a secondary toroid (Rogowski Coil))
Accessories Required	Weld Current Meter



An outline of the procedures to be performed are as follows:

- 1) Configure the Weld Control
- 2) Setup Program 0 with basic parameters for short circuit welds
- 3) Reset and Disable Electrode Stepping
- 4) Calibrate Current (Toroid / Rogowski coil)
- 5) Select CCR – Constant Current Regulation
- 6) Adjust Weld Program Current

This procedure assumes the control has been installed, the secondary toroid (Rogowski coil) has been properly wired to the EN7000v2, and the WSP3 Handheld Pendant has been connected to the control. See for the [Installation](#) section more information.

11.4.1 Configure the Weld Control

Step	Description	Screen / Parameters	Key Inputs																																																		
1	Turn ON the EN7000v2 Weld Control																																																				
2	The Status Screen will be displayed on the WSP3																																																				
3	Press the F key to navigate to the <<Main Menu>>																																																				
4	Scroll down to the Edit Configuration line using the arrows																																																				
5	Press F and Return at the same time to enter the Configuration Menu																																																				
6	Set all of the configuration parameters as shown below.	<table border="1"> <thead> <tr> <th>Configuration Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>FEATURES</td><td>STANDARD</td></tr> <tr><td>2ND STAGE</td><td>OFF</td></tr> <tr><td>2ND STAGE</td><td>ONCE</td></tr> <tr><td>SENSOR</td><td>TOROID</td></tr> <tr><td>TOROID TEST</td><td>OFF</td></tr> <tr><td>FREQUENCY</td><td>50 Hz</td></tr> <tr><td>UNITS</td><td>METRIC</td></tr> <tr><td>STOP ON FAULT</td><td>NO</td></tr> <tr><td>EOS ON FAULT</td><td>YES</td></tr> <tr><td>HEADLOCK</td><td>NO</td></tr> <tr><td>PROG SELECTION</td><td>INTERNAL</td></tr> <tr><td>RETRACT</td><td>SIMPLE</td></tr> <tr><td>I/O SOURCE</td><td>DISCRETE</td></tr> <tr><td>ANALOG CONTROL</td><td>OFF</td></tr> <tr><td>ANALOG OUT</td><td>FORCE</td></tr> <tr><td>WAVE FORM 10V</td><td>30.0 kA</td></tr> <tr><td>CONTACTOR</td><td>0 s</td></tr> <tr><td>COM2</td><td>(RS485)</td></tr> <tr><td>COM3</td><td>(RS232)</td></tr> <tr><td>ETHERNET</td><td></td></tr> <tr><td>BACKUP TO WSP3</td><td></td></tr> <tr><td>RESTORE FROM WSP3</td><td></td></tr> <tr><td>INITIALISE DATA</td><td></td></tr> <tr><td>RESTART SYSTEM</td><td></td></tr> </tbody> </table>	Configuration Parameter	Value	FEATURES	STANDARD	2 ND STAGE	OFF	2 ND STAGE	ONCE	SENSOR	TOROID	TOROID TEST	OFF	FREQUENCY	50 Hz	UNITS	METRIC	STOP ON FAULT	NO	EOS ON FAULT	YES	HEADLOCK	NO	PROG SELECTION	INTERNAL	RETRACT	SIMPLE	I/O SOURCE	DISCRETE	ANALOG CONTROL	OFF	ANALOG OUT	FORCE	WAVE FORM 10V	30.0 kA	CONTACTOR	0 s	COM2	(RS485)	COM3	(RS232)	ETHERNET		BACKUP TO WSP3		RESTORE FROM WSP3		INITIALISE DATA		RESTART SYSTEM		<p>Use the +/- keys to alter a selected parameter. Press both keys simultaneously to set the parameter to 0 or the minimum value.</p>
Configuration Parameter	Value																																																				
FEATURES	STANDARD																																																				
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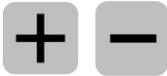
Step	Description	Screen / Parameters	Key Inputs
7	Scroll to the bottom of the menu to the RESTART SYSTEM line	<pre><<<CONFIGURE MENU>>> [CONFIGURATION PARAMETERS] BACKUP WSP3 RESTORE FROM WSP3 INITIALISE DATA RESTART SYSTEM</pre>	
8	Press the Return key to restart the control	<pre><<<CONFIGURE MENU>>> [CONFIGURATION PARAMETERS] RESTART SYSTEM</pre>	

11.4.2 Reset & Turn Off Electrode Stepper

If the Electrode Stepper is enabled, it can corrupt the calibration process. It is recommended that the Electrode Stepper be reset and disabled before calibrating the control.

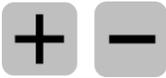
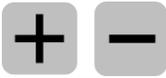
Step	Description	Screen / Parameters	Key Inputs
1	From the Status Screen press the F key		
2	Scroll down to the Edit Electrode line and press RETURN		
3	Scroll down to the Edit Stepper line and press RETURN		
4	Scroll down to ENABLE STEPPER liner and set to YES		 Use +/- keys to alter a selected parameter
5	Scroll up to RESET STEPPER and press the RETURN key		
6	Scroll down to ENABLE STEPPER and set to NO		 Use +/- keys to alter a selected parameter
7	Press F key to return to ELECTRODE menu		

11.4.3 Calibrate Current (Toroid / Rogowski coil)

Step	Description	Screen / Parameters	Key Inputs
1	From the ELECTRODE menu navigate to the CALIBRATE CURRENT line and press RETURN		
2	Scroll down to the POWER FACTOR: line and use the + and – keys to set value to 0.70		 <p>Use +/- keys to alter a selected parameter</p>
3	Scroll down to the CT line to confirm the value is set to 1950 mV/kA	  <p>STANDARD DEFAULT SETTING</p> <p>This may vary depending upon the CT and Burden Resistor Value used.</p>	 <p>Use +/- keys to alter a selected parameter</p>
4	Scroll down to the TURNS RATIO line and use the + and – keys to set the value to 50 : 1		 <p>Use +/- keys to alter a selected parameter</p>
5	Scroll down to the CONVERT line and use the + and – keys to set the value to USE RATIO		 <p>Use +/- keys to alter a selected parameter</p>
6	Scroll down the TOROID line and confirm the value is set to 150 mv/ka. This is the default value. This value may be adjusted later based on results from the short circuit welds		 <p>Use +/- keys to alter a selected parameter</p>
7	Press F key to return to the ELECTRODE menu		
8	Press F key to return to the MAIN menu		

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Step	Description	Screen / Parameters	Key Inputs														
9	Scroll up to the EDIT PROGRAM line and press the RETURN key																
10	On the PROGRAM line use the + and – keys to select PROGRAM 0 <i>Note</i> – the program selected here will be used for the short circuit welds to calibrate the control.		 Use +/- keys to alter a selected parameter														
11	Scroll down to EDIT TIME and press the RETURN key																
12	Program the weld times with the following settings	<table border="1" data-bbox="716 747 959 1010"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>PRESQUEEZE</td> <td>0 ~</td> </tr> <tr> <td>SQUEEZE</td> <td>99 ~</td> </tr> <tr> <td>UPSLOPE</td> <td>0 ~</td> </tr> <tr> <td>MAIN HEAT</td> <td>8 ~</td> </tr> <tr> <td>DOWNSLOPE</td> <td>0 ~</td> </tr> <tr> <td>HOLD</td> <td>50 ~</td> </tr> </tbody> </table>	Parameter	Value	PRESQUEEZE	0 ~	SQUEEZE	99 ~	UPSLOPE	0 ~	MAIN HEAT	8 ~	DOWNSLOPE	0 ~	HOLD	50 ~	 Use +/- keys to alter a selected parameter
Parameter	Value																
PRESQUEEZE	0 ~																
SQUEEZE	99 ~																
UPSLOPE	0 ~																
MAIN HEAT	8 ~																
DOWNSLOPE	0 ~																
HOLD	50 ~																
13	Press F to return to the PROGRAM MENU																
14	Scroll to the EDIT CURRENT line and press the RETURN key																
15	Program the weld currents with the following settings	<table border="1" data-bbox="691 1272 984 1518"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>MAIN: MODE</td> <td>PHA</td> </tr> <tr> <td>MAIN: HEAT</td> <td>20.0%</td> </tr> <tr> <td>MAIN: CURRENT</td> <td>8.00 KA</td> </tr> <tr> <td>MAIN: MONITOR</td> <td>NO</td> </tr> <tr> <td>LOW LIMIT</td> <td>5%</td> </tr> <tr> <td>HIGH LIMIT</td> <td>5%</td> </tr> </tbody> </table>	Parameter	Value	MAIN: MODE	PHA	MAIN: HEAT	20.0%	MAIN: CURRENT	8.00 KA	MAIN: MONITOR	NO	LOW LIMIT	5%	HIGH LIMIT	5%	 Use +/- keys to alter a selected parameter
Parameter	Value																
MAIN: MODE	PHA																
MAIN: HEAT	20.0%																
MAIN: CURRENT	8.00 KA																
MAIN: MONITOR	NO																
LOW LIMIT	5%																
HIGH LIMIT	5%																
16	Press F to return to the PROGRAM menu																
17	Scroll down to the EDIT OPTIONS menu and press the RETURN key																
18	Program the weld options with the following settings	<table border="1" data-bbox="691 1808 984 1881"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>PROGRAM INHIBIT</td> <td>NO</td> </tr> </tbody> </table>	Parameter	Value	PROGRAM INHIBIT	NO											
Parameter	Value																
PROGRAM INHIBIT	NO																

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Step	Description	Screen / Parameters	Key Inputs																
		<table border="1"> <tr> <td>PRE-HEAT</td> <td>NO</td> </tr> <tr> <td>PULSATIONS</td> <td>1</td> </tr> <tr> <td>REPEAT MODE</td> <td>NO</td> </tr> </table>	PRE-HEAT	NO	PULSATIONS	1	REPEAT MODE	NO	Use +/- keys to alter a selected parameter										
PRE-HEAT	NO																		
PULSATIONS	1																		
REPEAT MODE	NO																		
19	Press F to return to the PROGRAM menu																		
20	Press F to return to the MAIN menu																		
21	Scroll up to the USE PROGRAM line and verify it is set to 0	<pre> <<<MAIN MENU>>> USE PROGRAM 0 </pre>																	
22	Press F to return to the STATUS SCREEN	<table border="1"> <tr> <td>Measured</td> <td>Ready</td> <td></td> <td></td> </tr> <tr> <td>Main</td> <td>-- 0 A</td> <td>prog 0</td> <td></td> </tr> <tr> <td>Current</td> <td>- 8.0 kA</td> <td>5.66 kN</td> <td></td> </tr> <tr> <td></td> <td>-- 0 A</td> <td>~30.5%</td> <td></td> </tr> </table>	Measured	Ready			Main	-- 0 A	prog 0		Current	- 8.0 kA	5.66 kN			-- 0 A	~30.5%		
Measured	Ready																		
Main	-- 0 A	prog 0																	
Current	- 8.0 kA	5.66 kN																	
	-- 0 A	~30.5%																	
23	Make a weld and compare the displayed current on the WSP3 to the weld meter																		
24	If the values do not match, navigate to the CALIBRATE CURRENT menu and change the TOROID value until the display current on the WSP3 matches the value on the Weld Current Meter	<pre> <<<MAIN MENU>>> USE PROGRAM 0 EDIT PROGRAM EDIT ELECTRODE <<<ELECTRODE MENU>>> EDIT COUNTER EDIT STEPPER CALIBRATE CURRENT <<<CURRENT CAL MENU>>> TOROID 150 mv/kA FACTOR 1 </pre>																	
25	Adjust the Sensitivity value accordingly. If the readings are not close, adjust the Sensitivity value based on the equation	$\text{Sensitivity} = (\text{Control reading} * 150) / \text{Meter Reading}$																	

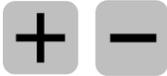
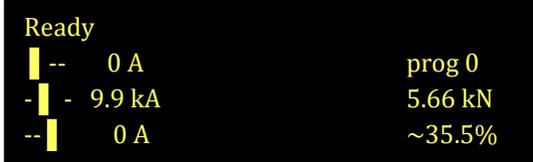
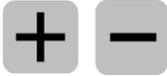
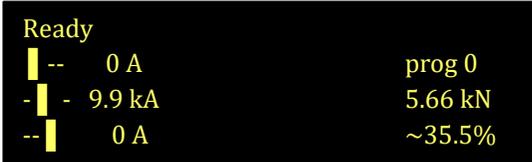
11.4.4 CCR – Constant Current Regulation

Now that the toroid (Rogowski coil) has been calibrated, the secondary current output by the control is equivalent to the actual secondary current. The EN7000v2 is now ready to use in CCR – Constant Current Regulation.

Step	Description	Screen / Parameters	Key Inputs														
1	From the Status Screen press the F key																
2	Scroll up to the EDIT PROGRAM line and press the RETURN key																
3	On the PROGRAM line use the + and – keys to select PROGRAM 0 <i>Note</i> – the program selected here will be used for the short circuit welds to calibrate the control.		 Use +/- keys to alter a selected parameter														
4	Scroll down to EDIT TIME and press the RETURN key																
5	Program the required times to make a good weld.	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>PRESQUEEZE</td> <td>0 ~</td> </tr> <tr> <td>SQUEEZE</td> <td>99 ~</td> </tr> <tr> <td>UPSLOPE</td> <td>0 ~</td> </tr> <tr> <td>MAIN HEAT</td> <td>8 ~</td> </tr> <tr> <td>DOWNSLOPE</td> <td>0 ~</td> </tr> <tr> <td>HOLD</td> <td>50 ~</td> </tr> </tbody> </table>	Parameter	Value	PRESQUEEZE	0 ~	SQUEEZE	99 ~	UPSLOPE	0 ~	MAIN HEAT	8 ~	DOWNSLOPE	0 ~	HOLD	50 ~	 Use +/- keys to alter a selected parameter
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MAIN HEAT	8 ~																
DOWNSLOPE	0 ~																
HOLD	50 ~																
6	Press F to return to the PROGRAM MENU																
7	Scroll to the EDIT CURRENT line and press the RETURN key																
8	Select MAIN: MODE PHA	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>MAIN: MODE</td> <td>PHA</td> </tr> <tr> <td>MAIN: HEAT</td> <td>20.0%</td> </tr> <tr> <td>MAIN: CURRENT</td> <td>8.00 KA</td> </tr> </tbody> </table>	Parameter	Value	MAIN: MODE	PHA	MAIN: HEAT	20.0%	MAIN: CURRENT	8.00 KA							
Parameter	Value																
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Step	Description	Screen / Parameters	Key Inputs														
9	Adjust Phase Angle PHA until a TARGET Current is reached. ie 10kA by monitoring the current on the STATUS screen.	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>MAIN: MODE</td> <td>PHA</td> </tr> <tr> <td>MAIN: HEAT</td> <td>65.0%</td> </tr> <tr> <td>MAIN: CURRENT</td> <td>10.00 KA</td> </tr> <tr> <td>MAIN: MONITOR</td> <td>NO</td> </tr> <tr> <td>LOW LIMIT</td> <td>5%</td> </tr> <tr> <td>HIGH LIMIT</td> <td>5%</td> </tr> </tbody> </table>	Parameter	Value	MAIN: MODE	PHA	MAIN: HEAT	65.0%	MAIN: CURRENT	10.00 KA	MAIN: MONITOR	NO	LOW LIMIT	5%	HIGH LIMIT	5%	
Parameter	Value																
MAIN: MODE	PHA																
MAIN: HEAT	65.0%																
MAIN: CURRENT	10.00 KA																
MAIN: MONITOR	NO																
LOW LIMIT	5%																
HIGH LIMIT	5%																
10	To monitor the result of the programmed target current return to the to the STATUS SCREEN. ** Keep adjusting PHA until the Target is reached. (9.9 kA is close enough).																
11	Select MAIN: MODE CCR	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>MAIN: MODE</td> <td>CCR</td> </tr> <tr> <td>MAIN: HEAT</td> <td>20.0%</td> </tr> <tr> <td>MAIN: CURRENT</td> <td>8.00 KA</td> </tr> <tr> <td>MAIN: MONITOR</td> <td>NO</td> </tr> <tr> <td>LOW LIMIT</td> <td>5%</td> </tr> <tr> <td>HIGH LIMIT</td> <td>5%</td> </tr> </tbody> </table>	Parameter	Value	MAIN: MODE	CCR	MAIN: HEAT	20.0%	MAIN: CURRENT	8.00 KA	MAIN: MONITOR	NO	LOW LIMIT	5%	HIGH LIMIT	5%	 <p>Use +/- keys to alter a selected parameter</p>
Parameter	Value																
MAIN: MODE	CCR																
MAIN: HEAT	20.0%																
MAIN: CURRENT	8.00 KA																
MAIN: MONITOR	NO																
LOW LIMIT	5%																
HIGH LIMIT	5%																
12	Program the required WELDING CURRENT via the MAIN: CURRENT parameter.	<table border="1"> <thead> <tr> <th>Parameter</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>MAIN: MODE</td> <td>CCR</td> </tr> <tr> <td>MAIN: HEAT</td> <td>20.0%</td> </tr> <tr> <td>MAIN: CURRENT</td> <td>10.00 KA</td> </tr> <tr> <td>MAIN: MONITOR</td> <td>NO</td> </tr> <tr> <td>LOW LIMIT</td> <td>5%</td> </tr> <tr> <td>HIGH LIMIT</td> <td>5%</td> </tr> </tbody> </table>	Parameter	Value	MAIN: MODE	CCR	MAIN: HEAT	20.0%	MAIN: CURRENT	10.00 KA	MAIN: MONITOR	NO	LOW LIMIT	5%	HIGH LIMIT	5%	 <p>Use +/- keys to alter a selected parameter</p>
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MAIN: HEAT	20.0%																
MAIN: CURRENT	10.00 KA																
MAIN: MONITOR	NO																
LOW LIMIT	5%																
HIGH LIMIT	5%																
13	To monitor the result of the programmed target current return to the to the STATUS SCREEN																

12 TERMINOLOGY

Term	Definition
Constant current	Closed loop control of weld current resulting in the weld current being regulated to a programmed value.
CT	See Current transformer.
Current transformer	A coil of wire wound on a circular core. This is used to measure the current in a cable passing through the circular core. EN7000V2 can use a CT to measure primary current.
Cool time	The time between weld pulses.
Downslope	A linear decrease in current from the Main heat value to a final value.
Downslope time	Time taken for the welding current to decrease from the Main heat value to a final value. Expressed in mains cycles.
End of sequence	An output that switches on as the electrodes open on completion of a weld. The output indicates the end of the weld sequence.
EOS	See End of sequence.
HAV	Hi-lift Air Valve. See also Retract.
Heat	A measure of power put into a phase angle controlled (non- constant current) weld. The Heat relates directly to the firing angle on the mains voltage waveform. Expressed as a percentage.
Hold	The time between the last application of current and the electrodes opening. This interval allows the molten material created by the weld process to solidify.
Hold time	The time period following the last weld pulse prior to the electrodes opening. This period allows the molten material to solidify. Expressed in mains cycles.
IP address	Internet Protocol address. A unique address used by devices on an Ethernet network.
Initiation signal	The signal that starts the weld sequence. See also Start signal
kA	Kilo amp (1000 amps).
kVA	Unit of power (1000 volt amps).
mA	Milliamp (1/1000 amp).
mV	Millivolt (1/1000 volt).
Off time	In a Repeated weld sequence this is the time between sequences. Expressed in mains cycles.
PHA	Phase angle control.
Phase angle control	Open loop control of weld current using Heat setting. This method does not use Constant Current and the current achieved can be influenced by external parameters such as mains voltage, cable lengths, etc..
Post-heat	The application of current to prevent the weld cooling too quickly.
Pre-heat	The application of current prior to welding for the purpose of burning through plating or surface contamination.
Presqueeze	The time interval in a weld sequence for the electrodes to close onto the workpiece.
Presqueeze time	The time allowed for the welding electrodes to close onto the components to be welded. Expressed in mains cycles.
Primary current	The current in the primary winding of the weld transformer which is the current drawn from the mains whilst welding.
Program select	A group of inputs representing the binary value of the weld program to be used.
Proportional valve	A device for regulating air-line pressure. Controlled by 0 to10 V dc signal.

TERMINOLOGY

Configuring & Calibrating EN7000v2 with the WSP3 Pendant

Term	Definition
Pulsations	The number of times the Main heat interval is repeated during the sequence. Successive applications of Main heat are separated by Cool2 time.
Retract	The electrodes have two open positions: fully open to move the weld gun to and from the work piece, and a working position for welding.
Retract air valve	For use on a gun where the electrodes can be opened and closed in two stages. This is an electrically operated valve for admitting air to the air cylinder that controls the electrode movement.
2nd stage	A signal required to allow the weld sequence to proceed.
Secondary current	The current in the secondary winding of the weld transformer which is the weld current.
Squeeze	The time interval in a weld sequence for the electrodes to exert full welding force on the work piece.
Squeeze time	The time allowed for the welding electrodes to build up full pressure on the components to be welded. Expressed in mains cycles.
Start signal	The signal that starts the weld sequence.
Stepper	A program of parameters required for stepping.
Stepping	A technique of progressively increasing the weld current over the course of a large number of welds in order to compensate for the effects of electrode wear.
Thermostat	A switch device that operates at a certain temperature.
Tip dress acknowledge	An input to acknowledge that the electrodes have been dressed.
Tip dress request	An output to indicate that the electrodes require dressing.
Tip dressing	Filing or machining worn electrodes to restore their original shape and dimensions.
Toroid	A device used for sensing current in a cable. The current carrying cable must pass through the toroid. The toroid used for EN7000V2 weld controls is a Rogowski coil.
Upslope	A linear increase in current from an initial value to the Main heat value.
Upslope time	Time taken for current to increase from an initial value to the Main heat value. Expressed in mains cycles.
VA	Volt amp
WAV	See Weld air valve.
Weld air valve	Electrically controlled valve for admitting air to the air cylinder responsible for forcing the weld electrodes together.
Weld current	High current passed from one electrode to the other, through the components being welded. The current must be large enough to generate sufficient heat to melt the metal and produce a weld.
Weld transformer	Electrical component for converting mains voltage input to low voltage, high current output.

13 ADDITIONAL WIRING DIAGRAMS

The additional wiring diagrams for standard products are found in this section. The complete list of part numbers and corresponding wiring diagrams can be found in [Table 6: Standard Product Wiring Diagram List by Part Number](#).

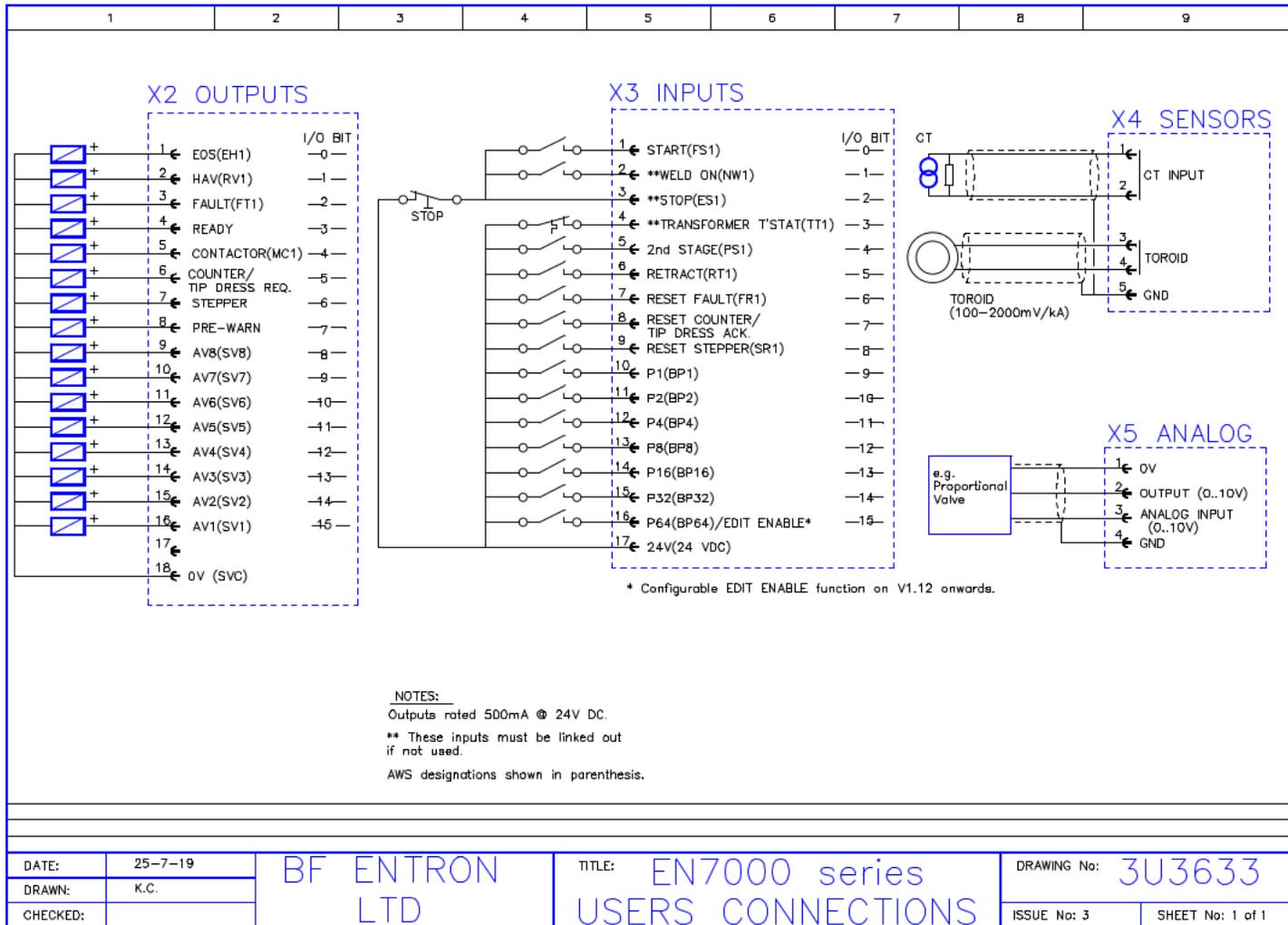


DOCUMENTATION REQUEST

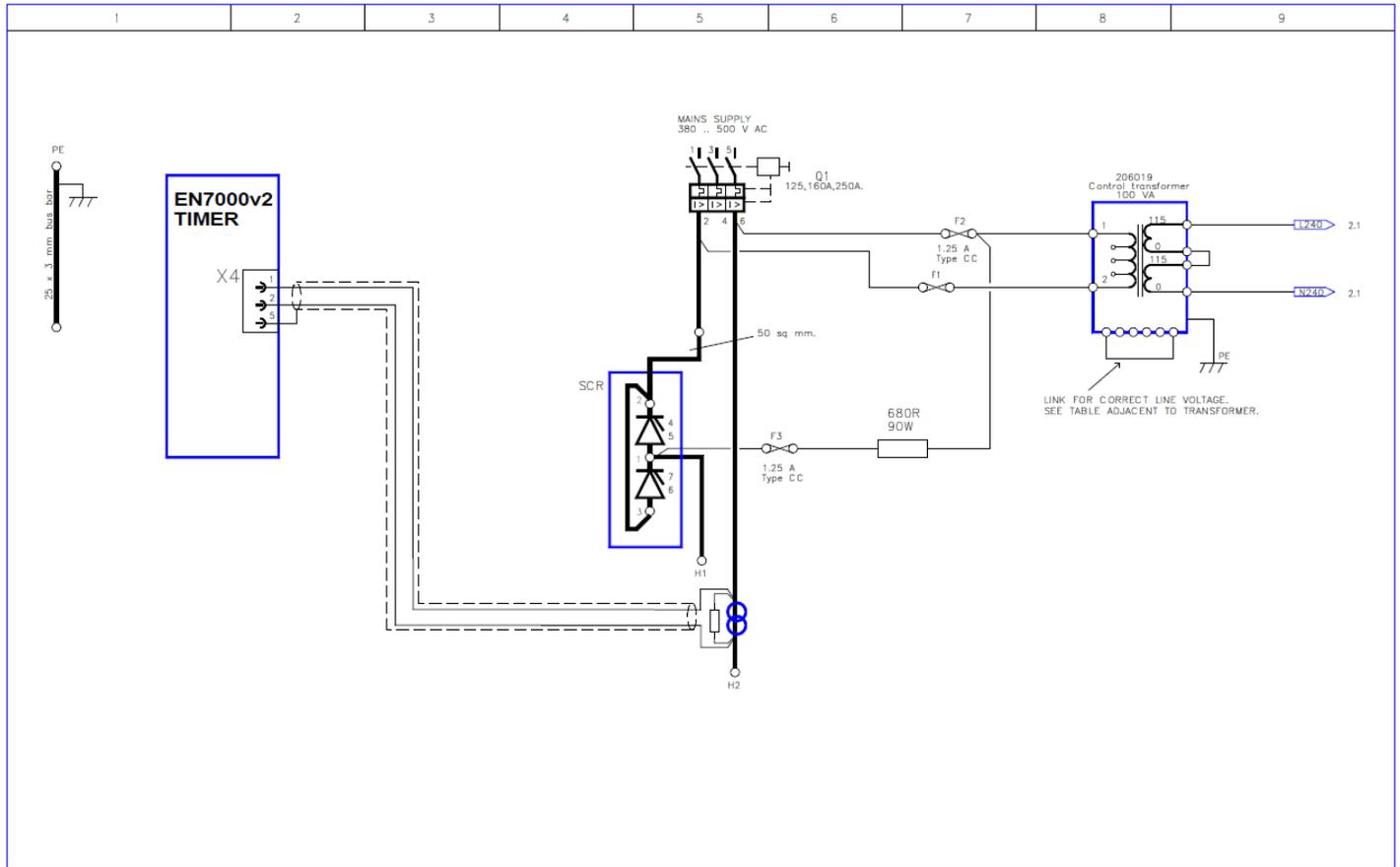
If your part number is not defined in [Table 6](#), please email ENTRON at customerservice@entroncontrols.com to request the drawing for your product. Please include the following in your request: **your name, company name, part number, and product serial number**.

You can also visit www.entroncontrols.com/resources/entron-library.html for pdf versions of the wiring diagrams.

13.1 Customer Connections Diagram (3U3633)



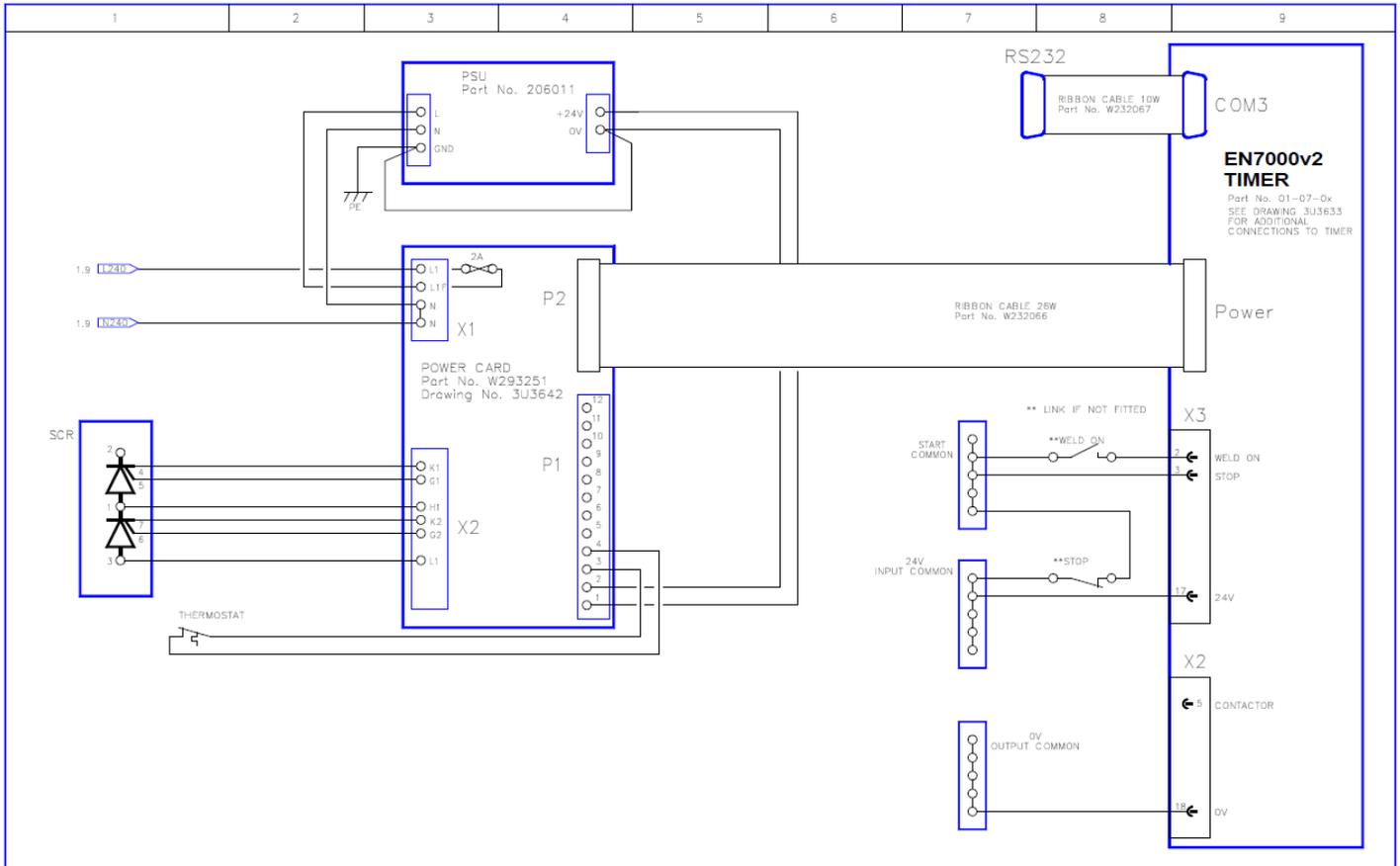
13.2 3U3740



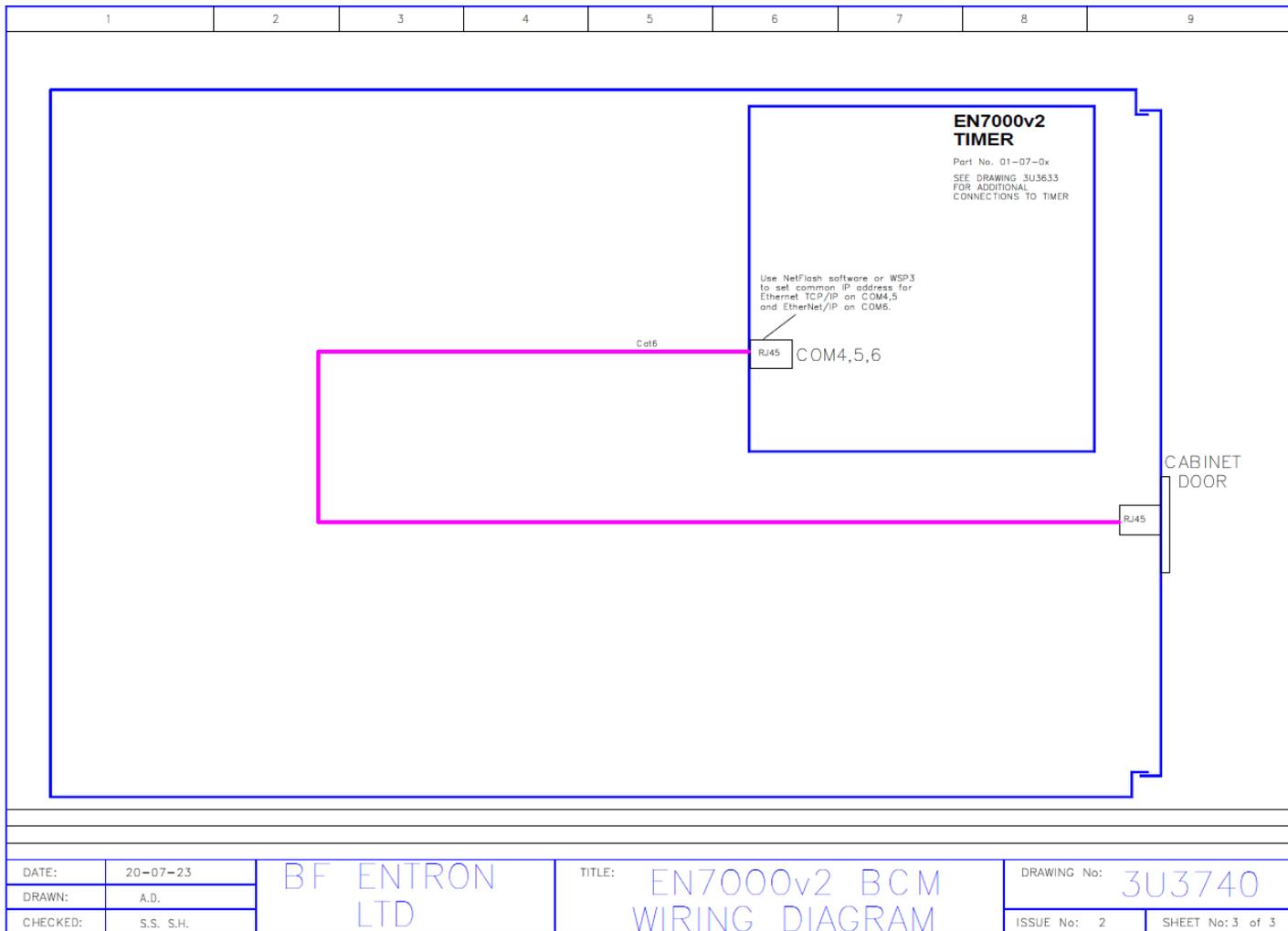
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CHECKED:	S.S. S.H.					

ADDITIONAL WIRING DIAGRAMS

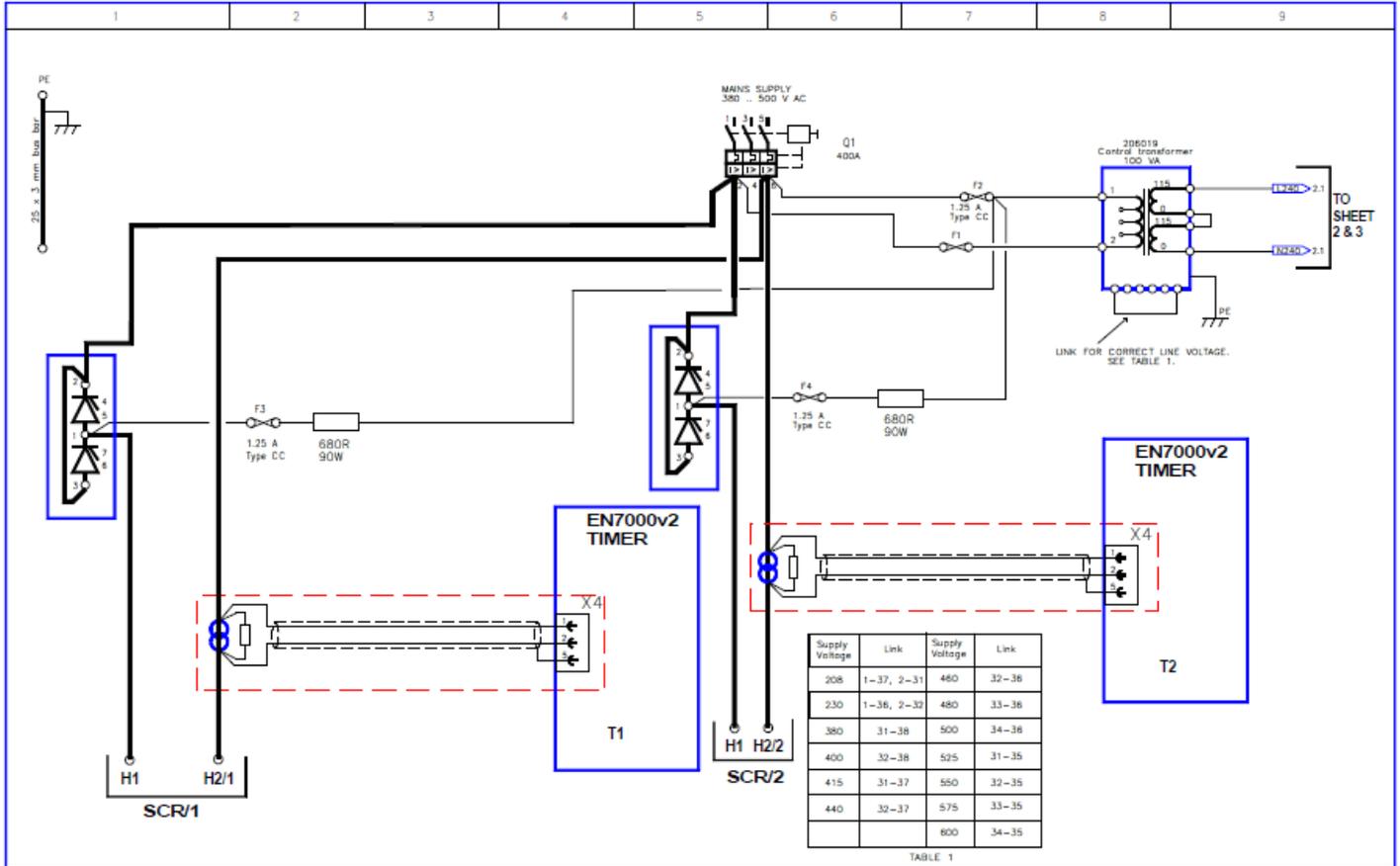
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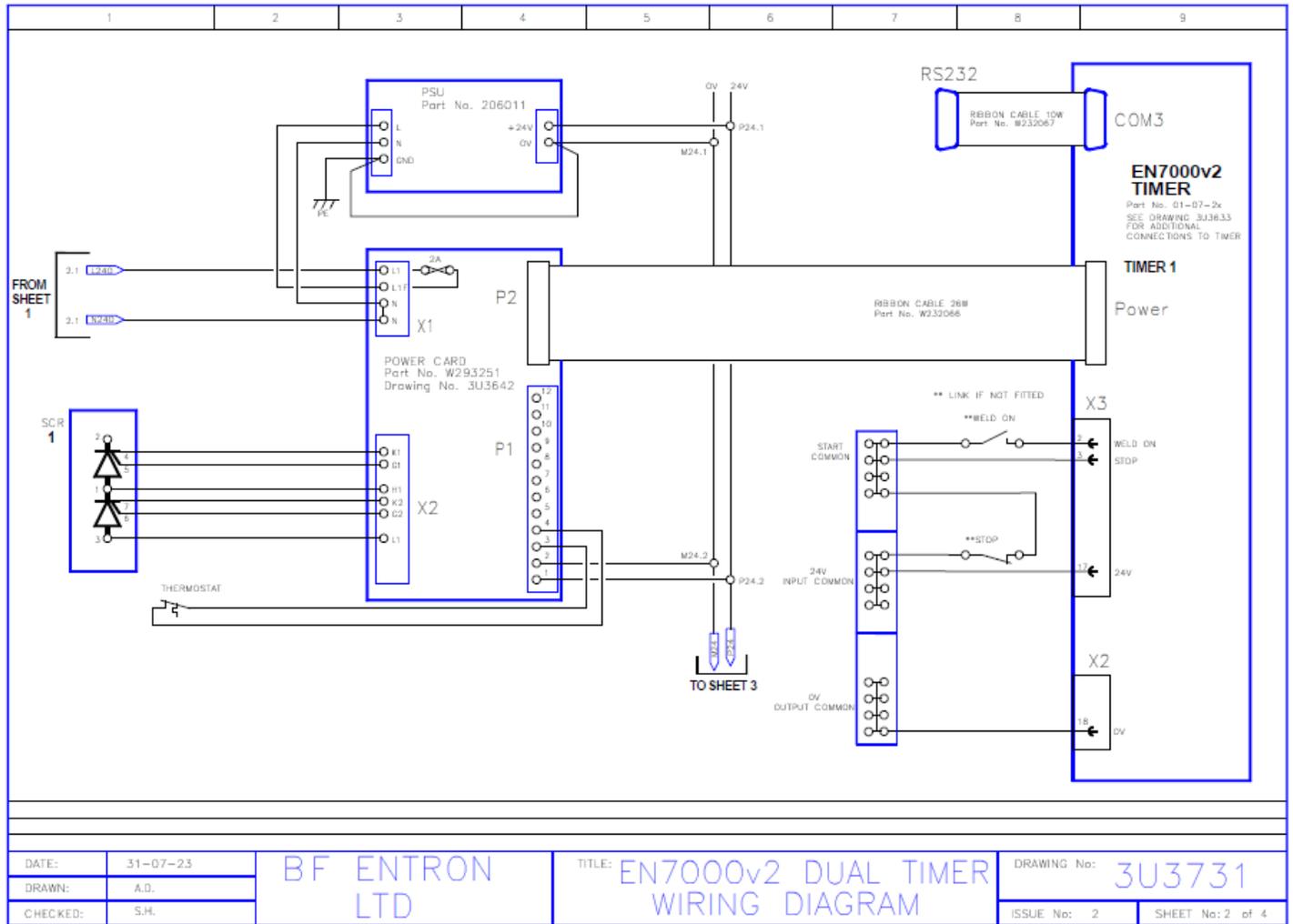
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CHECKED:	S.S. S.H.				



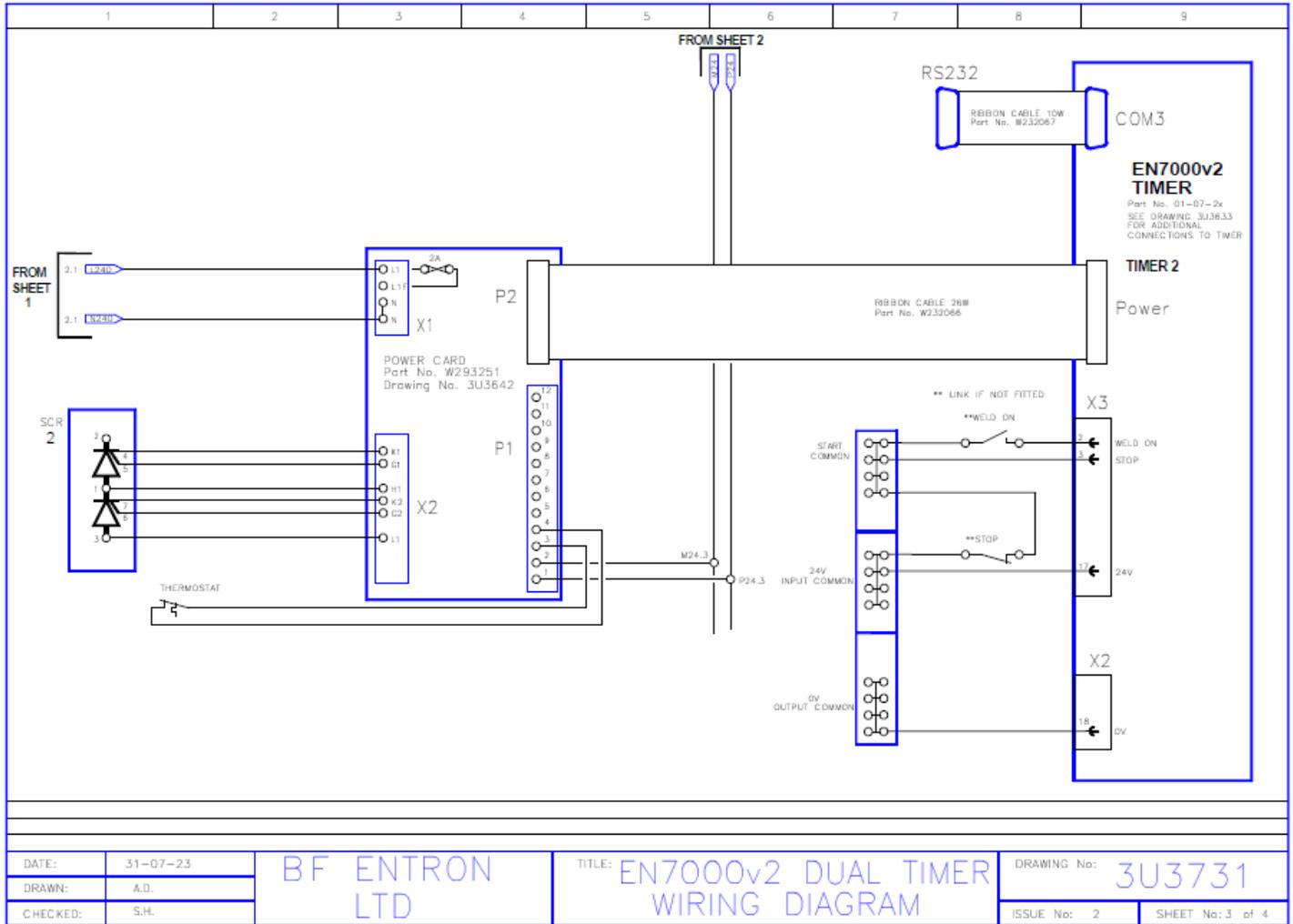
13.3 3U3731



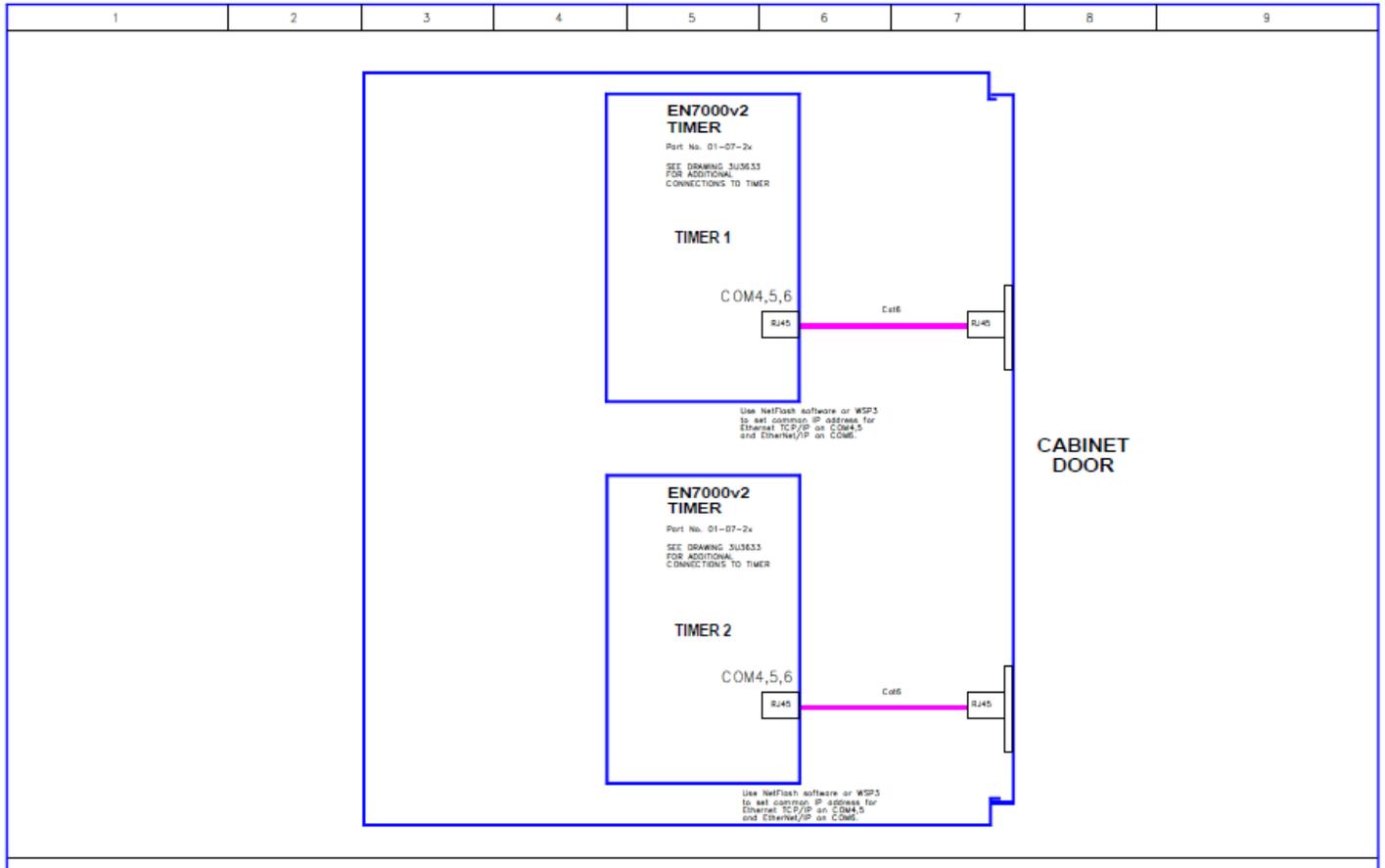
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DRAWN:	A.D.			ISSUE No:	2	SHEET No:	1 of 4
CHECKED:	S.H.						



DATE:	31-07-23	BF ENTRON LTD	TITLE: EN7000v2 DUAL TIMER WIRING DIAGRAM	DRAWING No: 3U3731		
DRAWN:	A.D.			ISSUE No: 2	SHEET No: 2 of 4	
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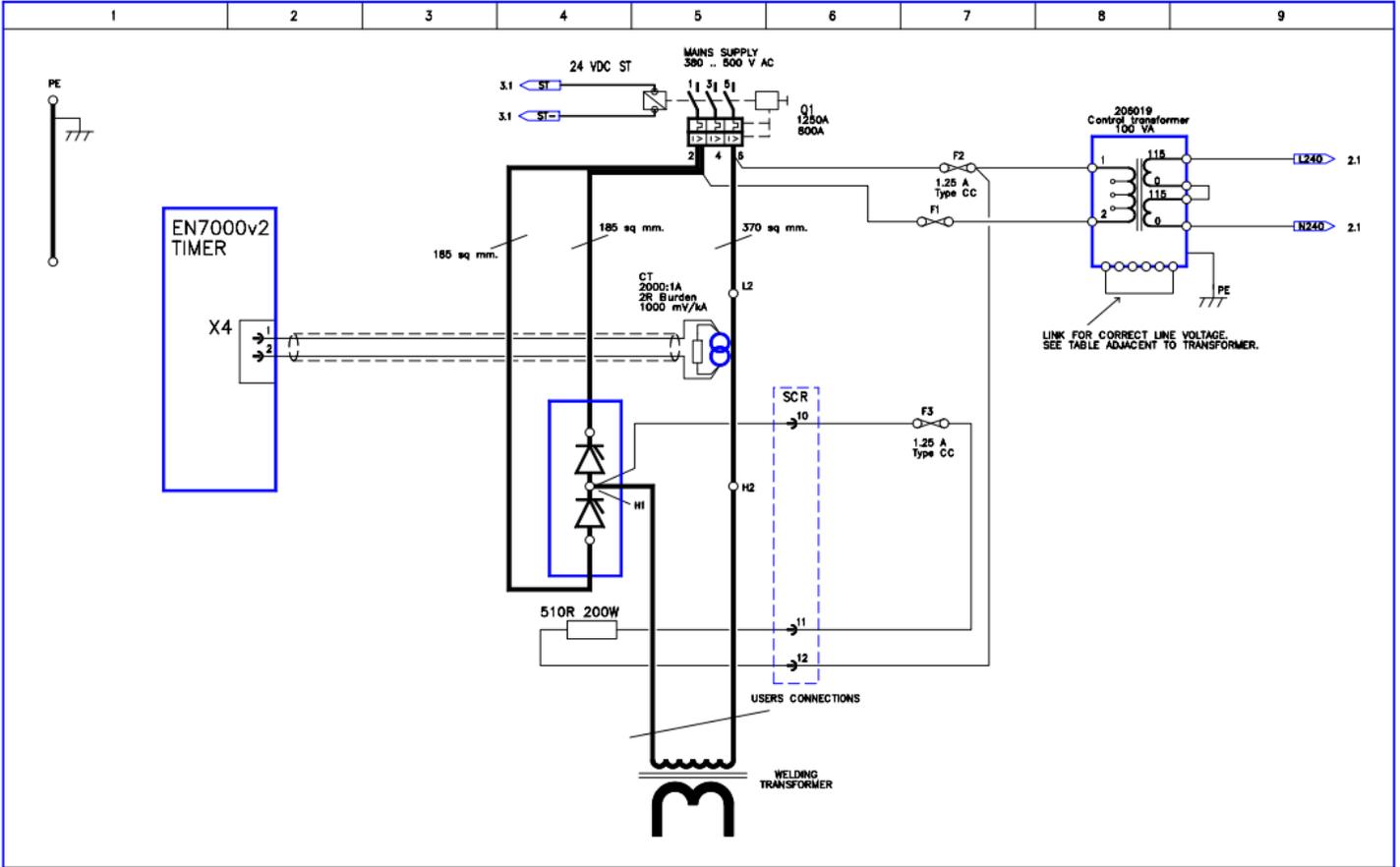


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CHECKED:	S.H.					



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CHECKED:	S.H.					

13.4 3U3743

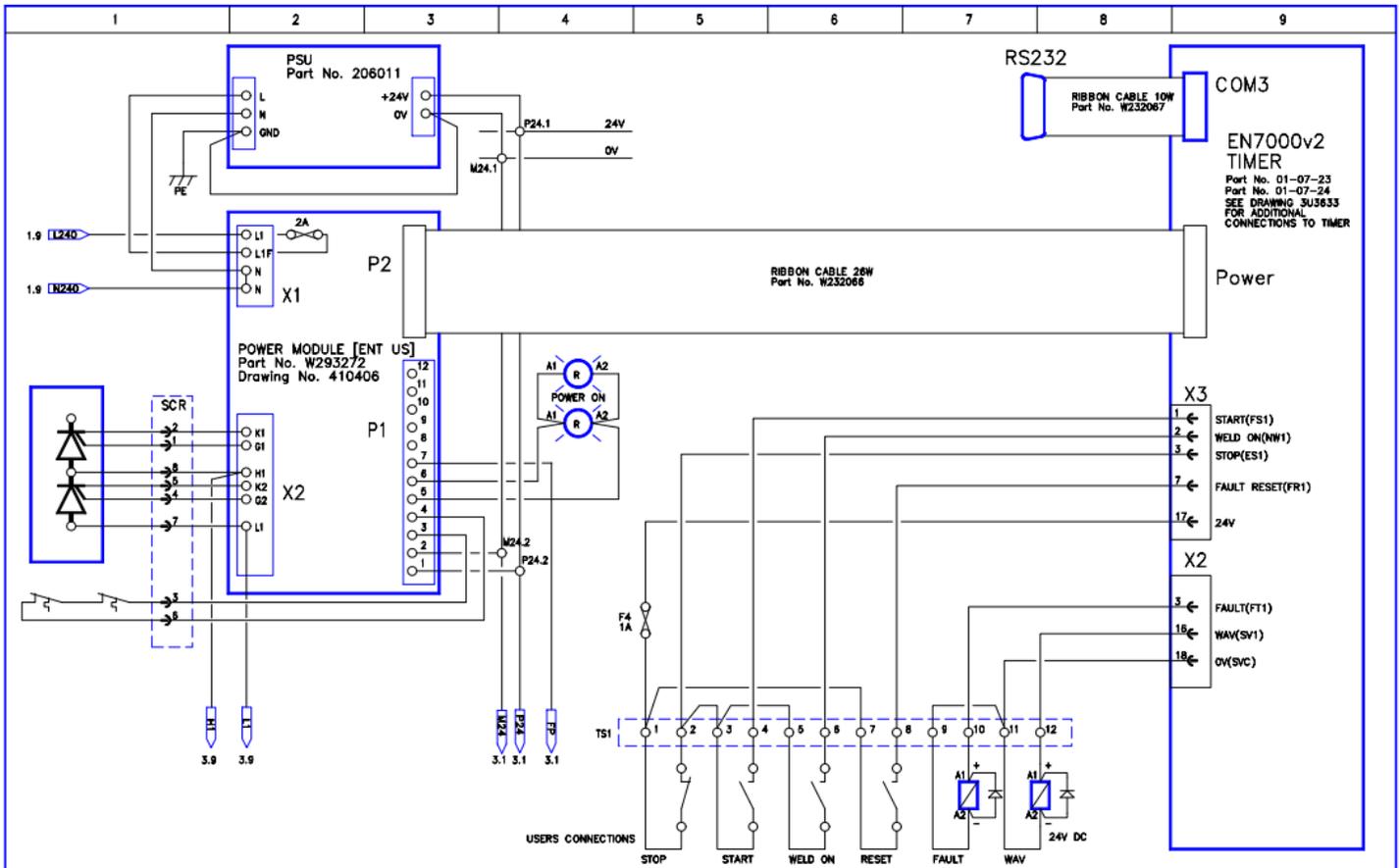


Note: REV 1 BUILD

DATE:	02-FEB-2023	BF ENTRON LTD	TITLE:	EN7000v2 TC2000/ TC3000 WIRING DIAGRAM WITH POWER BOARD ENT US	DRAWING No:	3U3743
DRAWN:	A.D.		ISSUE No:	1	SHEET No:	1 of 4
CHECKED:	S.H. S.S.					

ADDITIONAL WIRING DIAGRAMS

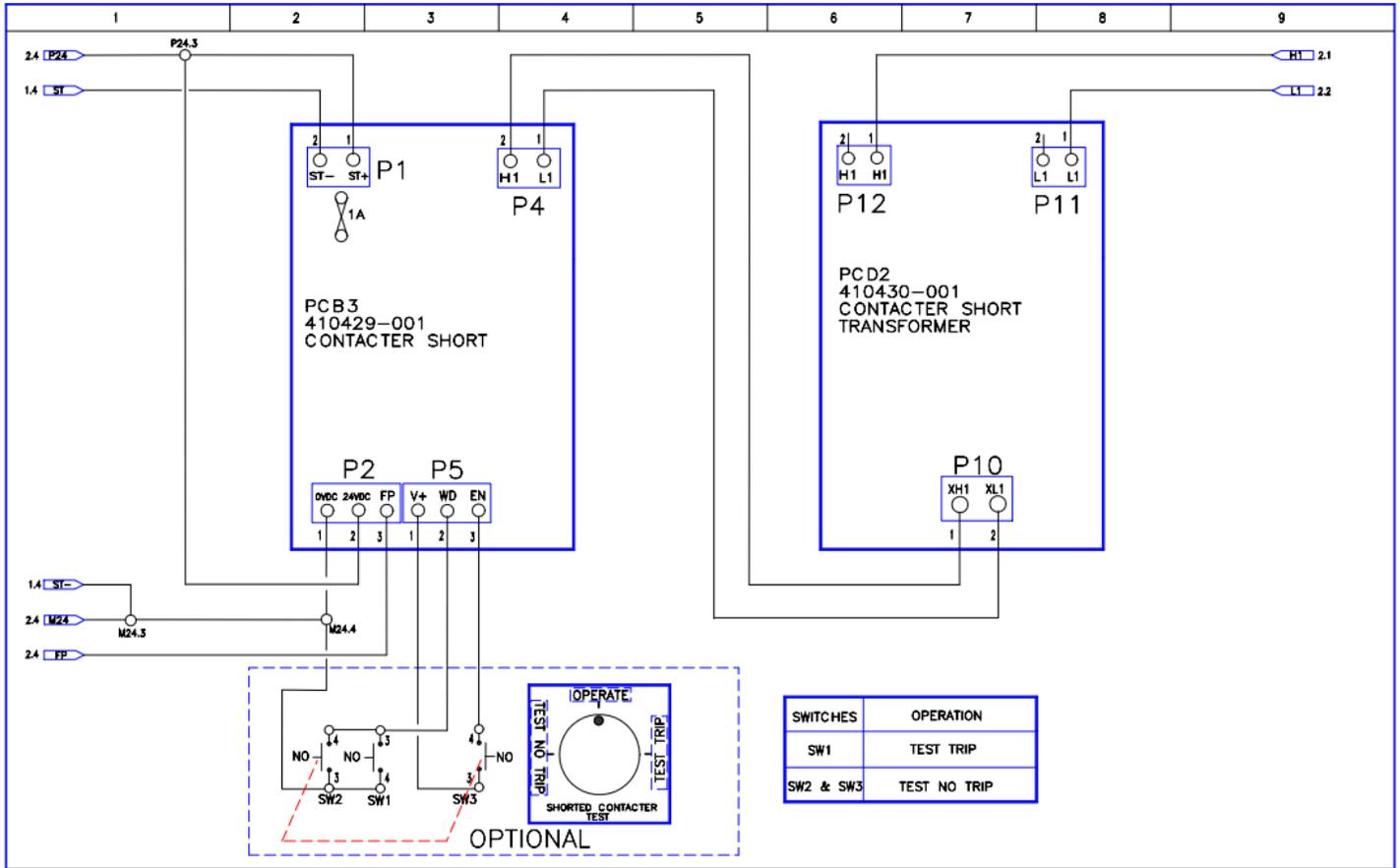
3U3743



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DRAWN:	A.D.			ISSUE No:	1	SHEET No: 2 of 4
CHECKED:	S.H. S.S.					

ADDITIONAL WIRING DIAGRAMS

3U3743

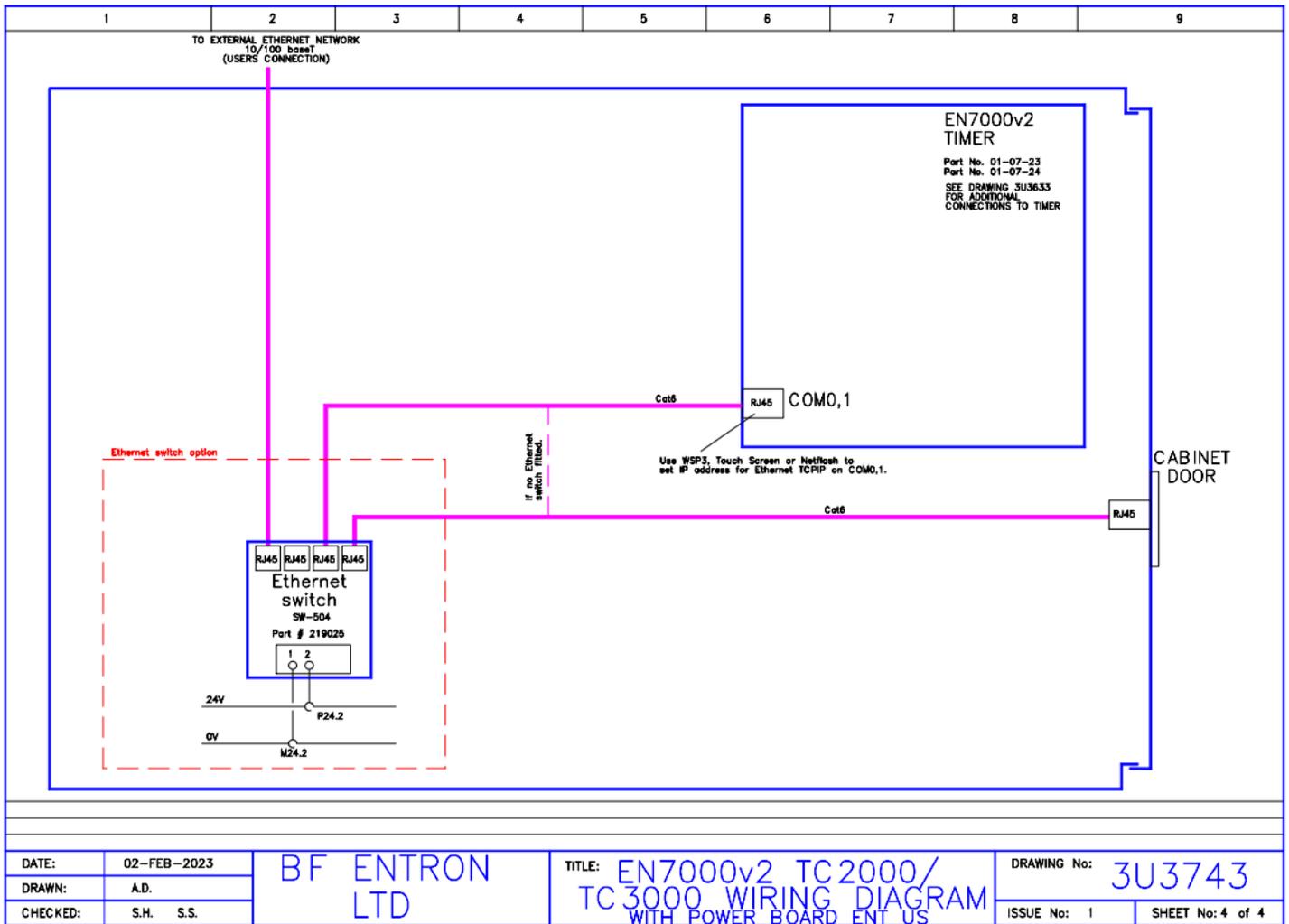


SWITCHES	OPERATION
SW1	TEST TRIP
SW2 & SW3	TEST NO TRIP

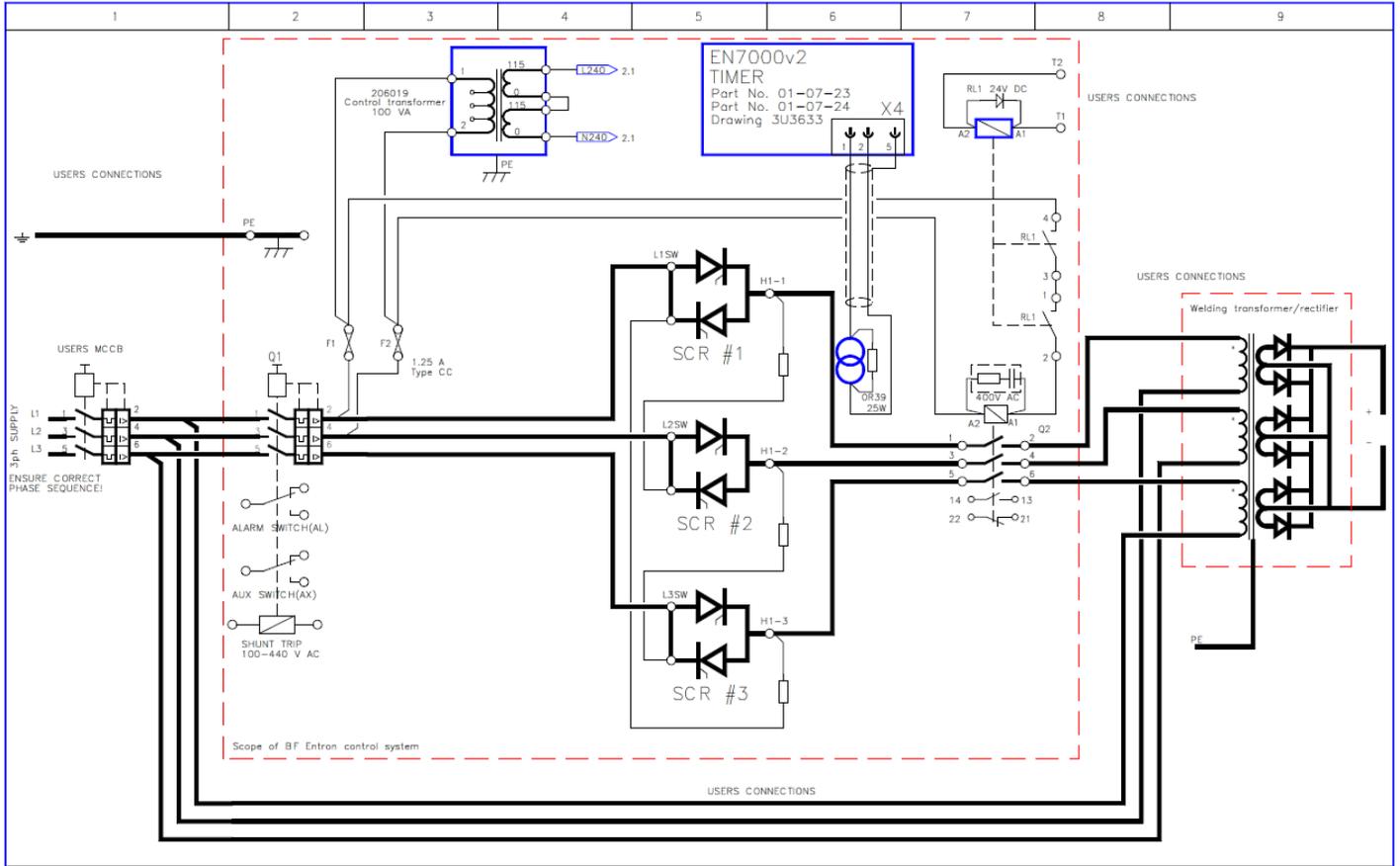
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DRAWN:	A.D.			ISSUE No:	1	SHEET No: 3 of 4
CHECKED:	S.H. S.S.					

ADDITIONAL WIRING DIAGRAMS

3U3743



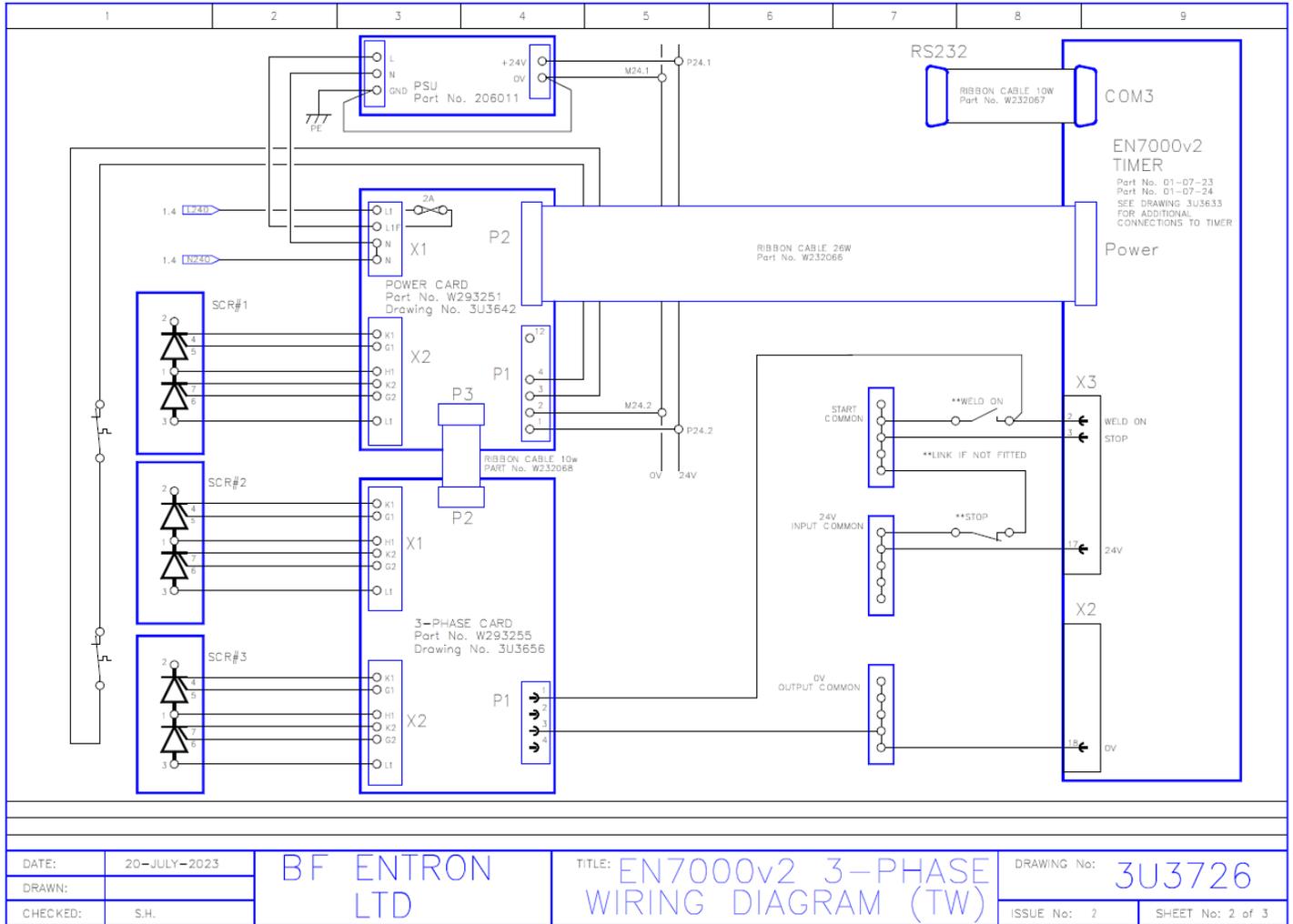
13.5 3U3726



DATE:	20-JUL-2023	BF ENTRON LTD	TITLE: EN7000v2 3-PHASE WIRING DIAGRAM (TW)	DRAWING No:	3U3726	
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CHECKED:	S.H.					

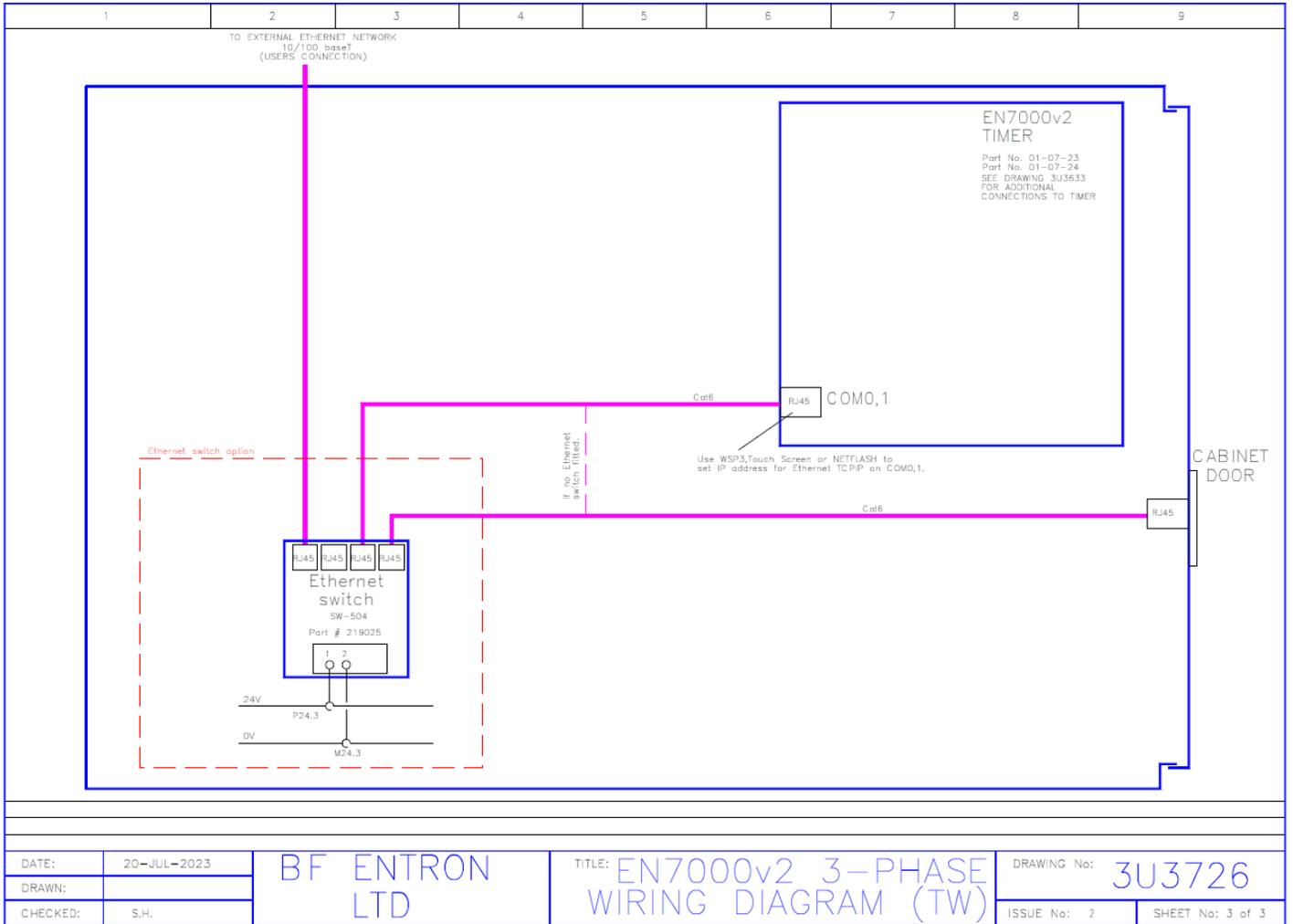
ADDITIONAL WIRING DIAGRAMS

3U3726

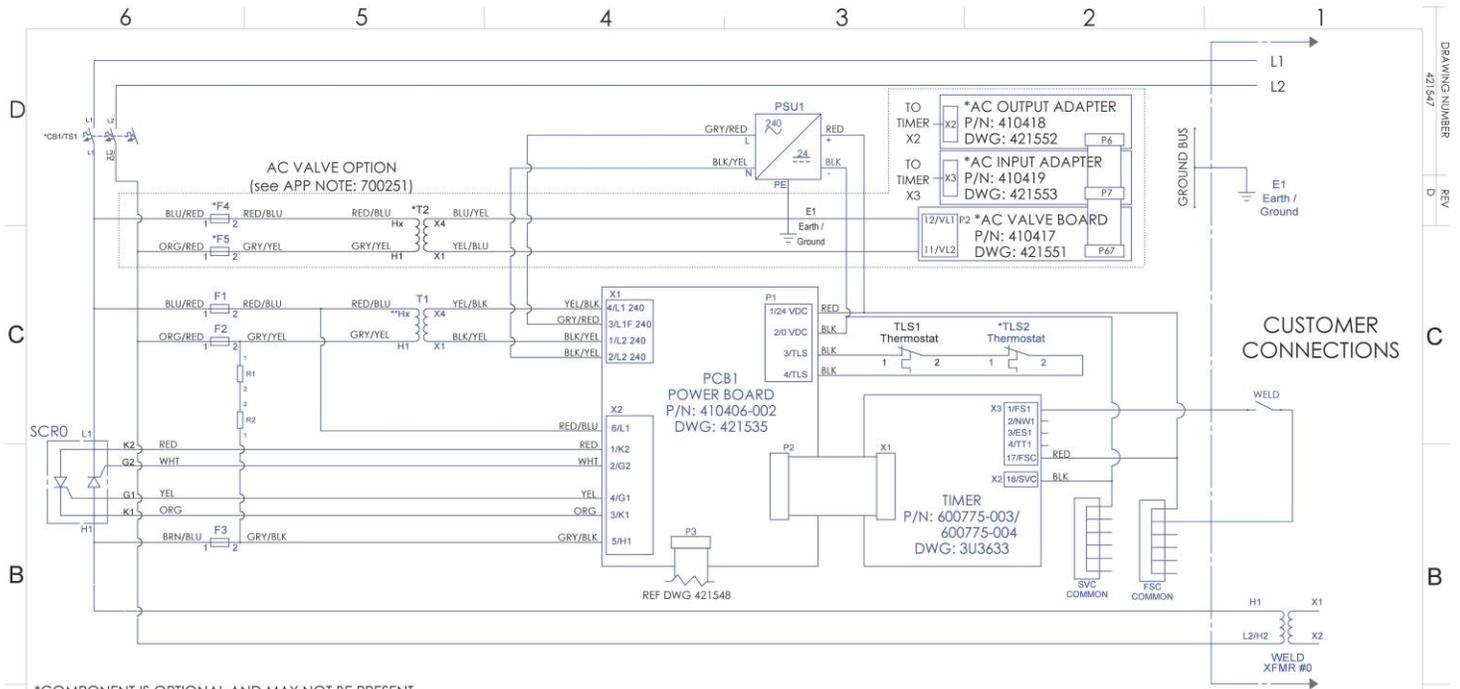


ADDITIONAL WIRING DIAGRAMS

3U3726

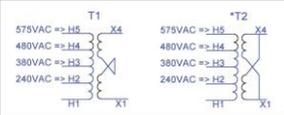


13.6 421547



*COMPONENT IS OPTIONAL AND MAY NOT BE PRESENT
 ** SEE IMAGE 1: T1 SECONDARY VOLTAGE SHOULD NOT EXCEED 264VAC; IF LINE VOLTAGE DOES NOT MATCH ANY OPTIONS IN IMAGE 1, SELECT THE NEXT HIGHER VALUE.

**IMAGE 1: CONTROL CONFIGURATION FOR LINE VOLTAGE



COMPONENT	VALUE / ATING
F1	1.25A@600VAC CLASS CC
F2	1.25A@600VAC CLASS CC
F3	1.25A@600VAC CLASS CC
*F4	1.25A@600VAC CLASS CC
*F5	1.25A@600VAC CLASS CC
R2 / *R2-HWR	500Ω@100w / 90Ω@680W
R1 / *R1-HWR	500Ω@100W / 90Ω@680W

TEST POINT 1	TEST POINT 2	VOLTAGE
T1-H1	T1-**Hx	AC LINE VOLTAGE
PCB1-X1-2	PCB1-X1-4	220-264 VAC
*PCB2-P2-12	*PCB2-P2-11	110-120VAC
SCRO-L1	SCRO-H1	AC LINE VOLTAGE
PSU1 -	PSU1 +	24VDC

ENTRON

DRAWN BY	DATE	CHECKED BY	DATE
EJP	12/21/2021		
TOLERANCE	SCALE	DESCRIPTION	
ANGLES: ±1/2°	None	EN7000v2 WIRING DIAGRAM USA	
DECIMALS: ±.010			
FRACTIONS: ±1/64			
SHEET NUMBER	DRAWING NUMBER	REV	
1 OF 1	421547	E	

DRAWING NUMBER: 421547
REV: D
C
B
A



13.7 421548

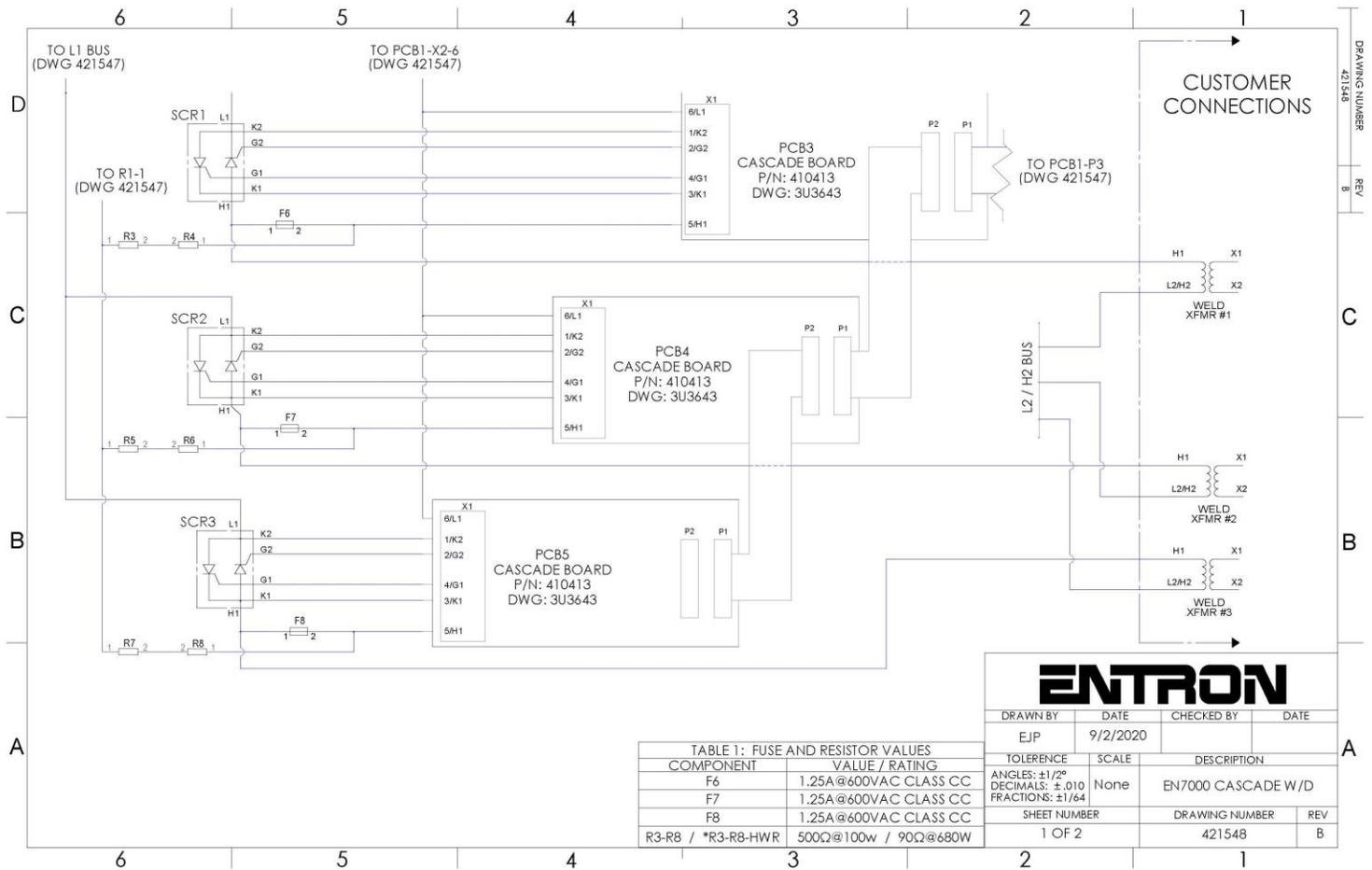


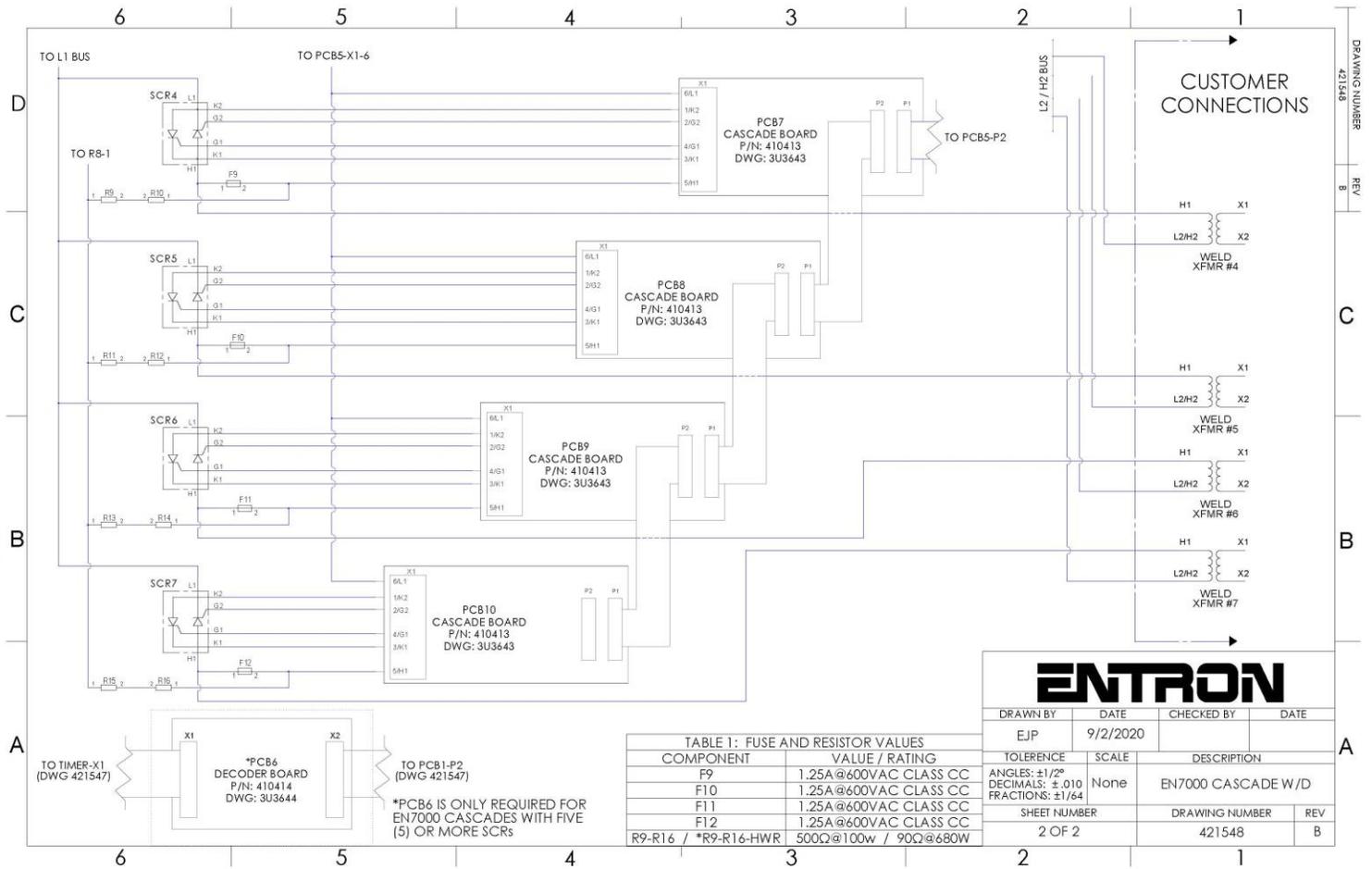
TABLE 1: FUSE AND RESISTOR VALUES

COMPONENT	VALUE / RATING
F6	1.25A @600VAC CLASS CC
F7	1.25A @600VAC CLASS CC
F8	1.25A @600VAC CLASS CC
R3-R8 / *R3-R8-HWR	500Ω@100w / 90Ω@680W

ENTRON

DRAWN BY	DATE	CHECKED BY	DATE
EJP	9/2/2020		
TOLERANCE	SCALE	DESCRIPTION	
ANGLES: ±1/2° DECIMALS: ±.010 FRACTIONS: ±1/64	None	EN7000 CASCADE W/D	
SHEET NUMBER	DRAWING NUMBER	REV	
1 OF 2	421548	B	

DRAWING NUMBER: 421548
REV: B



ENTRON

DRAWN BY	DATE	CHECKED BY	DATE
EJP	9/2/2020		
TOLERANCE	SCALE	DESCRIPTION	
ANGLES: ±1/2°	None	EN7000 CASCADE W/D	
DECIMALS: ±.010		SHEET NUMBER	DRAWING NUMBER
FRACTIONS: ±1/64		2 OF 2	421548
			REV
			B

TABLE 1: FUSE AND RESISTOR VALUES

COMPONENT	VALUE / RATING
F9	1.25A@600VAC CLASS CC
F10	1.25A@600VAC CLASS CC
F11	1.25A@600VAC CLASS CC
F12	1.25A@600VAC CLASS CC
R9-R16 / *R9-R16-HWR	500Ω@100w / 90Ω@680W

*PCB6 IS ONLY REQUIRED FOR EN7000 CASCADES WITH FIVE (5) OR MORE SCRS