Technical Information

PLUS+1® HMI Peripherals
HMR CAN Rotary Input Device

Revision history   *Table of revisions*

Date	Changed	Rev
April 2019	Corrected pin connector name to DEUTSCH DT04-4 pin connector	0104
July 2018	Corrected reference literature titles	0103
June 2018	Corrected title	0102
June 2018	First edition	0101

Contents

HMR literature references

Reference literature

Literature title	Literature type	Literature number
PLUS+1® HMI Peripherals — HMR CAN Rotary Input Device	Technical Information	BC00000397
PLUS+1® HMI Peripherals — HMR CAN Rotary Input Device	Data Sheet	AI00000327
PLUS+1® GUIDE Software	User Manual	AQ00000026

Technical Information (TI)

A TI is comprehensive information for engineering and service personnel to reference.

Data Sheet (DS)

A DS is summarized information and parameters that are unique to a specific model.

API Specifications (API)

An API is specifications for programming variable settings.

API specifications are the definitive source of information regarding pin characteristics.

PLUS+1® GUIDE User Manual

The Operation Manual (OM) details information regarding the PLUS+1® GUIDE tool used in building PLUS+1® applications. This OM covers the following broad topics:

- How to use the PLUS+1® GUIDE graphical application development tool to create machine applications
- How to configure module input and output parameters
- How to download PLUS+1® GUIDE applications to target PLUS+1® hardware modules
- How to upload and download tuning parameters
- How to use the PLUS+1® Service Tool

Latest version of technical literature

Comprehensive technical literature is online at *www.danfoss.com*

User liability and safety statements

OEM responsibility

The OEM of a machine or vehicle in which Danfoss products are installed has the full responsibility for all consequences that might occur. Danfoss has no responsibility for any consequences, direct or indirect, caused by failures or malfunctions.

- Danfoss has no responsibility for any accidents caused by incorrectly mounted or maintained equipment.
- Danfoss does not assume any responsibility for Danfoss products being incorrectly applied or the system being programmed in a manner that jeopardizes safety.
- All safety critical systems shall include an emergency stop to switch off the main supply voltage for the outputs of the electronic control system. All safety critical components shall be installed in such a way that the main supply voltage can be switched off at any time. The emergency stop must be easily accessible to the operator.

Overview

HMR CAN Rotary Input Device

The HMR CAN Rotary Input Device brings screen navigation closer to the operator, allowing "blind operation" and minimizing the need to reach for buttons/dials/touch-screen on the display during operation. The back-lit buttons can be used as hot keys to quickly navigate to a screen or used for machine functions, while the indicator bars on each button provide optical feedback to the operator

The HMR has been optimized for ergonomic, five finger control. The seven large buttons are available with standard icons, or customizable to meet application needs. Each button features RGB LEDs for backlight and light bars that are controllable via CAN messaging, with adjustable light intensity. The rotary knob encompasses an eighth push button and includes RGB LED lighting at the base.

The HMR features robust mechanical, electrical, and Ingress Protection specifications that meet the demands of mobile machine operation. It is suitable for installation in open and enclosed cabs.

Features

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Ordering information

Model variants

Part number	Order code	Description
11217428	HMR-111-00-1-0-0-0-0	HMR, No Graphics, LED Indicators
11202900	HMR-111-00-1-0-1-0-0	HMR, Number Graphics, LED Indicators
11202899	HMR-111-00-1-0-2-0-0	HMR, Navigation Graphics, LED Indicators
11217427	HMR-111-00-1-1-1-0-0	HMR, Number Graphics, LED Indicators, Danfoss Logo
11217426	HMR-111-00-1-1-2-0-0	HMR, Navigation Graphics, LED Indicators, Danfoss Logo

Model code

A			B			C		D	E	F	G	H
H	M	R										

Model code key

A—Model name	Description
HMR	HMR CAN Rotary Input Device, PLUS+1® HMI Peripherals

B—LED lights	Description
111	Indicator bar, back-light, and knob LEDs (RGB)

C—PCBA / Special features	Description
00	HMR, version 0

D—Rotary knob configuration	Description
1	Standard ring-style knob

E—Knob logo	Description
0	No logo
1	Danfoss logo
2	Generic **Your Logo Here** logo
9	Custom logo

F—Button graphic configuration	Description
0	No graphics (blank)
1	Number graphics
2	Navigation graphics
8	ISO graphics
9	Custom graphics

G—Special features (software)	Description
0	No special software features
9	Custom configuration file

H—Hand-rest option	Description
0	No hand-rest
9	Custom hand-rest

Ordering information

Related products

4 pin mating connector	Part number
DEUTSCH 4 PIN Connector Kit	11028348

Product ratings

Electronic components environmental testing

Climate environment

Description	Applicable standard	Comment
Storage temperature	IEC 60068-2-1, test Ab, IEC 60068-2-2 test Bb	
Operating temperature	IEC 60068-2-1, test Ab, IEC 60068-2-2 test Bd	
Thermal cycle	IEC 60068-2-2, test Na, IEC 60068-2-38 (partial)	
Humidity	IEC 60068-2-78, IEC 60068-2-30 test Db	Damp heat steady state and cyclic.
Degree of protection	IEC 60529	

Chemical environment

Description	Applicable standard	Comment
Salt mist	IEC 60068-2-58 test Kb	
Chemical resistance	ISO 16750-5	

Mechanical environment

Description	Applicable standard	Comment
Vibration	IEC 60068-2-6 test Fc, IEC6008-2-64 test Fh	
Bump	IEC 60068-2-29 test Eb	
Shock	IEC 60068-2-27 test Ea	
Free fall	IEC 60068-2-32 test Ed	

Electrical/electromagnetic

Description	Applicable standard	Comment
EMC emission	ISO 13766, SAE J1113-13	Electromagnetic compatibility for earth moving machinery.
EMC immunity	ISO 13766	Electromagnetic compatibility for earth moving machinery.
Electrostatic discharge	EN 60-1 000-4-2	
Auto electrical transients	ISO 7637-2, ISO 7637-3	
Short circuit protection	Danfoss test	Inputs and outputs survive continuous short circuit. Normal function resumes when short is removed.
Reversed polarity protection	Danfoss test	Survives reverse polarity at supply voltage for at least five minutes.

Product ratings

Specifications

Characteristics

Processor	ARM Cortex M3, 32 bit, 120 MHz
RAM	64 kB
EEPROM	32 kB
Supply voltage	9 to 36 V_{DC}
Connector	DEUTSCH DT-4
IP rating (with mating connector attached)	IP66 and IP67
Operating temperature	-40℃ to +85℃ [-40°F to 185°F]
Storage temperature	-40℃ to +85℃ [-40°F to 185°F]
Weight	0.159 kg [0.351 lb]
Vibration/Shock	IEC 60068-2-64 (7.67g) /2-27 (50g)
EMI/RFI rating	100 V/M
Humidity	IEC 60068-2-78, 60068-2-30
Transients	ISO 7637/1, 2, 3
Button Cycle Life	1 Million Cycles
Rotary Dial Cycle Life	1 Million Cycles

Ingress Protection (IP) rating

HMR CAN Rotary Input Device carries a full Ingress Protection rating of IP 67.

Color and command options

The HMR offers various color and command option for application specific customization.

- Each of the buttons has 2 Indicator LEDs located on the edge of the unit. Each one of these has an Enable signal - they share the RGB signals.
- Each of the buttons has 2 backlight LEDs paired together sharing the RGB signals.
- The rotary encoder has a group of 6 backlights that can be configured.

Indicator and backlight color options

Indicator default colors

Index	Default color	R	G	B
0	Green	0	0xFFFF	0
1	Yellow	0xFFFF	0xFFFF	0
2	Red	0xFFFF	0	0
3	White	0xFFFF	0xFFFF	0xFFFF
4	Cyan	0	0xFFFF	0xFFFF
5	Blue	0	0	0xFFFF
6	Magenta	0xFFFF	0	0xFFFF
7	Black	0	0	0
8	Dark Blue	0x1919	0x1919	0x7070
9	Purple	0x5454	0x1919	0x6D6D
10	Amber	0xFFFF	0xBFBF	0
11	Maroon	0xFFFF	0xCCCC	0x3333
12	Teal	0x3838	0x8E8E	0x8E8E
13	Light Blue	0x8787	0xCECE	0xFAFA
14	Dark Green	0	0x6464	0
15	Light Green	0x3C3C	0xB3B3	0x7171

Backlight default colors

Index	Default color	R	G	B
0	White	0xFFFF	0xFFFF	0xFFFF
1	Green	0	0xFFFF	0
2	Red	0xFFFF	0	0
3	Blue	0	0	0xFFFF
4	Cyan	0	0xFFFF	0xFFFF
5	Yellow	0xFFFF	0xFFFF	0
6	Magenta	0xFFFF	0	0xFFFF
7	Black	0	0	0
8	Dark Blue	0x1919	0x1919	0x7070
9	Purple	0x5454	0x1919	0x6D6D
10	Amber	0xFFFF	0xBFBF	0
11	Maroon	0xFFFF	0xCCCC	0x3333
12	Teal	0x3838	0x8E8E	0x8E8E
13	Light Blue	0x8787	0xCECE	0xFAFA
14	Dark Green	0	0x6464	0
15	Light Green	0x3C3C	0xB3B3	0x7171

Color and command options

Indicator and backlight command options

Mode	Allowed speeds	Allowed phases
Off	N/A	N/A
On	N/A	N/A
Flashing	Low Medium High	Normal Inverted
Breathing	Low Medium High	Normal Inverted

CAN messaging protocol

J1939

The system supports various types of J1939 messaging, using J1939 compliant baud rates in the following ranges.

Description	Unit	Minimum	Maximum	Typical	Comment
Available Baud rates	kbps			50	The default baud rate is 250 kbit.
				100	
				125	
				250	
				500	
				1000	

The system performs an address claim per J1939-73 and provide programmable name for various fields in address claim.

Programmable name for various fields

Name field	Default	Customer configurable	Comment
ECU Instance	1	Yes	
Function Instance	0	Yes	
Function	135	Yes	Keypad
Vehicle System	0	Yes	Non-specific
Vehicle System Instance	1	Yes	
Industry Group	0	Yes	Global

CAN messaging protocol

HMR transmitted Message Structure

The system default shall utilize a standard AUXIO1 message from J1939-71 to send the button and encoder status.

DiffCount Differential count provides the count of rotary ticks since the last message. Turning clockwise provides positive incrementation, counter-clockwise negative.

AbsCount Absolute count, since power up, tracks between start value and max value. If rollover is enabled, AbsCount keeps track of counts until a max value is reached then rolls over to start value if turning clockwise. As well as, rolls over from start value to max value if turning counter-clockwise. Turning clockwise provides positive measurements, counter-clockwise negative.

Byte 0		Byte 1		Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Bit 0 - 1	Button 4*	Bit 0 - 1	Encoder Button*	Reserved	Reserved	DiffCount LSB	DiffCount MSB	AbsCount LSB	AbsCount MSB
Bit 2 - 3	Button 3*	Bit 2 - 3	Button 7*						
Bit 4 - 5	Button 2*	Bit 4 - 5	Button 6*						
Bit 6 - 7	Button 1*	Bit 6 - 7	Button 5*						

* States for buttons:

   0 - Off

   1 - On

   2 - Error

   3 - Not applicable

HMR configuration Message Structure

The system shall receive the AUXIO2 message from J1939-71 that contains the LED control data for all 7 buttons and rotary encoder, message only allows for 3 colors choices and 1 blink rate of medium. This is the generic configuration.

Allowed colors	Index 0	Index 1	Index 2
Allowed states	0 - Off	1 - On	2 - Blink medium
Value of 3	Indicates no change		

	Byte 0 (Button 1)	Byte 1 (Button 2)	Byte 2 (Button 3)	Byte 3 (Button 4)	Byte 4 (Button 5)	Byte 5 Button 6	Byte 6 (Button 7)	Byte 7 (Encoder Button)
Bit 6-7	Backlight Color Index	Backlight Color Index	Backlight Color Index	Backlight Color Index	Backlight Color Index	Backlight Color Index	Backlight Color Index	Backlight 1 Color Index
Bit 4-5	Indicator Color Index	Indicator Color Index	Indicator Color Index	Indicator Color Index	Indicator Color Index	Indicator Color Index	Indicator Color Index	
Bit 2-3	LED 1 State	LED 1 State	LED 1 State	LED 1 State	LED 1 State	LED 1 State	LED 1 State	Backlight 1 State
Bit 0-1	LED 2 State	LED 2 State	LED 2 State	LED 2 State	LED 2 State	LED 2 State	LED 2 State	

CAN messaging protocol

Command values

The HMK requires the reception of the J1939-21 PDU1 format for the proprietary messages.

The HMK will expect an ID of:

0X18EFDASA   **DA** is the Destination Address (address of HMR).

SA is Source Address of sender of the data.

Use the following command values.

Command Value	Name	Description
0x0FCD	CMD_BRIGHTNESS	Changes the parameters for LED brightness, global setting
0x0FCC	CMD_BACKLIGHT_COLOR	Changes the RGB settings of one of the indexes of backlight colors
0x0FCE	CMD_AUX_OUTPUTS	Commands the auxiliary outputs to turn on / off
0x0FCB	CMD_BUTTON_LEDS	Commands a single button indicator, backlight colors and blink rates
0x0FCC	CMD_MAIN_COLOR	Changes the RGBW settings of one of the indexes of indicator colors
0x0FCF	CMD_CONFIG	Changes various configuration settings of the unit

J1939 proprietary messages

The message should be structured in the following format for the corresponding proprietary messages.

LED brightness

The system supports a LED brightness message that sets the global brightness of each of the RGB colors with a value from:

- 0-254 (254 being full brightness)
- 255 Not Available / No Change

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD_BRIGHTNESS LSB	CMD_BRIGHTNESS MSB	Red	Green	Blue	White	Don't save through Power cycle	255
		Min: 0	Min: 0	Min: 0	Min: 0	Min: 0	
		Max: 254	Max: 254	Max: 254	Max: 254	Max: 1	
		No Change: 255	No Change: 255	No Change: 255	No Change: 255	Save through power cycle	

Backlight LEDs

The system supports a proprietary message to set the RGB Color configuration for one of the color settings for the backlight LED and overwrites any of the corresponding indexes of the RGB settings from the previous LED color table.

CAN messaging protocol

Byte 0	Byte 1	Byte 2		Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD_BACKLIGHT _COLOR LSB	CMD_BACKLIGHT _COLOR MSB	Color Index: 0-15		Red	Green	Blue	White	Reset to default
		Reserved: 16-127		RGB 0-255	RGB 0-255	RGB 0-255	RGB 0-255	RGB 0-255
		No change: 255						
		Bit 7	0 = read					
			1 = write					

CAN messaging protocol

LEDs

The system supports a proprietary message to set the RGB Color configuration for one of the color settings for the Indicator LED and overwrites any of the corresponding indexes of the RGB settings from the previous Backlight color table.

Byte 0	Byte 1	Byte 2		Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD_BUTTON _LEDS LSB	CMD_LED1_2 _COLOR MSB	Color Index: 0-16		Red	Green	Blue		
		Reserved: 17-254		RGB 0-255	RGB 0-255	RGB 0-255		
		No change: 255						
		Bit 7	0 = read					
			1 = write					

Blink rate and indicator configuration for buttons

The system supports an individual message that allows for setting all the blink rates and selection of colors for backlight and indicator for each button.

Type	Speed	Inverted
0 - Off	0 - Slow	0 - No
1 - On	1 - Medium	1 - Yes
2 - Blink	2 - Fast	2 Reserved
3 - Breathe	3-6 Reserved	3 - No Change
4-6 Reserved	7 - No Change	
7 - No Change		

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD_BUTTON _LEDS LSB	CMD_BUTTON _LEDS MSB	Button #: 1-7	Backlight Color: 0-15	Backlight State: Bit 0-2: Type Bit 3-5: Speed Bit 6-7: Invert	Indicator Color: 0-15	LED1 State: Bit 0-2: Type Bit 3-5: Speed Bit 6-7: Invert	LED2 State: Bit 0-2: Type Bit 3-5: Speed Bit 6-7: Invert
		Reserved: 0; 8-254	Reserved: 16-254		Reserved: 16-256		
		No Change: 255	No Change: 255		No Change: 255		

Blink rate and indicator configuration for rotary

The system supports an individual message that allows for setting all the blink rates and selection of colors for backlight for the encoder dial.

Type	Speed	Inverted
0 - Off	0 - Slow,	0 - No,
1 - On,	1 - Medium,	1 - Yes,
2 - Blink,	2 - Fast,	2 - Reserved,
3 - Breathe,	3-6 - Reserved,	3 - No Change
4-6 - Reserved,	7 - No Change	
7 - No Change		

CAN messaging protocol

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CMD_ENCODER _LEDS LSB	CMD_ENCODER _LEDS MSB	Encoder: 8	Backlight Color: 0-15	Backlight State:	Unused	Unused	Clear Counts:
		Reserved: 0-7; 9-254	Reserved: 16-254	Bit 0-2: Type	255	255	Clear - 1
		No Change: 255	No Change: 255	Bit 3-5: Speed			No Change: 2-255
				Bit 6-7: Invert			

Rotary encoder configuration

The encoder count value configuration must be done using PLUS+1® Service Tool, it allows for more customization to the rotary encoder.

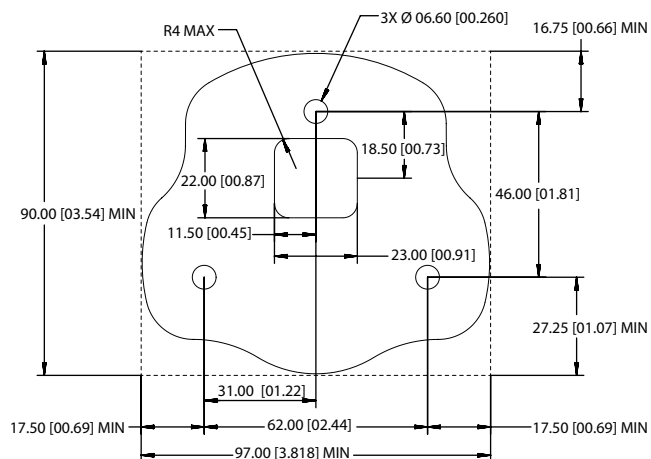| Configuration	Value	Comments
Start Value	0 - Max Value	The delta value defines how many counts can be done with the rotary.
Maximum Range	Start Value - 65535	
Rollover	Enable/Disable	When max value is achieved the rotary is either: **(Enabled)** Count begins at max or start value depending which way rotary is being turned. **(Disabled)** Reaches max or start value and does not go further.

Installation and start-up

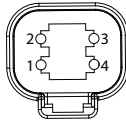### Dimensions

HMR CAN Rotary Input Device

mm [in]

96.44 [03.80]
88.96 [03.50]
Ø 45.00 [01.77]

56.77 [02.24]
51.20 [02.02]
38.27 [0151]
17.45 [00.69]

Three bolts
Max torque 4.5 N•m (40 in•lb)
Thread M6

46.00 [01.81]
62.00 [02.44]

A

Mounting

R4 MAX
3X Ø 06.60 [00.260]
16.75 [00.66] MIN
18.50 [00.73]
46.00 [01.81]
22.00 [00.87]
90.00 [03.54] MIN
11.50 [00.45]
23.00 [00.91]
27.25 [01.07] MIN
31.00 [01.22]
17.50 [00.69] MIN
62.00 [02.44]
17.50 [00.69] MIN
97.00 [3.818] MIN
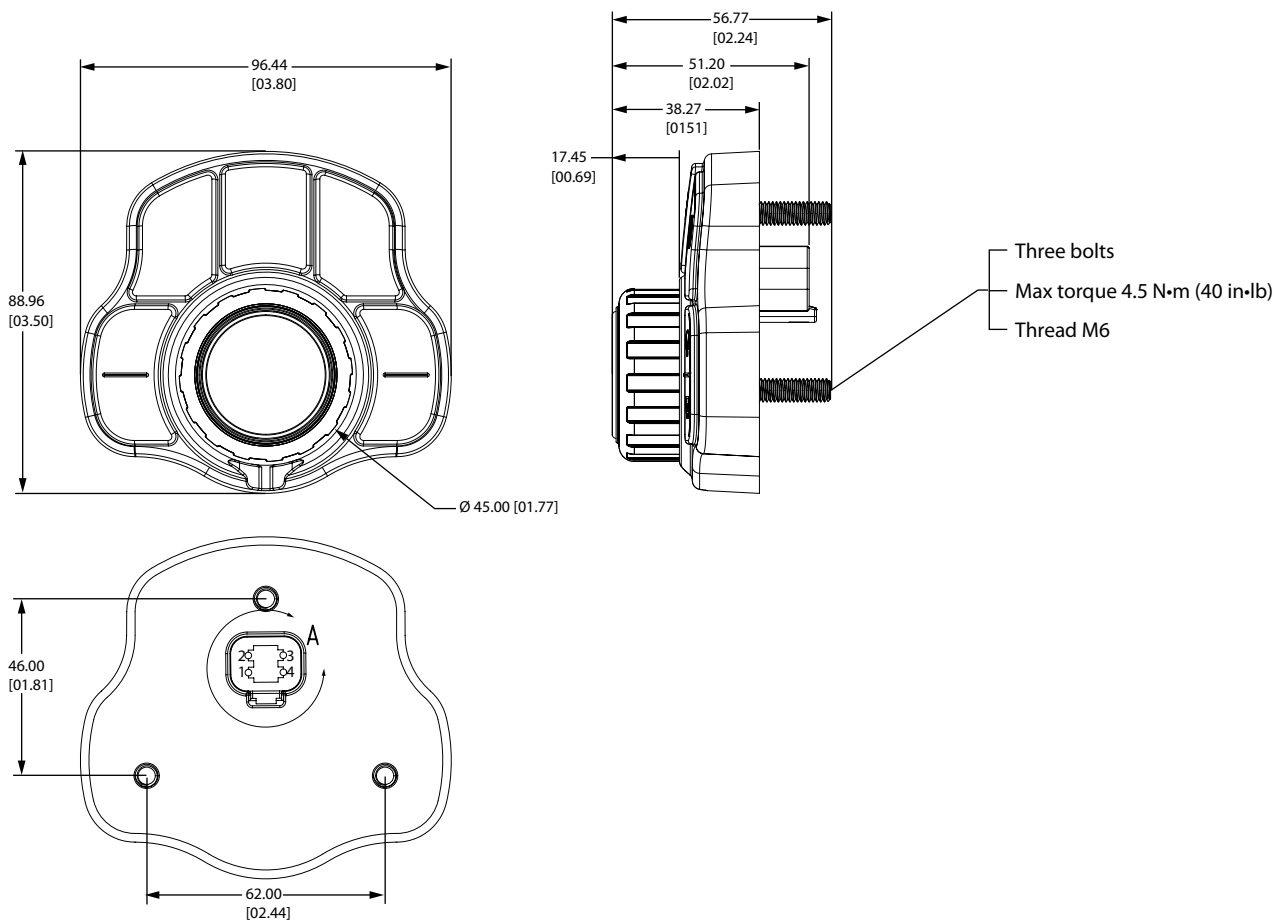
Installation and start-up

Connectors

Pin assignments

DEUTSCH DT04-4 pin connector

Pin	Controller function
1	Power ground -
2	Power supply +
3	CAN Hi
4	CAN Lo

Machine wiring guidelines

⚠ **Warning**

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. Improperly protected power input lines against over current conditions may cause damage to the hardware. Properly protect all power input lines against over-current conditions. To protect against unintended movement, secure the machine.

🛇 **Caution**

Unused pins on mating connectors may cause intermittent product performance or premature failure. Plug all pins on mating connectors.

- Protect wires from mechanical abuse, run wires in flexible metal or plastic conduits.
- Use 85˚ C (185˚ F) wire with abrasion resistant insulation and 105˚ C (221˚ F) wire should be considered near hot surfaces.
- Use a wire size that is appropriate for the module connector.
- Separate high current wires such as solenoids, lights, alternators or fuel pumps from sensor and other noise-sensitive input wires.
- Run wires along the inside of, or close to, metal machine surfaces where possible, this simulates a shield which will minimize the effects of EMI/RFI radiation.
- Do not run wires near sharp metal corners, consider running wires through a grommet when rounding a corner.
- Do not run wires near hot machine members.
- Provide strain relief for all wires.
- Avoid running wires near moving or vibrating components.
- Avoid long, unsupported wire spans.
- Ground electronic modules to a dedicated conductor of sufficient size that is connected to the battery (-).
- Power the sensors and valve drive circuits by their dedicated wired power sources and ground returns.
- Twist sensor lines about one turn every 10 cm (4 in).
- Use wire harness anchors that will allow wires to float with respect to the machine rather than rigid anchors.

Installation and start-up

Machine welding guidelines

⚠️ **Warning**

High voltage from power and signal cables may cause fire or electrical shock, and cause an explosion if flammable gasses or chemicals are present.
Disconnect all power and signal cables connected to the electronic component before performing any electrical welding on a machine.

The following is recommended when welding on a machine equipped with electronic components:

- Turn the engine off.
- Remove electronic components from the machine before any arc welding.
- Disconnect the negative battery cable from the battery.
- Do not use electrical components to ground the welder.
- Clamp the ground cable for the welder to the component that will be welded as close as possible to the weld.

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