



# Protective Shield

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## MEWP SHIELD System (LIN v1.0) User Manual

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## About this Document

### Document Information

Document Type User Manual  
Document Abstract Listing of all the step-by-step instructions for use of the MEWP.  
Document Status In-Review  
Document Prepared By Protective Documentation Team



### Document Revision History

Sr. #	Version	Date	Comments
1.	0.1	January 01, 2024	Initial Draft
2.	0.2	April 22, 2024	Protective Standard Template incorporated.
3.	1.0	May 14, 2024	Final version in new format

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# 1 Disclaimer

	Please read the disclaimer info carefully and understand the risks before operating.
	This document does not replace and is not intended to replace any local, state, provincial, including without limitation applicable in the jurisdiction of installation. Protective Pty Ltd. assumes no responsibility for the compliance or non-compliance with such laws or codes in connection with the installation of the product.

*Crushing incidents may result in injury or death. Use of multiple systems reduces risk of incident and Protective Shield should be used as an operator aid and backup system only. It is not a substitute for suitable experience, training, safe work practices and procedures or due care.*

*The information contained on this document is of a general nature only. It should not be relied upon to assess risk. Users and operators of the machinery to which the Protective Shield is fitted, must separately assess, and verify risks before use. Product capability and operation is dependent on correct system selection, setup and installation, and maintenance by appropriately qualified and authorized personnel. Regular inspections of the Protective Shield components and validation of system performance, forms a part of the required maintenance of the system.*

*Because of the nature of the sensors used in this system, it is essential that they are cleaned before use as part of the system's pre-start check procedure. If the sensors are unable to transmit the ultrasonic pulses due to physical obstruction of the sensor's faces (either intentional or accidental) the sensor will be unable to detect obstacles in its field of view.*

*For further information on whether the system is right for you please contact our sales staff. For details on the product capabilities see the relevant Product Manual.*

## Technical Support

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## 2 About this Installation Manual

	This manual is for qualified personnel only. The tasks described in this manual may only be performed by qualified personnel.
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### 2.1 Symbols Used

The following types of safety instructions and general information appear in this document described as below:

Symbol	Type of Hazard	Description
	DANGER	Indicates a hazardous situation that needs immediate attention. If not avoided, serious injury or even death may occur.
	WARNING	Indicates a hazardous situation that needs immediate attention. If not avoided, serious injury or even death may occur.
	CAUTION	Indicates a hazardous situation that needs immediate attention. If not avoided, serious injury or even death may occur.
	NOTE	Provides you tips that are valuable for the optimal operation of your product.

### 2.2 Abbreviations and Acronyms

Abbreviation	Description
BLE	Bluetooth Low Energy
LIN	Local Interconnect Network
LED	Light Emitting Diode
MCU	Shield Master Control Unit
(M)EWP	(Mobile) Elevated Work Platform
OP	Operator Panel Component
PI	Protective Innovations
SHIELD	The PROTECTIVE SHIELD System, including all provided components, wiring and hardware.

## 3 About the Product

### 3.1 About Protective Shield

PROTECTIVE SHIELD is the innovative Mobile Elevated Work Platform (MEWP), secondary guarding safety device that engages its worker protection function BEFORE an incident occurs. The purpose of the PROTECTIVE SHIELD system is to reduce the risk of crush incidents whenever the EWP machine itself or the basket is moved.

Using ultrasonic sensor technology for proximity detection and control, the PROTECTIVE SHIELD system engages the worker protection function to identify potential hazards before an elevated work platform (EWP) incident occurs. Protective Shield provides excellent secondary guarding protection in industrial proximity control by seamlessly interfacing to the existing EWP controls via logical dry-contact connections into the machine's existing dead-man / lockout signals for control override.

The system functions by utilizing one or more ultrasonic sensors to detect the presence of objects within a predetermined threshold distance. When an object is detected within the threshold or 'Alarm' zone of a sensor, the system stops the machine and alerts the operator of the obstacle via the LED indicators and siren. The system will also warn the operator when an object is being approached before the alarm distance has been reached (Warning Zone).

The 'Override' button on the system's operator panel will allow machine movement when engaged for a predetermined amount of time while the sensor is obstructed. The Override button is an acknowledgement from the operator that an object is within the alarm zone of the machine.

The sensors have a nominal 4.5m detection range following a prescribed beam pattern. In practice, detection distances are set for EWP use at working height. To best utilize the sensor, it should be angled in the direction of the basket motion that is most likely to cause injury to the persons in the vehicle. Multiple sensors can be utilized to achieve the desired coverage depending on intended use.



### 3.2 Product Overview

The Protective Shield System is designed to provide an early detection of crush hazards when operating from the basket controls. The system uses ultrasonic sensing mounted to the machine control box to detect potential hazards.

The system is comprised of multiple components, which communicate along a common LIN-BUS. Up to 16 individual devices can be connected to the bus at a time, with a maximum of 8 sensor modules.

A standard Protective Shield System comprises of:

- 1 x Master Control Unit
- 1 x Operator Panel
- 1 x Sensor Module

☞	<ul style="list-style-type: none"> <li>The level of protection provided by the system depends on the installation arrangement of sensors. It is important to understand the limitations of the system.</li> <li>If you are unsure about whether the current system provides adequate protection for your needs, please contact support.</li> </ul>
☞	<ul style="list-style-type: none"> <li>The OEM 'personality' profile of the MEWP should be considered when setting the detection stop distance (see Protective Shield Application Manual).</li> <li>In some cases, gradual stops can be configured as per OEM instructions on MEWPs to lessen the impact of sudden stops. If an MEWP is using a gradual stop personality profile, consider increasing the detection stop distance via the Protective Shield mobile phone application.</li> </ul>

### 3.2.1 Master Control Unit

The Master Control Unit houses all the main control electronics and provides configuration and monitoring access via an App utilizing BLE connectivity. The Master Control Unit has the following features:

- BLE for Bluetooth Connection
- LIN-BUS for Communications
- Polycarbonate Enclosure
- IP-65 Rating – Dust Tight and Water Resistant to jets of water / rain
- Operating range of -30 to +85 °C

☞	<ul style="list-style-type: none"> <li>The Master Control Unit will also monitor for any missing devices and enter alarm mode in the event of an undetectable sensor.</li> </ul>
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### 3.2.2 Operator Panel

The Operator Panel is the main interface between the machine operator and the system. The Operator Panel connects to the Master Control Unit over the LIN-BUS to provide visual indication

of the system status and houses an override button, which when activated by the operator, allows machine movement within the alarm zone in the event of an alarm / error situation.



### 3.2.3 Sensor Modules

The sensor module is used to detect the presence of objects within 4,500mm of the top of the sensor. The 'Alarm' zone is the distance an object is detected triggering the alarm status of the sensor and system. The 'Warning' zone is 1.5x the distance of the Alarm zone.









### 3.3 Technical Data

Sensor Specification	
Specification	Value
Supply Voltage	3.3V
Average Current Draw	65mA (@3.3V) <i>(Note 1)</i>
Communications	LIN-BUS
Max. Nodes per Bus	8
Sensing Range	280mm Min. 4500mm Max.
Size	77L x 55W x 32H (L, R, D-Models), 77L x 67W x 32H (B-Model) <i>(Note 2)</i>
Net Weight	110 grams
Mounting	<ul style="list-style-type: none"> <li>• Four mounting points</li> <li>• M3.5 Screws or M4 Bolts</li> <li>• Brackets provided or supplied by customer <i>(Note 3)</i></li> </ul>
Operating Temperature	-30 to +85 °C
Storage Temperature	-40 to +105 °C
Ingress	IP67 in accordance with ISO16750 Section 5.4.3
Enclosure	Diecast aluminum alloy, black powder coated
Operator Panel	
Specification	Value
Supply Voltage	12-24V
Average Current Draw	11mA (@12V), 6mA (@24V)
Communications	LIN-BUS
Max. Nodes per Bus	1
Size	121L x 54W x 33H
Net Weight	135 grams
Mounting	<ul style="list-style-type: none"> <li>• Four mounting points, M3.5 Screws or M4 Bolts</li> <li>• Brackets provided or supplied by customer <i>(Note 3)</i></li> </ul>
Operating Temperature	-30 to +85 °C
Storage Temperature	-40 to +105 °C
Ingress	IP67 in accordance with ISO16750 Section 5.4.3
Enclosure	Diecast aluminum alloy, black powder coated
Master Control Unit	
Specification	Value
Power	12- or 24-volt automotive (4.8 - 40 VDC) Max 100mA



Internal Power Hold-up	5 seconds for orderly user alert and shutdown <i>(Note 4)</i>
Operator Interface	GUI via Bluetooth® to Android® or iOS® device
Communications	LIN-BUS, CAN-BUS
LIN-BUS Limitations	Max 16 Nodes, Max 40m length <i>(Note 5)</i>
Internal Lockout Contact	240VAC / 220VDC contact Rating, 3A contact current Max.
Open Drain Outputs	Sink, 2.5A 60VDC max (interface to ext. lamps, sounders etc.)
Size	122L x 83W x 40H not including space for cable exits
Net Weight	300 grams
Mounting	Four mounting points, M6 hard-mounted
Operating Temperature	-30 to +85 °C
Storage Temperature	-40 to +105 °C
Ingress	IP65 in accordance with ISO16750 Section 5.4.3
Enclosure	Polycarbonate with clear lid
Electrical Susceptibility	Meets ISO7637 parts 1&2

	<ul style="list-style-type: none"> <li>• <u>Note 1:</u> Actual battery draw is far less when considering power conversion. ~4mA @12V</li> <li>• <u>Note 2:</u> Sensor model selection depends on individual use cases.</li> <li>• <u>Note 3:</u> Sensor and User panel mounting brackets can be supplied depending on the machine model / use case. For custom brackets, a mounting template can be provided.</li> <li>• <u>Note 4:</u> Brownout detected at 11 volts and if the supply voltage is lower than 11 volts for more than 0.5 seconds, an orderly shutdown is initiated.</li> <li>• <u>Note 5:</u> LIN-BUS limitations in accordance to ISO17897</li> </ul>
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## 4 System Operation

	<ul style="list-style-type: none"> <li>This section explains the normal operation of the Protective Shield System. For correct functioning the Protective Shield system must be installed and configured correctly. The positioning and configuration of the sensor is a key-element in the correct functioning of the system.</li> </ul>
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### 4.1 Pre-start System Checks

	<ul style="list-style-type: none"> <li>Before operating any machinery with the Protective Shield System installed, a pre-start check is mandatory to ensure that all system components are functioning correctly and to ensure no damage has occurred to the system during transit / storage.</li> </ul>
	<ul style="list-style-type: none"> <li><b>Never skip the Pre-start checks. Failure to do so may result in serious injury or death.</b></li> </ul>

A simplified pre-start checklist should be implemented according to your company guidelines and should preferably be a part of the machine's pre-start check. Protective has existing Quick Access & Prestart Guides available on request.

#### 4.1.1 Checks to Perform Before Power On

Sr. #	Check	Steps / Details
1.	Check Master Control Unit	<ul style="list-style-type: none"> <li>Ensure all cabling leading into the controller is connected.</li> <li>No wiring shows signs of strain / stress.</li> <li>Inspect MCU front panel and enclosure for any physical damage (cracks, dents, etc.).</li> <li>MCU is mounted securely</li> </ul>
2.	Check the Sensor(s)	<ul style="list-style-type: none"> <li>Check sensor alignment (bent brackets, loose mounting, etc.).</li> <li>Make sure that the sensor face is clean (free from any dirt or foreign materials).</li> <li>Inspect sensor face for any damage (chips, dents, etc.).</li> <li>Ensure sensor connector is secure and undamaged.</li> <li>Inspect sensor cabling for any damage (cuts, signs of stress, kinks, etc.).</li> </ul>



#### 4.1.2 Checks to Perform on System Power-up

Sr. #	Check	Steps / Details
1.	Check Sensor Functioning	<ul style="list-style-type: none"> <li>Ensure all LEDs on the Operator Panel Unit illuminate in sequence to indicate correct startup functionality.</li> <li>Check that no errors occur on startup (Indicated by blinking RED indicator and beeping horn / buzzer).</li> <li>Check that all connected sensors have an illuminated LED indicator to show that power is provided.</li> <li>Block each sensor one-by-one to check that they are communicating with the MCU correctly, and that the lockout features are behaving as expected.</li> </ul>

		<ul style="list-style-type: none"> <li>Block sensor with hand (intentionally invoke RED indicator), check that the Override button on the Operator Panel is functioning correctly by pressing it and observing that the BLUE indicator becomes visible AND that the siren output stops sounding.</li> <li>With the sensor blocked and the override active (BLUE indicator), ensure that the machine can be moved after activating the dead-man switch.</li> </ul>
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## 4.2 System Startup

- The following procedures assume that the system has been installed, tested and commissioned correctly and that the system is powered from a power supply/battery system on the machine that is within specifications.
- On successful startup, the operator panel LEDs should all light up sequentially. Afterwards, the Green LED will stay ON, indicating power is OK.

	<ul style="list-style-type: none"> <li>If GREEN LED is OFF, it indicates that the supply voltage is not present. Check the power source and retry.</li> </ul>
	<ul style="list-style-type: none"> <li>If GREEN LED is blinking, it indicates a low supply voltage. Turn off the system and check the power source for the correct voltage range.</li> </ul>

## 4.3 Normal Operation

The following table in this section describes the indications and sounds that represent normal operation of the Shield system. Point 6 provides some guidance on errors that are most likely to be encountered.

Sr. #	Event / State	Details / Description
1.	Power up	<ul style="list-style-type: none"> <li>The GREEN LED stay ON after initial blinking.</li> </ul>
2.	No Objects / Obstacle Detected	<ul style="list-style-type: none"> <li>The GREEN LED stay ON indicating normal operation or "All Clear" status.</li> </ul>
3.	Warning State (Near Obstacle Status)	<ul style="list-style-type: none"> <li>When the operator begins to approach an object, the system will enter a 'Warning' state.</li> <li>In this state, the machine is still able to move, and the Amber LED and the horn output will pulse at a rate of 2.5Hz, alerting the operator of an approaching object.</li> <li>The Warning zone of a sensor is 1.5x the Alarm zone. <ul style="list-style-type: none"> <li>A sensor with a 1-meter alarm threshold will have a warning threshold of 1.5 meters.</li> </ul> </li> <li>The system will warn when at least 1 sensor is in Warning zone, and no sensors are reporting a higher alert level (Alarm, Error).</li> </ul>
4.	Alarm State (Obstacle Detected)	<ul style="list-style-type: none"> <li>When the sensor detects an obstacle within its Alarm threshold, the system will enable the machine lockout and the operator panel will display a solid Red LED.</li> <li>The machine will not move any further in this state and the Red LED will remain active until the hazard is cleared.</li> <li>The operator can re-enable the machine movements by either clearing the obstruction from the sensor</li> </ul>

		area or by pressing the manual override button on the operator panel.
5.	Override state (Operator manually overrides in alarm state)	<p><b><u>Alarm State</u></b></p> <ul style="list-style-type: none"> <li>• If the system is in the Alarm state, pressing the override button will disable the safety relay. The operator control will be enabled.</li> <li>• In this state, the Blue Override indication LED will turn ON and will Blink Red/Blue alternatively.</li> </ul> <p><b><u>Warning State</u></b></p> <ul style="list-style-type: none"> <li>• The override will remain active even in the Warning state.</li> <li>• As the machine is moving away from the obstacle, the warning siren output will not re-engage.</li> <li>• This allows the operators to enable the override from alarm, move away from the obstacle and continue to work in the warning zone without the siren constantly activating.</li> </ul> <p><b><u>Error State</u></b></p> <ul style="list-style-type: none"> <li>• If the system is in the Error state, the override will clear the buzzer, and will also clear the LED state. The override will also enable the machine movements.</li> </ul> <p><b><u>Override Auto clear Function</u></b></p> <ul style="list-style-type: none"> <li>• When the affected sensor's Alarm zone is clear (i.e., the obstacle is clear), the Override will automatically clear. It takes the system only ONE second to detect the status and clear the Override state.</li> <li>• As the system clears the Override state, the machine can be re-locked if another obstacle is detected in the Alarm zone.</li> <li>• In case of a System Error, the Override state will clear after 10 seconds. This enables the operator to move the machine to a safe area and fix the malfunction. This prevents the need for a constant override if a system component is removed / damaged.</li> </ul>
6.	Error State (System Error)	<ul style="list-style-type: none"> <li>• The system will enter the "Error" state when a device is missing from the LIN-BUS, or any LIN-BUS device reports an error.</li> <li>• In the Error state the Red LED will blink continuously and the siren will also activate.</li> <li>• In the error state, the machine will Lockout.</li> </ul>

## 4.4 State Outputs

The tables in this section summarize the various states of the LED's, relay contact and the buzzer for all system events and states for each module.

### 4.4.1 Master Control Unit

STATE	OUT-1	Aux. Relay	Buzzer Out	Machine Enable
Clear	OFF	OFF	OFF	ENABLE
Clear + Override	OFF	OFF	OFF	ENABLE
Warn	OFF	OFF	BEEP	ENABLE
Warn + Override	OFF	OFF	OFF	ENABLE
Alarm	BLINK	ON	ON	LOCKOUT
Alarm + Override	OFF	OFF	OFF	ENABLE
Error	BLINK	ON	BEEP	LOCKOUT
Error + Override	OFF	OFF	OFF	ENABLE
Low Voltage	OFF	OFF	OFF	LOCKOUT




### 4.4.2 Operator Panel

STATE	POWER LED	STATUS LED	
Clear	ON	GREEN	
Clear + Override	ON	GREEN	BLUE
Warn	ON	AMBER BLINK	
Warn + Override	ON	AMBER	BLUE
Alarm	ON	RED	
Alarm + Override	ON	RED	BLUE
Error	ON	RED BLINK	
Error + Override	ON	RED	BLUE
Low Voltage	BLINK	OFF	
No LIN Master	BLINK	WHITE BLINK	

### 4.4.3 Sensor Modules

STATE	STATUS LED
Clear	GREEN
Clear + Override	GREEN
Warn	AMBER
Warn + Override	AMBER
Alarm	RED
Alarm + Override	BLUE
Error	RED BLINK
Error + Override	BLUE

## 5 Troubleshooting

	<ul style="list-style-type: none"> <li>This quick reference troubleshooting guide is not a repair or maintenance guide. Efforts to alter product parameters may result in permanent damage to the product.</li> </ul>
	<ul style="list-style-type: none"> <li>The electrical parts inside the product are non-serviceable, do not try to modify them in any way. It may result in electric shock or serious injury.</li> </ul>
	<ul style="list-style-type: none"> <li>Please contact our support team for recommendations, suggestions and troubleshooting.</li> </ul>

Sr. #	Situation	Possible Cause	Solution(s)
1.	Green indicator blinking on startup and no system functionality	Insufficient Voltage	<ol style="list-style-type: none"> <li>Check Master Control Unit's wiring. Ensure that all the wiring into the Master Control Unit is correct and that a constant 12-24V DC source is being applied from the machines control power.</li> <li>Make sure that the power coming into the system is NOT a 12-24V data signal of any kind.</li> <li>Check the bus voltage with the device disconnected (Cinch connector removed from MCU) to see if the bus normally has the correct voltage.</li> <li>If not, the supply line may be incorrect or could be shorted / current limited by another device.</li> <li>If the supply voltage is correct, the supply line might not have the power capabilities to run the device OR there could be an issue with one of the devices itself.</li> <li>Disconnect all LIN devices from the bus and supply power to the MCU.</li> <li>Reconnect devices one-by-one until a power failure is detected to isolate a potentially faulty system module.</li> <li>If the issue persists after replacing the module, check the current limit of the connected power supply line. If the current limit is correct and still the device does not function, please connect our support.</li> </ol>
2.	Blinking RED indicator and horn / buzzer on startup	Equipment damage or missing	<ol style="list-style-type: none"> <li>One or more configured system modules are not detected by the MCU OR a module is reporting an internal error.</li> <li>Check each system module (sensors, etc.) for blinking RED indicators. If a sensor has a blinking RED indicator, the physical sensor part of the module is damaged, and the unit must be replaced.</li> <li>No blinking RED indicators means a LIN device is missing. Inspect all LIN-BUS devices have an active indicator light to show power is supplied. Check that all LIN-BUS connections are secure.</li> <li>Inspect cabling for any damage (cuts, signs of stress, pinched cables, etc.)</li> <li>If available, check the debug log of the MCU to see which devices aren't communicating before contacting support.</li> </ol>

3.	No input from override button	Controller issue	<ul style="list-style-type: none"> <li>i. Restart the controller by removing power until the blinking GREEN indicator turns off.</li> <li>ii. Connect to the MCU in the Protective Shield App.</li> <li>iii. With the App open and connected, press the button on the physical Operator Panel and check to see if the App Button changes too.</li> <li>iv. If not, replace the Operator Panel.</li> <li>v. If the button does change, block / remove a Shield Sensor to trigger alarm mode.</li> <li>vi. If pressing the button does not enable Override, contact support.</li> </ul>
4.	System constantly alarming / intermittently alarming with no objects in range	Sensor Malfunction	<ul style="list-style-type: none"> <li>i. Observe sensor indicator lights to determine which sensors are causing the false triggers.</li> <li>ii. Make sure that all sensor faces are free from dirt and foreign material that may causing false triggers.</li> <li>iii. Ensure that the sensors are correctly mounted and there are no parts of the machine frame within view of the sensor.</li> <li>iv. Check all wiring connections leading to the sensors are secure.</li> <li>v. If false triggers persist, replace the faulty sensor module.</li> <li>vi.</li> </ul>
5.	Operator Panel displays Green / White blinking lights on startup	Connection Issues	<ul style="list-style-type: none"> <li>i. This implies that the Operator Panel is powered, but cannot see the MCU on the LIN-BUS</li> <li>ii. Ensure all connectors are fully done up and secure.</li> <li>iii. Power off all system components and make sure everything powers on at the same time.</li> <li>iv. Make sure the MCU is running by checking for a BLE connection in the App.</li> <li>v. If the problem persists, contact support.</li> </ul>

## Our Technical Support

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