

The MacKay Guardian™ *SOLO*



Operation and Maintenance Guide

JJ12-001 v1.5 February, 2013



Copyright © (2013) **J.J. MacKay Canada Limited**. All rights reserved.

MacKay Guardian™ Solo Operation and Maintenance Guide

For meter application software version E80B.084x and higher

MacKay Document Number: JJ12-001 Version 1.5

J.J. MacKay Canada Limited reserves the right to modify this document without prior notice. The information contained herein includes information which is confidential and proprietary to **J.J. MacKay Canada Limited**. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written consent of **J.J. MacKay Canada Limited**. If however, your only means of access is electronic, permission to print one copy is hereby granted.

Instructions in this document do not purport to cover all details or variations in equipment or software, nor to provide for every possible contingency to be met during installation, operation, and maintenance. If further information is desired, or if particular problems arise that are not covered sufficiently for the purchaser's purpose, the matter should be referred to **J.J. MacKay Canada Limited**.

J.J. MacKay Canada Limited may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from **J.J. MacKay Canada Limited**, the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

MacKay Meters is a registered trade name of **J.J. MacKay Canada Limited**. The MacKay logo, MacKay Guardian and SmartChute are either trademarks or registered trademarks of **J.J. MacKay Canada Limited** in Canada and other countries. Windows and Windows NT are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. PRESAT is a registered trademark of Preventative Maintenance Corp. LPS is a registered trademark of Holt Lloyd Corporation. ProGold is a trademark of Caig Laboratories, Inc. All other trademarks are the property of their respective owners.

FCC Statement:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- 1) This device may not cause harmful interference, and
- 2) This device must accept any interference received, including interference that may cause undesired operation.

Any change or modification to the product not expressly approved by ***J.J. MacKay Canada Limited*** could void the user's authority to operate the device.

This equipment complies with FCC radiation exposure limits set forth in an uncontrolled environment.

This equipment should be installed and operated with minimum distance 20cm between the equipment and the user's body.

Industry Canada Statement:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- 1) this device may not cause interference, and
- 2) this device must accept any interference, including interference that may cause undesired operation of the device

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- 1) l'appareil ne doit pas produire de brouillage, et
- 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device has been designed to comply with safety requirements for exposure to radio waves (SAR) in accordance with RSS-102.

This device should be installed and operated with minimum distance 20cm between the equipment and your body.

Cet artifice a été conçu pour se plier à la sécurité les exigences pour l'exposition aux ondes radioélectriques (SAR) dans conformité avec RSS-102.

Cet artifice devrait être installé et fait marcher avec la distance minimale 20 centimètres entre l'équipement et votre corps.

Revision History

| Version | Description of Changes | Initials | Date of Change |
|---------|--|-------------|----------------|
| 1.0 | Initial Version (Draft) | GEC | June 2011 |
| 1.1 | FCC & Industry Canada Statements added | GEC | Aug 15 2011 |
| 1.2 | DRAFT – format and content changes | RJP | Feb 8, 2012 |
| 1.3 | DRAFT – content changes-edits | GEC/RJP | Mar 2, 2012 |
| 1.4 | content changes-edits | GEC/RJP/AJS | Jan 9, 2013 |
| 1.5 | Updated pictures | AJS | Feb 8, 2013 |
| | | | |

Take Note

MacKay has attempted to update pictures/screen shots to the most current revision, where there is a possibility that some confusion could result in describing a particular item/function/procedure.

To identify noteworthy changes/additions to the document, where possible/practical a yellow text box, as shown below, will appear next to the section that has been changed.

NEW!

Table of Contents

| | | |
|-------|--|----|
| 1. | Introduction | 1 |
| 1.1 | List of Terms | 2 |
| 2. | MacKay Guardian™ Solo: General Description | 3 |
| 3. | MacKay Guardian™ Solo: Detailed Description..... | 11 |
| 3.1 | General Specifications | 11 |
| 3.2 | Field Serviceability | 12 |
| 3.3 | Power Supply | 12 |
| 3.4 | Indication Front..... | 13 |
| 3.5 | Indication Rear | 15 |
| 3.6 | Credit Card and Coin Acceptance Indication | 17 |
| 3.7 | Identification Label | 18 |
| 3.8 | SmartChute™ Coin Discriminator Assembly: General..... | 19 |
| 3.8.1 | Coin Acceptance and Discrimination | 20 |
| 3.9 | Card Reader Assembly: General | 22 |
| 3.9.1 | Card Acceptance | 23 |
| 3.9.2 | SAM Holders | 23 |
| 3.10 | Upgradeability and Peripheral Port | 24 |
| 3.11 | Programmable Feature Options..... | 25 |
| 3.12 | Internal Timekeeping | 25 |
| 3.13 | Memory..... | 26 |
| 3.14 | Memory Retention at Power Failure | 26 |
| 3.15 | Revenue Audit Capabilities | 26 |
| 3.16 | Transfer of Data | 27 |
| 3.17 | Coin and Card Check during Maintenance | 27 |
| 3.18 | Modular Components | 28 |
| 4. | Portable Data Terminal: Description..... | 29 |
| 5. | Web Based Management Software: Sentinel™ MMS..... | 30 |
| 6. | MacKay Guardian™ Solo: “How does it work?” | 31 |
| 6.1 | Coin Operation | 31 |
| 6.2 | Card Operation..... | 33 |
| 6.3 | Maintenance/Data Collection Using the RF Probe Interface (RFI) | 36 |
| 6.4 | Meter & LCD Display Activity During & Following Reset | 37 |
| 6.5 | Requirement for Periodic Data Transfer | 39 |
| 7. | Meter Installation and Removal from Housing..... | 40 |
| 7.1 | MacKay Guardian™ Solo Installation..... | 40 |
| 7.2 | MacKay Guardian™ Solo Removal..... | 41 |

| | | |
|-------|---|----|
| 8. | Troubleshooting | 42 |
| 8.1 | Repair Guide | 42 |
| 8.2 | Final Test | 43 |
| 8.3 | Common Faults | 43 |
| 8.3.1 | TBD | 43 |
| 9. | Maintenance and Repair | 44 |
| 9.1 | Testing a New Battery Pack | 44 |
| 9.2 | Replacing Meter Battery Packs | 44 |
| 9.3 | Meters Returned to Meter Repair Depot for Repair | 47 |
| 9.4 | Disassembly | 48 |
| 9.5 | Disassembly of Lower Coin Chute Assembly | 48 |
| 9.6 | Replacing Coin Discriminator | 49 |
| 9.7 | Removal of the Main Control Board (MCB) Assembly | 50 |
| 9.8 | Removal of the wireless cellular expansion board (WCEB) | 50 |
| 9.9 | Replacing a Card Guide/MAG Head Assembly | 52 |
| 9.10 | Replacing a Chip Card Reader Board | 53 |
| 9.11 | Replacement/Removal of Lithium ion Battery | 54 |
| 9.12 | Replacing the Rear Enforcement Display Assembly | 55 |
| 9.13 | Replacing the Front Display | 56 |
| 9.14 | Replacing the Solar Panel | 57 |
| 9.15 | Replacing the Antenna Cover Assembly | 57 |
| 9.16 | Testing a Reassembled Meter | 58 |
| 9.17 | Annual Maintenance | 59 |
| 9.18 | Monthly Maintenance | 59 |
| 9.19 | Weekly Maintenance | 60 |
| 9.20 | Handling, Transportation and Storage of Meters | 60 |
| 9.21 | MacKay Guardian™ Solo Meter Parts List | 62 |
| 10. | Returning a Meter to MacKay | 66 |

List of Figures

| | |
|--|----|
| • Figure 1 – MacKay Guardian™ Solo | 1 |
| • Figure 2 – Front of the MacKay Guardian™ Solo | 4 |
| • Figure 3 – Rear of the MacKay Guardian™ Solo..... | 5 |
| • Figure 4 – Right View of the MacKay Guardian™ Solo | 6 |
| • Figure 5 – Left View of the MacKay Guardian™ Solo | 7 |
| • Figure 6 – Internal View of MacKay Guardian™ Solo | 8 |
| • Figure 7 – Exploded Parts View of the MacKay Guardian™ Solo | 9 |
| • Figure 8 – MacKay Guardian™ Solo Main Controller Board – (Connector Side) | 10 |
| • Figure 9 – Front LCD..... | 13 |
| • Figure 10 – Rear Red LCD (Various Displays)..... | 15 |
| • Figure 11 – Solo meter and housing with labels for coin and credit card acceptance and card insertion..... | 17 |
| • Figure 12 – Sample Identification Label | 18 |
| • Figure 13 – SmartChute™ Coin Discriminator Assembly..... | 19 |
| • Figure 14 – SmartChute™ Coin Discriminator Internal Diagram | 20 |
| • Figure 15 – Top View, Close-Up Showing Anti-Pull Back Levers | 21 |
| • Figure 16 – Card Reader Assembly Top and Bottom View..... | 22 |
| • Figure 17 – Solo Peripheral Port for Future Expansion | 24 |
| • Figure 18 – Front Cover opened to reveal inside components..... | 28 |
| • Figure 19 – Portable Data Terminal (PDT) | 29 |
| • Figure 20 – MacKay Sentinel Meter Management System | 30 |
| • Figure 21 – Opened MacKay Guardian™ Solo with battery packs..... | 45 |
| • Figure 22 – MacKay Guardian™ Solo Alkaline Battery Pack..... | 45 |
| • Figure 23 – MacKay Guardian™ Solo Lithium-Ion Rechargeable Battery Pack..... | 46 |
| • Figure 24 - Quick Release Pin..... | 48 |
| • Figure 25 - Wireless Cellular Expansion Board..... | 51 |
| • Figure 26 - button flex cable connectors on MCB | 51 |
| • Figure 27 - 3-Pin solar panel connector | 51 |
| • Figure 28 - Battery Pack Connectors (J11 and J12) | 52 |
| • Figure 29 - card guide/mag head assembly | 52 |
| • Figure 30 – J5 - Magnetic Head Connector on MCB | 53 |
| • Figure 31 - chip card reader board retaining screws..... | 53 |

| | |
|--|----|
| • Figure 32 - Lithium-Ion battery pack, harness, and MCB connector | 54 |
| • Figure 33 - Enforcement Display Assembly..... | 55 |
| • Figure 34 - Two enforcement bracket retaining screws | 55 |
| • Figure 35 - Front Display Board Ribbon Cable..... | 56 |
| • Figure 36 - Coax "UFL" type connection and removal tool | 58 |
| • Figure 37 – Mackay Guardian™ Solo "Exploded View" | 62 |

List of Tables

| | |
|---|----|
| • Table 1 – Mackay Guardian™ Solo Parts List..... | 65 |
|---|----|

1. Introduction

This document describes the basic operation, assembly and the maintenance procedures for the **MacKay Guardian™ Solo** (Solo) and assumes that meter application version E80B.084x or higher is used. This document is intended for the installation and service personnel who will install and maintain the meters. It generally describes the meter hardware, which can be configured to accept payment by coins, client-approved smart cards, as well as credit cards. It will show the Solo parts and how they are interconnected, disassembled and reassembled as well as the basic operational checks for normal operation.



• Figure 1 – MacKay Guardian™ Solo

1.1 List of Terms

The following terms will be used extensively throughout this document. This section is provided for clarification purposes, and to save further explanation throughout the remainder of the manual.

- MCB: Main Controller Board.
- PDT: Portable Data Terminal.
- WCEB: Wireless Cellular Expansion Board (also referred to as Radio Board)
- Solo or Meter: MacKay Guardian™ Solo parking meter mechanism.
- LCD: Liquid Crystal Display.
- LED: Light Emitting Diode.
- SAM: Secure Access Module.
- Coin Chute: Refers specifically to the MacKay SmartChute™ Coin Discriminator.
- Test Card: A valid smart card or test credit card used for Solo testing purposes.
- Test Coin: A valid coin used for Solo testing purposes.
- Test Chute: A fully functional SmartChute™ coin discriminator used for Solo testing purposes.
- Test Card Reader: A fully functional card reader assembly used for Solo testing purposes.



2. MacKay Guardian™ Solo: General Description

The **MacKay Guardian™ Solo** consists of high strength zinc alloy metal covers and frame, consisting of an upper front cover assembly attached to a lower frame assembly, mated with a back cover assembly. All electronic components and sub-assemblies are held or mounted within the upper front cover assembly and the lower frame assembly.

When placed into and secured into a traditional heavy duty meter housing, there is no longer a need for a traditional “cap” or cover as the metal front and back cover assemblies also provide the necessary strength and security previously provided by the old “cap”, while still offering the public a large user display, numerous payment options and a large rear enforcement display. The Solo is designed such that when unlocked, the front cover assembly with attached lower frame assembly can be easily detached and removed from the back cover assembly and meter housing.

Alternatively the front cover assembly has a unique feature in that it can be detached from the back cover and hinged open leaving the lower frame assembly in the housing. This allows for the most common forms of service work such as inspecting/clearing coin chutes, card slots and battery replacement to be done with the meter held in place freeing up the technicians hands. The main controller board assembly containing the processor, program memory, and other circuits together with the rechargeable battery pack and many other electronic components are secured internally to the front cover assembly, while the coin chute, peripheral boards and main or non-rechargeable battery pack are secured in the lower frame assembly. All of these components are easily inspected and serviced when the meter is unlocked and the front cover assembly is hinged forward into its open/service position.

The lower frame assembly including the coin chute and backplane board plus any optional peripheral boards such as an RFID Reader Board or vault door sensor interface are electrically connected to the main controller board by way of a 20-pin ribbon cable. The coin chute is rigidly held in place when the lower front zinc frame member is attached to the lower back zinc frame member.

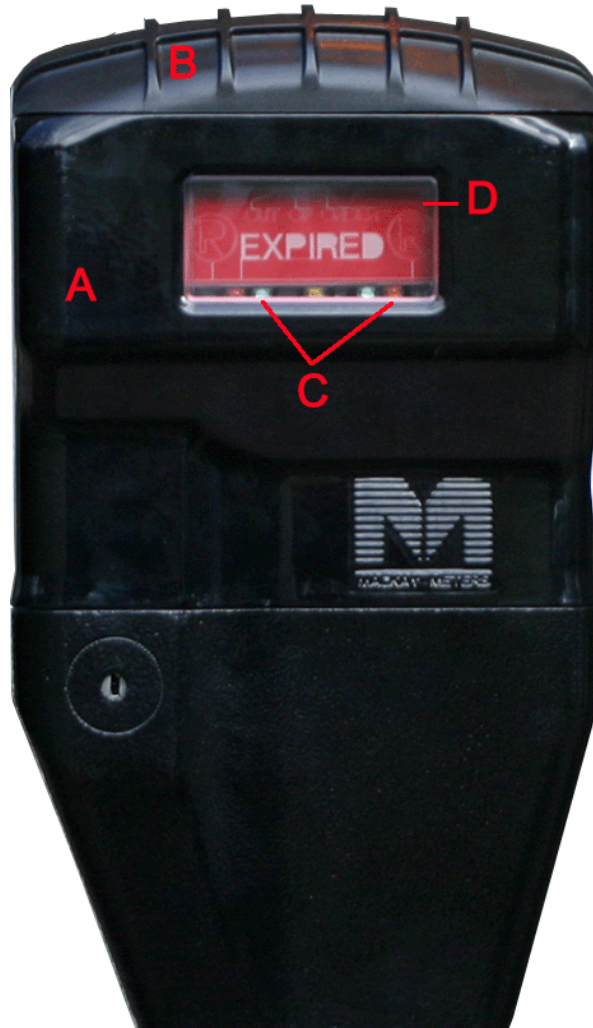
The large main non-rechargeable battery pack is attached to and powers the main board by way of its own 4-wire harness. It is located in the lower frame assembly and is secured in place by its own weight in a large plastic battery holder attached to the back of the lower frame assembly. The appropriate stainless steel coin slot is dropped into place on the lower front frame member. A hanger on the back of the battery cover allows the meter to be hung to the exterior of the housing for coin testing.

When viewed from the front, the separate coin and card slots are visible. Both are accessible to the user when the Solo is properly installed into a mechanism housing. Above and slightly back is the back-lit graphics LCD, visible through a rectangular opening on the front cover. To the left of the LCD, are the light sensor and three visual indicator LEDs for use by enforcement and maintenance staff. The red and green LEDs are used for enforcement or meter status indication, usually to indicate that the meter is OK/in a valid “time purchased” state or to indicate that the meter is in an expired state. The yellow LED is used primarily to indicate that service or maintenance is required. The card slot is for accepting either chip based smart cards, as well as traditional magnetic stripe type credit cards. The coin slot is used to accept coin payment as well as allow for communications between the portable data terminal (PDT) and the Solo using the RF probe interface.



• Figure 2 – Front of the MacKay Guardian™ Solo

| | | | |
|---|---|---|----------------------------|
| A | Down (-) Button (decrease payment / time) | G | ✓ (Confirm) Button |
| B | Up (+) Button (Increase payment / time) | H | X (Cancel) Button |
| C | Enforcement/Service LEDs (Front) | I | Solar Panel Bezel |
| D | Light Sensor | J | Solar Panel |
| E | Graphics LCD | K | Chip / Credit Card Slot |
| F | Antenna Cover Assembly | L | Coin Slot |
| | | M | Contactless Reader Antenna |



• Figure 3 – Rear of the MacKay Guardian™ Solo

- | | | | |
|---|------------------|---|--------------|
| A | Back Cover | D | Rear Red LCD |
| B | Antenna Cover | | |
| C | Enforcement LEDs | | |



• Figure 4 – Right View of the MacKay Guardian™ Solo

A Front Cover Assembly

D Mechanism Housing

B Rear Cover Assembly

C Antenna Cover



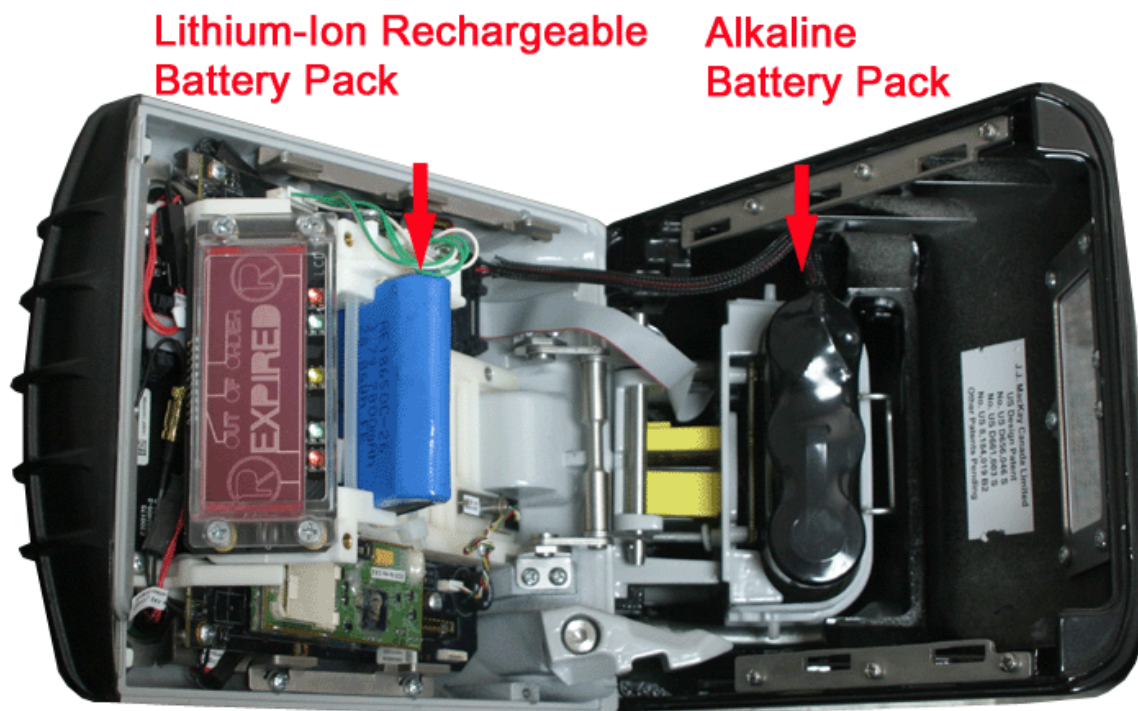
• Figure 5 – Left View of the MacKay Guardian™ Solo

A Front Cover Assembly

D Mechanism Housing

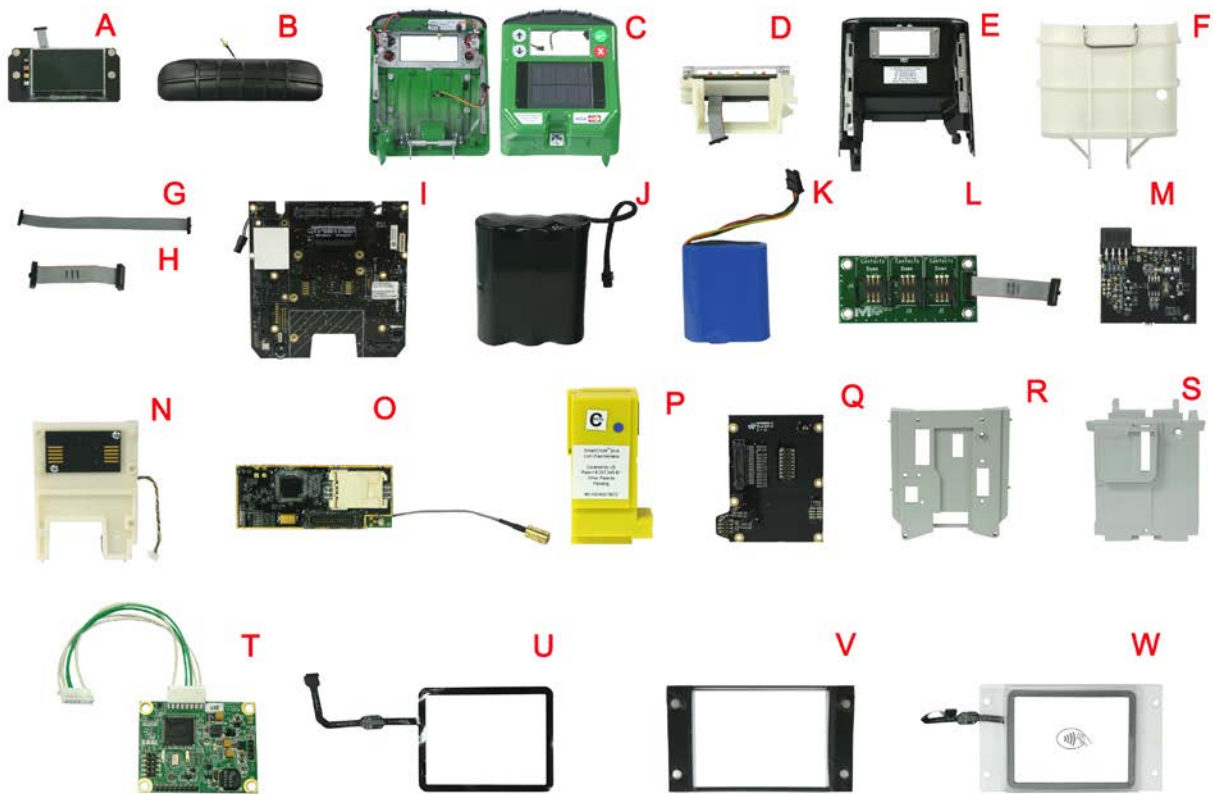
B Back Cover Assembly

C Antenna Cover



• Figure 6 – Internal View of MacKay Guardian™ Solo

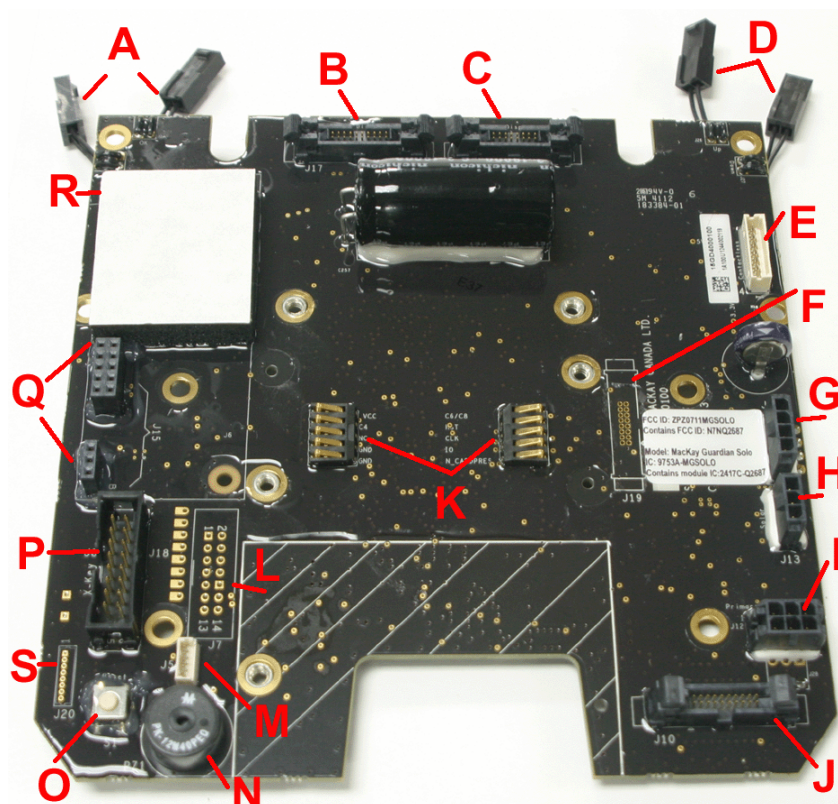
- | | |
|---------------------------------|-----------------------|
| A Main Alkaline Battery Pack | G Front Cover |
| B Lithium-Ion Rechargeable Pack | H Chip Card Reader |
| C Antenna Cover | I Card Guide/Mag Head |
| D Enforcement Display | J Pivot Linkage |
| E Wireless Cellular Exp. Board | K Quick Release Pin |
| F Cellular SIM Holder | L Coin Chute |



• Figure 7 – Exploded Parts View of the MacKay Guardian™ Solo

| | | | |
|---|-----------------------------------|---|--|
| A | Front Display Board | N | Chip Card Reader Board |
| B | Antenna Cover Assembly | O | Wireless Cellular Expansion Board (WCEB) |
| C | Front Cover | P | SmartChute Coin Validator |
| D | Rear Enforcement Display Assembly | Q | Backplane Board |
| E | Back Cover Assembly | R | Lower Rear Frame Member |
| F | Battery Holder and Hanger | S | Lower Front Frame Member |
| G | Backplane to MCB ribbon cable | T | Contactless Reader w/ I/F Cable (optional) |
| H | Front Display MCB ribbon cable | U | Contactless Flex Antenna |
| I | Main Controller Board | V | Lexan |
| J | 6xD Alkaline Battery Pack | W | Lexan w/ Contactless Payment Symbol |

- K Lithium Ion Battery Pack
- L SAM Board (optional)
- M RFID Reader Board (optional)



• Figure 8 – MacKay Guardian™ Solo Main Controller Board – (Connector Side)

- | | | | |
|---|---------------------------------|---|------------------------------------|
| A | Confirm/Cancel Button Connector | J | Backplane board connector |
| B | Enforcement Display Connector | K | Chip card reader connectors |
| C | Front Display Connector | L | peripheral port connector |
| D | Up/Down Button Connector | M | mag-head reader connector |
| E | RFID Reader connector | N | Piezo buzzer |
| F | SAM board connector | O | Reset button |
| G | Lithium-Ion Battery connector | P | X-Key programming connector |
| H | Solar Panel connector | Q | Wireless Cellular Board connectors |
| I | Alkaline 6xD battery connector | R | Foam spacer/support |

3. MacKay Guardian™ Solo: Detailed Description

3.1 General Specifications

The **MacKay Guardian™** Solo is a fully electronic parking meter mechanism, with solid-state semiconductor components.

The Solo is designed to operate accurately and dependably within a wide temperature range and under varied environmental conditions, including wind blown grime, rain, fog, salt air and street vibrations.

All electronic components and connections are fully weatherproofed where possible. The Solo has been designed to provide dependable operation when properly secured in its protective outer housing; however, the Solo is not waterproof, should never be immersed in water, and should not be left uncovered and fully exposed to driving rain and other elements for extended periods.

The Solo fits into the MacKay MKH 4500 meter case, as well as others, without modification. All exposed Solo parts fit almost flush with the outside of the case.

The only moving parts are those associated with the anti-tampering, anti-pullback features of the coin chute assembly, and the spring loaded rear enforcement display

The Solo lower coin chute assembly quickly and easily detaches from the front cover assembly, by removing a quick release pin located at the hinge point..

The Solo has a dual-processor design. One low power microprocessor is dedicated to run the main meter applications including the coin chute processing, time keeping and LCD functions. The second processor located on the WCEB is dedicated to interface with the wireless cellular radio module.

- 1) The meter application is designed to support both online credit card authorization and smart card interface for data transfer and transaction data management.
- 2) The Solo can support both coin and card operations and supports up to 16 different coins and/or tokens and up to three optional plug-in SAMs. It accepts coins through a coin interface module and card payments through a card interface module.
- 3) The ISO compliant smart card interface supports both T=0 and T=1 protocols. The Solo can be programmed to accept both asynchronous and synchronous card types.
- 4) The Solo has a 64 x 128 pixel front dot matrix LCD display capable of displaying alphanumeric messages and graphics.
- 5) The Solo has over 1 megabyte (1 million bytes) of non-volatile memory.
- 6) The Solo is powered by a solar-recharged lithium battery pack and a non-rechargeable alkaline battery pack. The Solo will always use any power from the lithium-ion battery pack first until it is fully discharged and then automatically switch to the alkaline battery.

The Solo will automatically switch back to the rechargeable battery pack when it has been recharged to a preset level by the solar panel.

- 7) The Solo is activated by either the insertion of a coin or a card, if enabled, or by pressing one of the selection buttons on the front of the meter.

3.2 Field Serviceability

- 1) The Solo is designed so that metallic and non-metallic foreign objects can be cleared from the coin chute and card reader slot under varied weather conditions within three minutes.
- 2) The Solo returns to full functionality after being cleared and reset. No special tools are required. It may be necessary to set the time of day clock using the PDT if the battery has been disconnected for an extended period. In most cases the Solo will automatically retrieve the current date and time from the remote network as soon as the cellular radio connects to the cellular network.

3.3 Power Supply

- 1) All battery packs are normally shipped from the factory installed but unplugged from the meters and without dielectric grease applied. Lithium-Ion batteries are always shipped fully charged when they leave the factory.
- 2) The battery packs are factory shrink-wrapped and supplied with a non-reversible plug-in connector. A label is found on one side of the battery pack. The label has the date of manufacture as well as a label to mark the battery pack installation date.
- 3) The alkaline 6-D battery pack will provide an average operational service life of 12 months, if specific assumptions of power use are not surpassed. Replacement battery packs should always be new, and have been properly stored and handled according to the battery manufacturer's specifications prior to use. A new battery pack has a measured, unloaded (open terminal) battery voltage of 9.0 volts or slightly higher. Note that previously unused battery packs that have an older manufacture date, should be used first, before battery packs with a newer manufacture date. Note that packs that have been sitting on the shelf, unused for an extended period, will not give the same operational service life as fresh new batteries.
- 4) A "Low Battery" icon on the front LCD will be activated when the Solo detects that the battery voltage is near the end of its operational service life (TBD volts). The amount of operational service life remaining, after the low battery icon is activated, is dependant on many factors including actual usage, and will vary between 5 and 30 days. If the battery is not replaced during this time, the Solo will shut down without further warning or indication when it detects that a specific absolute minimum battery threshold has been maintained for a 24-hour period. A battery pack is to be considered at or near its "low battery" threshold, and should not be used, if it has a measured, unloaded (open terminal) battery voltage of approximately TBD volts or less.

- 5) The Solo uses a switching power supply on the main board assembly, which supplies the necessary power to the various components when needed.
- 6) To conserve battery life, when the Solo is not in use by on-street users, many of the components are de-activated or powered down, however the graphic display and event detection circuitry on the main board and coin reader assembly continue to be activated. In this mode the Solo can and will appear to almost instantaneously respond to the insertion of coins and cards and other events that wake it up. During non-enforcement hours, to conserve additional battery life, the Solo can be programmed to go into its “low power” mode. In this mode the coin chute assembly is still activated, however the graphics display and all LEDs may be deactivated (appears blank).
- 8) The Solo battery pack consists of six standard alkaline D-size cell batteries (Duracell MN1300 (NEDA 13A) or an exact equivalent), connected in series, providing a nominal output voltage of 9.0 volts. Only high quality, industrial grade batteries such as the Duracell MN1300 should be used in replacement battery packs.

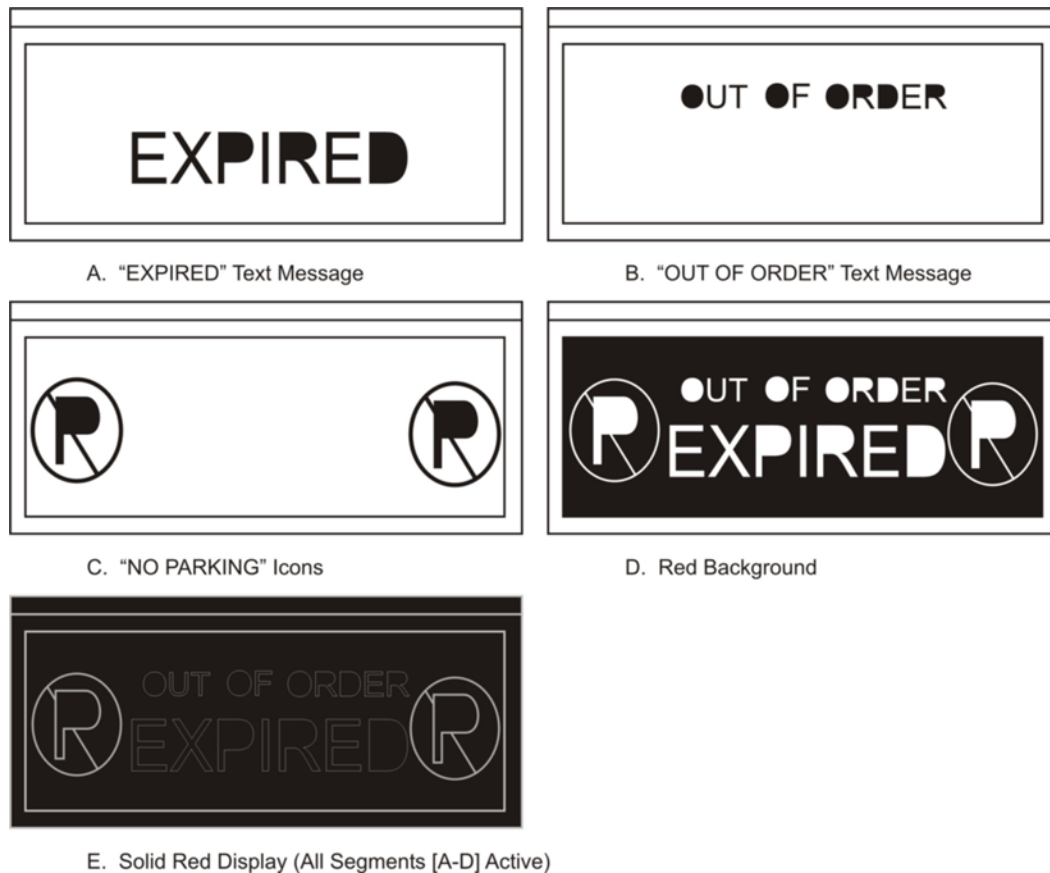
3.4 Indication Front



• Figure 9 – Front LCD

- 1) The Solo is capable of displaying the following:
 - Any symbol or pattern in a 64 high by 128 wide pixel graphics viewing area;
 - Seven lines of small font text of up to 20 characters each
 - Four lines of medium sized font text
 - Two lines of large font text
 - Negative sign or \$ symbol (or other symbol) located to the left of the left-most character;
 - Colon located between the second and third digits, when displaying time;
 - Decimal point located between the second and third digits for displaying cash values (\$0.01 - \$999.99);
 - International "No Parking" indicator;
 - "Low Battery" indicator;
 - "Out of Order" indicator;
 - "Last Coin Invalid" indicator.
- 2) The Solo has three front mounted LED indicators, a red, green and a yellow LED. The normal configuration is to have the green LED flashing when the Solo is "OK" or when in a valid "time displayed" state. It flashes the red LED when in a "No Parking" or "Meter Expired" state and flashes the yellow LED to indicate to the service and maintenance staff that the Solo is in a "maintenance required" state.
- 3) The programmed behavior of the indicator LEDs can only be adjusted by replacing the Solo's display attributes file. This file is created by and supplied by the manufacturer. Note that the indicator LEDs on the rear of the Solo follows the exact same indicator behavior as the LEDs on the front of the Solo.

3.5 Indication Rear



• Figure 10 – Rear Red LCD (Various Displays)

- 1) The Solo has a three square inch solid-state high contrast LCD on the back that is used to indicate paid status, expired status, and failed status. The LCD uses a red polarizer, which produces a high contrast, high visibility red color with a programmable variable flash rate.
- 2) The Solo can either statically display or flash the following information: "Out of Order", "Expired", 2 x International "No Parking" icons, and a solid red display. When the Solo is in normal operation and there is paid time remaining on the meter, the rear display will appear blank with the LCD's entire gray/silver background visible. When paid time has expired, the word EXPIRED, in RED on the LCD's gray/silver background will appear, and depending on the factory profile settings, this message may alternate with the reverse image equivalent, where the entire display is RED except for the word EXPIRED which will show on the LCD's gray/silver background.
- 3) The Solo has five rear mounted LED indicators, a left Red/Green led pair and a right Red/Green led pair as well as a single yellow LED. The normal configuration is to have the left hand green LED flashing when the meter is "OK" or when in a valid "time displayed" state. It flashes the left hand red LED when in a "No Parking" or "Meter Expired" state and flashes the yellow LED to indicate to the service and maintenance

staff that the Solo is in a “maintenance required” state. Note that the indicator LEDs on the rear of the Solo follows the exact same indicator behavior as the LEDs on the front of the Solo. The extra pair of red/green LEDs on the right side are only used when the Solo is configured for dual bay operation and are used to indicate the status of the right hand parking space while the left hand red/green led pair would be used for the left hand parking space.



3.6 Credit Card and Coin Acceptance Indication

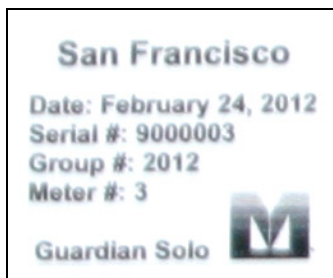
- 1) UV-tolerant vinyl labels with the accepted coins and credit cards printed on them will be placed on the front cover assembly in the depressed spaces provided. The labels may be changed by placing a new vinyl label over the old or by first removing the old one and applying a new one. As the rates and information can also be displayed on the graphic screen, the need for vinyl labels on the outside of the meter is reduced.



• Figure 11 – Solo meter and housing with labels for coin and credit card acceptance and card insertion

- 2) There is additional space that can be used for instructions or branding depending upon the client's needs. Figure 11 shows the MacKay Meters logo in those spaces.

3.7 Identification Label



• Figure 12 – Sample Identification Label

Each Solo will have a unique serial identification number. This serial number is assigned by MacKay at the time of manufacture and is found on the identification label located on the inside of the Solo front cover above the card guide. The label also contains the Meter ID # that was initially programmed into the Solo at the time of manufacture by MacKay.

Note that the serial number and the client assigned meter number found on the label are programmed into the Solo. They cannot be changed by the client.

The label information is also bar-coded (in code 39 format) for ease of retrieval/capture using appropriate bar code reading equipment/systems.

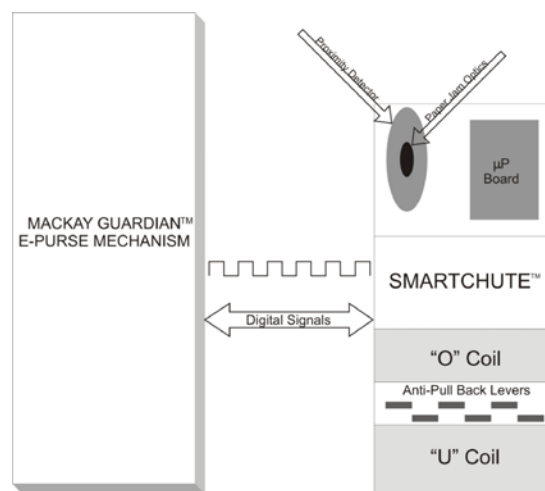
Other labels found on the Solo are the manufacture date label, patents notice label, QA/Inspection label, and FCC/IC certification label.

3.8 SmartChute™ Coin Discriminator Assembly: General



• Figure 13 – SmartChute™ Coin Discriminator Assembly

- 1) The coin chute, using magnetic coils, registers the parameters of coins that pass through the chute and relays this information to the main electronics board. The main electronics board decides the award of purchase time.
- 2) The coin chute is a plug-in assembly and it can be replaced in the field without re-calibration of the Solo or the use of special tools. There are no serviceable or replacement parts on the coin chute assembly.



• Figure 14 – SmartChute™ Coin Discriminator Internal Diagram

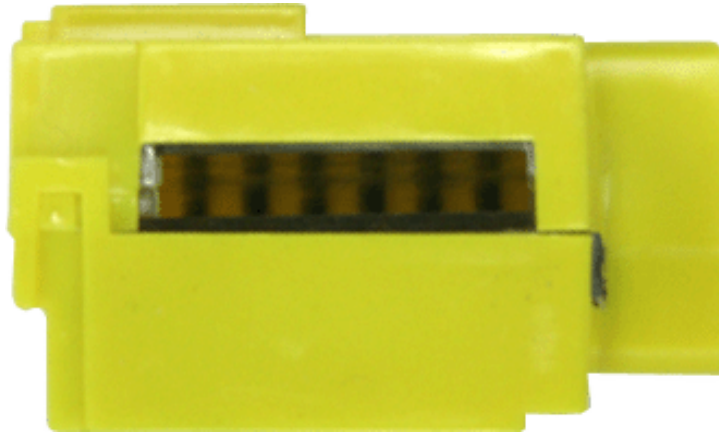
- 3) Subject to the actual location of the foreign object, the Solo can detect both metallic and non-metallic jams. When the coin chute detects a metallic or non-metallic jam, the Solo displays that it is inoperable. All detected jams are recorded in the maintenance log.

3.8.1 Coin Acceptance and Discrimination

- 1) The Solo is programmed to accept the following coins: the Sacagawea golden dollar, Susan B. Anthony dollar, Quarter, Dime and Nickel. The Solo is re-programmable to change/adjust the meter's coin recognition parameters of most accepted coins and tokens. The addition of most new coins can be accommodated in the future.
- 2) The *SmartChute* coin discriminator uses a proprietary inductive sensor design consisting of no less than three different coils to both activate and discriminate on coin insertion.
- 3) The Solo provides a count of all or most coin like metallic objects passing through the coin chute.
- 4) The coin chute provides a free-fall, almost straight drop coin channel. Coin jams can be cleared from either the top or bottom of the coin chute.

WARNING! SHARP METAL OBJECTS SHOULD NOT BE USED TO SERVICE OR CLEAR COIN JAMS FROM THE COIN CHUTE ASSEMBLY.

- 5) Significant build up of dirt/grime at the top of the coin chute may be sufficient to be detected as a non-metallic jam, and the Solo will go out of service. Replace the coin chute to correct this condition.

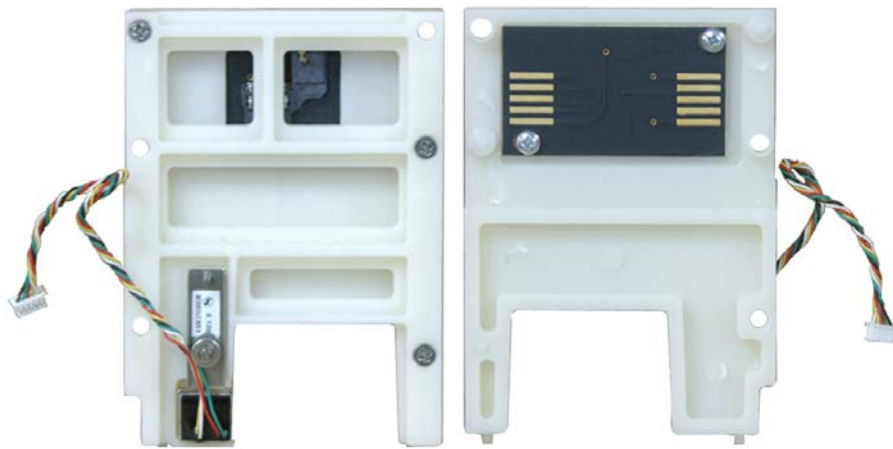


• Figure 15 – Top View, Close-Up Showing Anti-Pull Back Levers

- 6) The Solo has several independent mechanical anti-pull back levers, located at the lower part of the coin chute, which prevent the retrieval of deposited coins attached to strings, paddles, wires, etc. Coins should normally only be able to travel in one direction down through the coin chute. When clearing coin jams from the chute, the coins must not be forced in the opposite direction, as damage to the anti-pull back levers will occur and the product warranty will be voided.
- 7) The coin entrance has a replaceable stainless steel insert to provide some mechanical restriction of the maximum size (width/diameter) of the coins that can be inserted. To replace the coin slot insert, place the tip of a flat bladed screwdriver into the slot, and lift up on the slot.
- 8) Coins normally pass directly through the coin-chute into the sealed coin canister located in the vault. If jams are being recorded by the Solo, check for obstructions in the coin path.
- 9) In-shop coin testing of the Solo must always be carried out with the Solo placed in an upper mechanism housing assembly on a suitable stand. This will ensure that the in-shop testing being carried out is representative of how the Solo is actually used on-street. Coin testing should be done such that it is representative of on-street use. Coins should not be inserted in rapid succession or back-to-back without any pause between coins, nor should coins be flicked into the coin slot. This will result in missed coins and skewed test results.
- 10) The Solo's ability to discern and detect all inserted coins can be affected by a number of factors. They include the speed of the coin inserted, time between insertions, the angle of the Solo/post, and the presence of large amounts of water, dust, dirt and debris in the

coin chute. When investigating an Solo that has been reported as missing coins or having a large number of invalid coins, first inspect the post/housing to determine that it is not more than two (2) degrees of being plumb. A bent post will not allow the coin to free-fall through the coin chute, and the instances of invalid coins and jams will increase, with the severity of the bent post. Look down the coin chute and check for debris, water, dirt etc. Presence of enough of any of these substances that can slow down the coin as it free-falls through the coin chute may cause the coin (especially smaller lightweight coins like the dime) to not register correctly. Before placing the Solo back into the housing, always inspect inside the upper mechanism housing for evidence of coins or other debris that may have become caught in between the bottom of the chute and the housing.

3.9 Card Reader Assembly: General



• Figure 16 – Card Reader Assembly Top and Bottom View

- 1) The card reader is a plug in assembly that can be serviced and replaced without recalibration of the Solo or the use of special tools. There are no replacement/serviceable parts on the card reader assembly, except for the four mounting screws.
- 2) The Solo main board makes the decision on the purchase of time from all valid cards.
- 3) The card reader has a sealed “card present switch” that activates when a card is fully inserted into the card reader. If the card is not removed after a purchase or if the switch is jammed “on”, the Solo will deem the card reader jammed, will indicate the appropriate message, and record the event in the maintenance log.
- 4) The card slot should not allow entry by currently minted U.S. coins and each card reader has clean outs to allow for removal of debris/paper during maintenance.
- 5) The Solo frame provides a label showing embossed molded card contact symbol to indicate which way the card should be inserted. The chip should be facing up for proper operation.

- 6) A metal card reader support bracket is installed prior to assembly of the card reader assembly to the Solo by sliding the bracket over the outer edges of the card reader guides. The purpose of the card reader support bracket is to provide additional mechanical strength and support to the upper and lower plastic card guides on the card reader connector. There is a cutout in the support bracket so that the cleanouts of the card reader can still be cleared. Card readers that are replaced under warranty may also be supplied with integrated metal support brackets that serve this same purpose.

3.9.1 Card Acceptance

- 1) The Solo software controls the card acceptance. The inserted card is powered up, interrogated and validated using the appropriate command sequences and protocols associated with the card application in place to check the validity of the card. Once the validity of the card has been determined, the card purchasing cycle begins.
- 2) The card reader assembly does not lock the card in place, allowing the user to retrieve it at any time or after the purchase cycle ends.
- 3) The card reader assembly has a connector with internal card contacts. It is mated to a small circuit board to provide a rigid transition to the main board connector.
- 4) The card reader assembly has no electronic intelligence of its own. All of the driver and decision-making circuitry that establish communication with inserted cards is located on the main board.
- 5) The card reader assembly's card connector provides physical contacts to the inserted card as described by ISO 7816 specifications, Parts One to Four.

3.9.2 SAM Holders

- 1) The Solo meter has the ability to optionally support up to three SAMs and can be programmed to accept up to three (3) SAM-based smart card schemes.
- 2) The optional SAM holders in the Solo can be installed / accessed by opening the meter front cover. The optional SAM board is mounted as a piggy back board on the top of the existing chip card reader.
- 3) The Solo has non-volatile flash memory which can be re-programmed at a future time, to meet the operational need to support cards and SAMs of customer selected card schemes.
- 4) The SAM is used to actively challenge and authenticate each card. Each card transaction is recorded in the Solo meter's memory. After card transactions are collected, they are stored as secondary records, which remain until the next data collection.
- 5) Any further discussion on SAM holders and SAM based card schemes is beyond the intended purpose of this manual.

3.10 Upgradeability and Peripheral Port



• Figure 17 – Solo Peripheral Port for Future Expansion

- 1) The Solo peripheral port is a connector that supports future expansion and is visible and accessible to the left of the card guide when the meter case is opened.
- 2) The peripheral port is reserved for possible future use. This peripheral port connector has the necessary interface signals as well as industry standard serial communications interfaces, to support future add-on equipment.
- 3) The serial interface allows the meters to potentially communicate with MacKay support equipment to re-program the meters, change rates, etc., using a direct connection process. Two-way data transfer is possible, initiated by either the Solo or the hardware attached to the peripheral port.

3.11 Programmable Feature Options

- 1) The following meter profile features are programmable on the Solo:
 - Standard rate operation (one rate, 24 hours a day, 7 days a week)
 - Time of day multi-rate operation (up to 8 rates in a 24 hour period)
 - Day of week multi-rate operation (up to 8 different rates and time limits per day)
 - Charge current rate if time purchased extends into the next rate period, or charge the current rate till the time purchased enters the next rate period, then charge that rate
 - Pre-payment period (purchase time is held in escrow until the Solo is in a scheduled enforcement period)
 - No-parking times with warning period
 - Power saver (low power) feature for non-enforced periods
 - Overtime or grace periods
 - Exception Dates/Holidays (free parking, no pay periods, no parking)
- 2) The Solo is programmed with a specific profile to match the desired standard time and rate features for the City area/zone where the Solo will be located. The Sentinel™ meter management system creates these profiles using the initial profiles provided as templates. Once created, the profiles are wirelessly transferred to the Solo.

3.12 Internal Timekeeping

- 1) The Solo has a 365-day calendar real-time clock with backup capacitor/circuit to retain the day/date/time clock settings during battery replacement. The back-up power held in the back-up capacitor/circuit provides the user with up to 5 minutes to change the batteries without losing the time-of-day/clock settings.
- 2) The Solo will automatically check/set/adjust as necessary its date and time from the network each time it connects to the cellular network. The date and time can also be set using the PDT.
- 3) The time of day clock is accurate to +/-20 seconds per week.
- 4) The time of day clock is unaffected by the selection of standard or multi-rate operation. It remains in continuous operation and is never adjusted or stopped once the time is set except for daylight savings time adjustments (if required), battery removal and while depressing and holding down the reset button.

- 9) The day of week is tracked in the Solo and is displayed on the LCD along with the time-of-day and other service information when the reset button is pressed. Sunday is considered day 1, and the time is displayed in 24 hour format.
- 5) The Solo uses the time of day clock to schedule many events, including but not limited to, rate changes, on/off periods, self-diagnostics, and no parking periods.
- 6) The Solo internal display timers are designed to ensure that a user never receives less than the paid parking time. The coin chute measurements and main board validation determine if the user receives paid parking time. If the display shows 20 minutes after the last coin has been inserted, the count down timer is designed such that the user will never get less than 20 minutes of purchase time.
- 7) The time on the internal clock will be reset to the current network time whenever data is retrieved from the Solo. Date and time can also be sent using the PDT. It is important that the time/date set on the PDT is accurate as the PDT date and time is considered by the Solo as always being accurate and is uploaded to the Solo each time the PDT retrieves data.
- 8) All maintenance data and card transaction records stored within the primary audit data are time-stamped based on the current date and time in the meter.

3.13 Memory

The Solo stores all required maintenance and card transaction data, keeping a secondary copy of all records in memory even after they are transmitted to the back end. The redundant records are eventually replaced / overwritten over time, but will never be overwritten in less than 45 days. The backup audit records can be collected / retrieved from the Solo in the event of the loss of primary audit data from a PDT / back end, provided 45 days has not elapsed since the audit records were created.

3.14 Memory Retention at Power Failure

With the exception of the current time of day and the current purchase time (if any), stored data remains unaffected and is retained during power outages, such as a depleted or disconnected battery. The Solo memory stores programs and data for 10 years without degradation.

3.15 Revenue Audit Capabilities

- 1) The Solo maintains a count of each type of valid coin, invalid coins, token card transactions, and summary of electronic cash amounts and credit card amounts, storing each type of information separately in memory.

- 2) The Solo incremental coin count totals will closely match the physical coin count total. The Solo continues to increment its coin counters until they are reset during a coin audit using the PDT or collection card. This counting/increment activity includes periods of Free Parking and No Parking and low power periods.

All financial audit data, system log data and all other card transaction data may be collected/retrieved automatically by way of the wireless cellular network, or manually through the PDT RF probe interface.

The Solo has two sets of coin count registers. One set of registers is reset to zero after each coin audit (collection) is completed, while the other set of registers retains a cumulative count of each coin type until it reaches 65,535 counts (2^{16} bits). Once it reaches this count limit, it will reset to zero and continue to increment upwards as coins of that type are inserted.

3.16 Transfer of Data

- 1) The average time to download Summary Audit Data will normally not exceed 3 seconds. All other data transfer times will vary by the amount of data being held in the Solo.
- 2) The average time of field programming of Solo profiles will normally not exceed 10 seconds.
- 3) The transfer time associated with the collection of card transaction data will depend on the selected card scheme, as well as the number of card transaction records held in the Solo.

3.17 Coin and Card Check during Maintenance

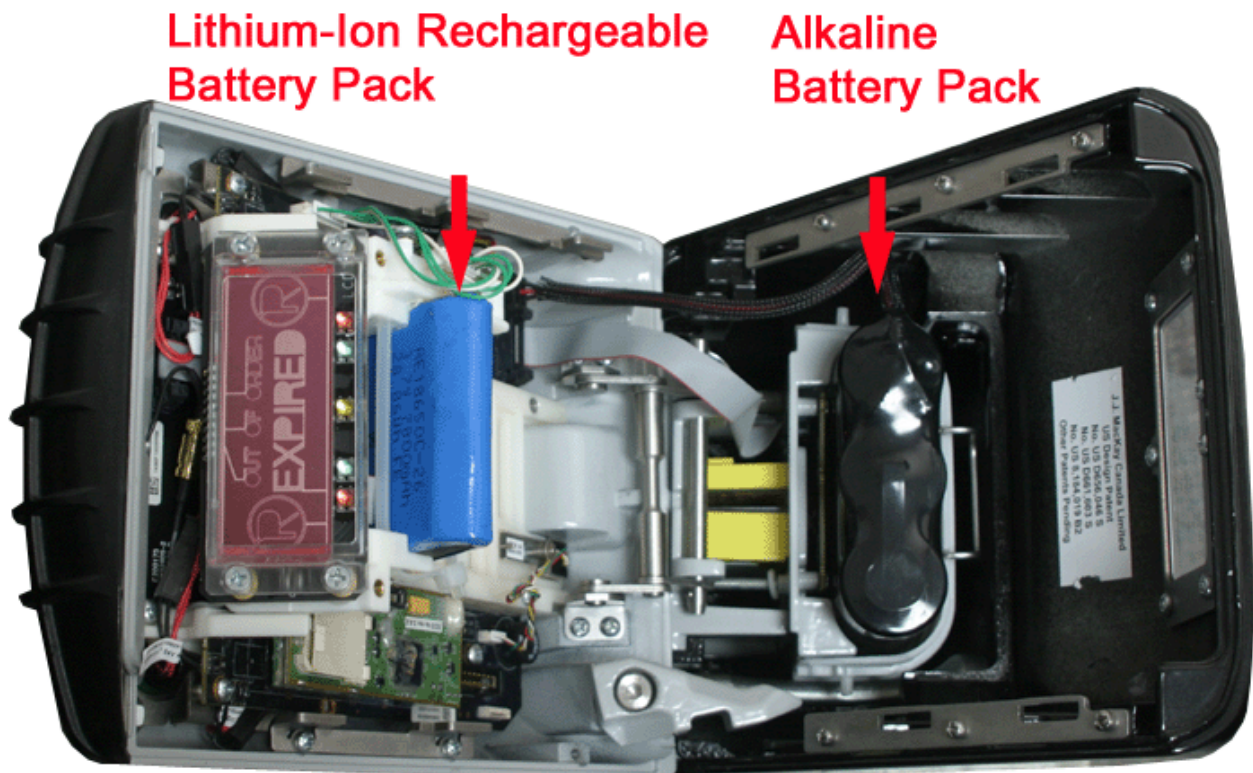
- 1) The Solo has a feature that temporarily disables the recording of cash totals to allow test purchases to be made on the meter without those test purchases being recorded in the audit data. The feature is invoked by pressing the reset button.

Following reset, and after the Solo displays its "lamp test" information, the internal counting of any subsequently inserted coins or card transactions is immediately disabled to allow for testing. Any test coins or cards inserted will cause the Solo to operate (and display purchased time as usual) however these test transactions will not register in the internal coin count registers or primary audit until there has been no coin or card transaction activity for at least 60 seconds, after which time the registering of coins in the count registers and card transactions in the primary audit is enabled automatically.

- 2) Once the testing is completed, the Solo will revert to normal operation without further operator intervention or commands.

3.18 Modular Components

- 1) The Solo consists of modular components that can be separated for repair and/or replacement.
- 2) The main wear and tear components can be accessed by removing the appropriate securing pins or screws, using a common #2 Philips screwdriver. All screws remain attached to the zinc frame and will not fall out after disassembly.
- 3) The major wear and tear components can be easily replaced in the field with the front cover opened.



• Figure 18 – Front Cover opened to reveal inside components

4. Portable Data Terminal: Description

The meter, once installed into the field, can be programmed and communicated with, by a portable data terminal (PDT), configured with the appropriate interface device and running suitable software to allow communications. The handheld devices employed are Microsoft® Windows® CE based computers, small, lightweight and rugged in design. The typical activities carried out in the field with the handheld devices are to change rates (or other programmable meter features), read and save the individual meter coin totals (audit) and transaction data, as well as recording meter status/maintenance activities. At the end of the day's maintenance or data collection activities, the PDT is returned to its cradle for battery charging and data transfer. Use of the PDT is beyond the scope of this manual, and additional information can be found in the appropriate PDT documentation.



• Figure 19 – Portable Data Terminal (PDT)

5. Web Based Management Software: Sentinel™ MMS

The MacKay Sentinel™ web based meter management software is used for organizing meter system data, generating reports, and managing the entire meter system. This web based software can be accessed using most web browsers and using the provided user access information. Use of Sentinel is beyond the scope of this manual, and additional information can be found in the Sentinel™ MMS Detailed User Guide documentation.



• Figure 20 – MacKay Sentinel Meter Management System

6. MacKay Guardian™ Solo: "How does it work?"

This section describes the basic coin and card operation of the **MacKay Guardian™** Solo meter, use of the Smart Card Interface (SCI) and the meter's display sequence following reset (Lamp Test).

6.1 Coin Operation

The **SmartChute™** coin discriminator (coin chute) uses patented sensor technology. The term "SmartChute" is derived from the fact that coin discriminator is managed by the main board microprocessor. There are actually three inductive sense coils in the *SmartChute* coin discriminator assembly, in addition to an optical sensor pair that is used to detect non-metallic jams in the upper part of the chute. The upper most sense coil is used to detect and signal that a coin is passing through the chute, while the remaining two sense coils provide a series of distinctive signatures that are captured and converted to a digital form. The series of captured signatures are usually unique for a given metallic object. Since both the US and Canadian Mints will usually control (within specified limits) the weight/metal content of each coin type, the insertion of identical coins will give approximately the same series of distinctive signatures. The *SmartChute* coin discriminator will provide a series of measured signatures from an inserted coin and the meter will compare those signatures with a table of known valid coins. When a match is found in the table, meter time is awarded to the user based on the value of the coin and the current rate structure. Otherwise, the coin is considered invalid, recorded as such, but no time awarded.

The Solo operates in the following manner when a coin is inserted:

All inserted coins pass down a common coin path, through the same coin slot. In the brief time it takes the coin to travel through the coin slot and exit out the bottom of the coin chute, the meter has activated its electronic circuits and analyzed the coin. For all metal objects inserted, the meter completes a number of measurements on the object using MacKay's patented coin discrimination technology. The measurements of the inserted coin are compared with known values of valid coins in a look-up table stored in the meter. Based on proper matching within the table the coin is determined to be valid or invalid.

If the coin is Invalid (i.e. not on the list of valid coins):

- The invalid coin symbol is turned on, if configured (see Figure 9, Item C).
- The meter's internal invalid coin counter¹ is increased by one.

If the coin is Valid:

- The meter's internal coin counter¹ for the valid coin type is increased by one.
- If, for example the inserted coin was to result in a purchase of 20 minutes of time, the meter's display would register 0:20, indicating zero hours, and twenty minutes of countdown time remaining. The internal timer counts down for each minute shown on the display. The meter display is decreased by one minute every time the internal timer passes zero.
- If there is no time on the meter or it is in an overtime period, the appropriate amount of time is added from zero and shown on the display. If the backlight is enabled it will turn on at this time (if a minimum purchase is enabled, subsequent coin insertions may be required before time is displayed).
- If there is time on the meter, the appropriate amount of time for the valid coin is added to the time shown on the display up to the meter's maximum time and this new time is displayed. If the meter has a scheduled OFF (low power) period immediately following the regular enforced time, the meter will only display the purchased time up to the next scheduled OFF period (e.g. if the enforced period which ends at 6:00pm, is followed by an OFF (low power) period, and the user inserts coins into the meter at 5:45pm, the most time that the meter can display (or the user can purchase) is 15 minutes).
- If the meter is on, but is functioning in a non-enforcement period (i.e. one hour before enforcement begins), and a coin is inserted to make a purchase, the time remaining between the time of purchase and the enforcement period is automatically added to the desired purchase time at no cost to the end user. For example, if enforcement begins at 9:00am, and a customer wishes to purchase one hour of time (value of \$1.00) at 8:15am, insertion of a \$1.00 coin would result in 1:45 being displayed.
- If the maximum time limit is reached (or attempted to be exceeded by excess coin payment), only the maximum amount of time allowed by the meter is displayed. Please note, the time limit sticker, if used, is normally located below each display, indicating the maximum time limit for the meter.
- When the display on the meter changes to 0:01, there is one minute of purchase time remaining. The display remains like this until the internal timer counts to zero,

¹ The meter's internal coin counter is an actual internal register or reserved memory located in the meter's memory that keeps track of the coins inserted into the meter and tokens removed from valid cards. This is non-volatile memory and will not get lost in the event of complete battery failure.

purchase time is now used up and the display either goes into a predetermined overtime period (Grace or Penalty) or shows the EXPIRED message (Violation).

6.2 Card Operation

All cards inserted activate the meter through the mechanical activation of a small, sealed, contact switch at the back of the card reader assembly. The card must be fully inserted to activate the switch. When activated, the meter provides power to the card, and determines whether the card is a valid client smart card. If the card is not identified it may be a credit card which will be read by the magnetic head reader as the card is removed.

A valid card normally contains stored value for parking, which is organized on the card as a count of full tokens, plus any additional value currently held in a partial token counter or register on the card. Each card token has a predetermined value, for example \$0.25 (token value). The partial token counter or register has a resolution of \$0.01 (partial token value). These values are determined up front, and then are set by the manufacturer during the manufacturing of the card. This is an irreversible process. That is, once the card token values have been set by the manufacturer, you cannot change the token values of the card because the “fuse” has been blown.

The token value is known by the meter, and based on the number of tokens counted the meter multiplies this total by the token value assigned by the customer. An example of this is if the meter counted 200 tokens on the card and the value assigned by the issuer is \$0.25 (200 x \$0.25), and there is zero in the partial token count, the value shown on the display is \$50.00. This means the customer has \$50 parking dollars on their card.

However, certain criteria, such as Card Initial Purchase Increment, Card Initial Increment Count and Card Purchase Increment, can be changed through profiles created and edited with Sentinel™ MMS. Use of Sentinel™ MMS is beyond the scope of this manual. Please consult new supplemental Sentinel™ MMS documentation regarding the creation of card profiles, or your MacKay Customer Service Representative for further details.

Certain card schemes can use either re-loadable or disposable cards, and are customizable within the meter application, created and provided by MacKay. Please contact your MacKay Customer Service Representative for further details on supporting other cards on the Solo.

Zero cash value remaining will be indicated with a display of zero or an appropriate message appearing on the meter's LCD. Under normal circumstances, the card is only removed once the desired amount of parking time has been purchased.

The Solo electronic parking meter normally operates in the following manner when a standard, authorized, token card is inserted (actual behavior is dependent upon the specifications of the token card scheme deployed):

- The meter attempts to validate the inserted card. This process is indicated to the user through the message “Processing” on the display.

If the card is Invalid:

- The meter will display a message indicating a card error and to pay using coins (for example, “Card Error, Use Coins”).
- If the card is left in the card reader device after the meter has displayed this message, the meter will in almost all cases display a “Coins Only” message until the card has been removed.

If the card is Valid:

- The meter takes a count of how much stored value is on the card. As money is removed from the card, the token count value becomes smaller.
- If the user would simply like to check the balance of his or her card, removal of the card can take place after the balance is displayed, and no value is deducted from the card.
- If there are tokens remaining on the card, and the card is left in the meter after the card balance has been displayed, the meter will attempt to initiate a purchase cycle.

Token Card Purchase Cycle

- If there is no time on the meter or it is in an overtime period (grace or penalty period), the appropriate amount of time is added from zero and shown on the display. Several token extractions may be required to complete a minimum purchase (if defined in the meter rate profile) before time is displayed.
- If, for example the inserted card was to result in a purchase of 20 minutes of time, the meter’s display would register 0:20, indicating zero hours, and twenty minutes of countdown time remaining. The internal timer counts down for each minute shown on the display. The meter display is decreased by one minute every time the internal timer passes zero.
- If there is time on the meter, the appropriate amount of time for each token is added to the time shown on the display up to the meter’s maximum time and this new time is displayed. If the meter has a scheduled OFF (low power) period immediately following the regular enforced time, the meter will only display the purchased time up to the next scheduled OFF period (e.g. if the enforced period which ends at 6:00pm, is followed by an OFF (low power) period, and the user inserts a card into the meter at 5:45pm, the most time that the meter can display (or the user can purchase) is 15 minutes).
- If the Solo is on, but is functioning in a non-enforcement period (e.g. one hour before enforcement begins), and a card is inserted to make a purchase, the time remaining between the time of purchase and the enforcement period is automatically added to the desired purchase time at no cost to the end user. For example, if enforcement begins at 9:00am, and a customer wishes to purchase one hour of time (value of \$1.00) at 8:15am, insertion of a card (after validation and display of the card balance) would result in the starting time of 0:45, then permitting the user to continue purchasing time up until the desired purchase has been made, resulting in a display of 1:45. Alternatively, the user

may purchase up until the maximum time on the Solo has been reached or the card is depleted of funds.

- If the inserted card does not have sufficient funds to complete a purchase, the meter will display the message “No Funds, Use Coins” or similar message. If the card remains in the card reader, the meter will display a “Coins Only” message until the card has been removed. The card user may always insert coins before or after a card transaction to buy additional time until the maximum time has been reached.
- If the maximum time limit is reached (or attempted to be exceeded by excess card payment), only the maximum amount of time allowed by the meter is displayed. Please note that the time limit is normally displayed, indicating the maximum time limit for the meter, along with a message indicating that the meter has reached its maximum purchase time. The one exception to this is if a purchase is made prior to an enforced period, where the remaining time between non-enforcement and enforcement is added to the purchase, and subsequently the display.
- Card purchases will only compound in standard increments (i.e. card initial purchase increment and card purchase increment as specified in the profile). There are two exceptions to this rule: one is if a purchase is initiated with residual time left on the meter. In this scenario, partial tokens will be extracted (i.e. in \$0.03 increments if so programmed in the meter’s profile) to bring the purchase to maximum time. The other exception is if a maximum time purchase is completed before the meter begins enforcement period. In this case, there may be an “odd” time remaining before enforcement begins. Therefore, the meter will take partial tokens (increments that may be less than the standard token value) to bring the meter to maximum time.

Solo Memory

- The meter's internal token counters increased by the number of tokens extracted from the card, which increases as long as the card remains in the card reader device up until the maximum time has been purchased.

Post-Purchase Solo Behavior

- If the card is left in the card reader device after the meter has reached its maximum time, and the meter has indicated that the transaction has ended and to remove the card, the meter will indicate to use coins only until the card has been removed.
- When the display on the meter changes to 0:01, there is one minute of purchase time remaining. The display remains like this until the internal timer counts to zero, purchase time is now used up and the display either goes into a predetermined overtime period (Grace or Penalty) or shows the EXPIRED message (Violation).

6.3 Maintenance/Data Collection Using the RF Probe Interface (RFI)

The Solo electronic parking meter operates in the following manner when a device called the RF Probe Interface (RFI) is inserted into the coin slot:

- All inserted devices will cause an interrupt to the main processor, which in turn will activate the appropriate circuits to initiate the interrogation of the card/device that was inserted into the card slot. If a very specific challenge and acknowledge sequence is successful then the meter determines that it is communicating with the PDT through the RF probe interface device.
- The meter then receives the appropriate commands from the PDT such as send audit data, set date/time, etc.
- Once the meter has responded to the commands issued, the link is terminated and the RFI device can be removed.

Note:

6.4 Meter & LCD Display Activity During & Following Reset

When the reset button is pressed and released, the primary time of day clock is shortly halted and started. Any previously purchased time is lost and the meter display time is reset to zero. The graphics display will be cleared while the reset button is depressed. When the reset switch is released, the meter carries out an internal health test/diagnostic, and if no problems are detected, it goes into normal service. During the reset cycle, the meter carries out what is referred to as its "LAMP TEST" and the following actions occur:

Once the meter initialization/start-up process and lamp test is started, it should be allowed to run to completion without interruption.

- 1) When the reset button is pressed, there will be an initial display pattern presented, then the display on the LCD will display the following information:

| | |
|---|--|
| 2012/3/1 Thu 9:14:56 g2012 m18 | Year / Month / Day Time: HH:MM:SS Group ID# Meter ID# |
| 1:00 \$2.00/hr PRO 299 299 DAF 99 99 DRP n/a | Max Time Rate per Period \$X.XX /hr Profile Version # Display Attribute Field Version # Define Rate Profile Version # |
| CAF 10112 BLF bad PCF 1 RCFG 901 | Coin Attribute File Version # Blacklist Field Version # Purse Configuration File Version # - memo cards Radio Configuration Version # |

| | |
|---|--|
| Apps Main F80B.0814 Bootstrap 0B.15 Chute r5-oB.10 | Main App version # Bootstrap App version # Chute App Version # |
| CONF ok MANU ok | CRC Check if configurations area OK CRC Check if Manufacture area OK |
| Batteries Alkaline 4.50V Li-Ion 4.10V | Battery Pack Voltages Alkaline Pack Lithium-Ion Pack |
| Status Ext ok Chute ok | Status (OK or 4 digit Hex# to denote the error) Extended Status (OK or 4 digit Hex# to denote the error) Chute Status (OK or 4 digit Hex# to denote the error) |
| radio failure | Any errors are reported / listed on this screen |
| Radio answers no error PAPP 02.03 EXPN 0B.12 | Radio communication status is shown here Any errors on WCEB are shown here Payment App Version # Expansion App Version # |

Note that it is normal that other icons/symbols appear during the above display sequence, as is shown in the various figures.

- 2) The above display sequences will also have flashed all the LEDs, and available LCD ICONS, and will have exercised all LCD pixels in the graphic display area.
- 3) The meter will pause at the last display, with the backlight momentarily active, while it does the following additional internal tests:
 - (a) Check communications with peripherals and coin chute
 - (b) Check data integrity of downloadable data items
- 4) Following the display of the health status information, the meter will go into service if it is able. The last two operations performed are the suppression of the counting of coins and card transactions for a period of 60 seconds, reset by a coin or card insertion, and it will log a reset maintenance event when the lamp test is complete. The counting of coins and card transactions will resume automatically after 60 seconds has elapsed since a coin or card was inserted.

Pressing the reset button is discouraged except for the following circumstances:

- 1) To access the coin/card test feature.
- 2) In cases where the meter is apparently non-responsive to normal stimuli.
- 3) Where requested to do so by MacKay originating operating procedures, or customer service representative, obeying all documented timing restrictions.

6.5 Requirement for Periodic Data Transfer

While there is substantial memory in the Solo meters to store maintenance activities and card transactions, this memory is finite and will eventually fill up over time and older data is overwritten with newer data and the older data is possibly lost or destroyed if the data has not been transferred to the back end. The meter is currently configured to go out of service if no data transfer has taken place for greater than 45 days.

7. Meter Installation and Removal from Housing

7.1 MacKay Guardian™ Solo Installation

First, remove the existing parking meter and cap if present. Then install the back cover piece of the Solo meter and test to ensure that it fits properly and confirm that the normal locking / unlocking is not impeded by the back cover. Next, install the Solo meter as described in the following section.

When first powered up, the **MacKay Guardian™** Solo meter will display the “Out of Order” message until it has been configured, described below, and will display a flashing amber LED until it has been connected to the cellular network. The PDT is typically used to do all meter installations and removals. The steps to carry out meter installation are:

- 1) Connect a fresh, new battery to the meter, and let the meter complete its lamp test and connect to the network.
- 2) Using the PDT, set the proper date and time on the meter.
- 3) If vault door sensors are installed, connect the meter’s vault door sensor interface cable to the mating connector.
- 4) Using the PDT, carry out the INSTALL procedure which sets the post ID where the meter is being installed.
- 5) Insert the lamp test service card or briefly press and then release the reset button, let the meter do a complete diagnostic, and once the lamp test has completed. Confirm that the meter is reading the correct post ID. Insert coins of each accepted denomination and a test card to test for normal/expected behavior (rate and max time).

Remember that for 60 seconds after the last coin or card insertion, the meter will not add coin or card transactions to the respective counter or data log. It is recommended to wait for 60 seconds with the meter before returning it to its housing or allowing the public to use the meter.

7.2 MacKay Guardian™ Solo Removal

A meter will need to be removed if, after normal on-street inspection and troubleshooting, the meter will still not operate reliably. A record of each meter removal MUST be made on the PDT to ensure that the meter/post database is kept accurate. This record can be done manually if the meter is non-responsive (dead battery, etc.) or using the Solo and SCI or LKI if the Solo is still able to communicate in this manner. The steps to carry this out are:

- 1) Using the PDT, carry out the REMOVE (or SWAP) METER procedure which identifies the meter being removed and the post affected. If the meter is non-responsive and communications with the meter is not possible the PDT keyboard is used to make the manual meter removal data entries.
- 2) Disconnect the Solo's vault door sensor interface cable (if present) from the mating connector.

When it is necessary to disconnect the Solo from the vault door sensor cable, care must be taken that both cable ends are grasped and then pulled apart. This will minimize stress and potential damage to the cable connection points at the meter's main board and the housing right bracket lock contacts. Pulling the meter away from the housing to force the separation of the cable may void the warranty.

- 3) Disconnect the battery from the meter.
- 4) Complete and attach a meter fault label to the meter or in the battery compartment so that the City's repair staff at their meter repair depot will know what the original fault was and what repair attempts have already been made.
- 5) If the meter cannot be repaired, and if it is still covered by warranty, return the meter to MacKay in accordance with prescribed warranty return procedures.

8. Troubleshooting

This section deals with basic troubleshooting. It is assumed that the user/reader of this guide has received adequate Solo training and knows how to use the MacKay MT-CE Handheld Application. Use discretion when determining which procedures can be carried out on-street and which require the meter to be taken to the meter repair depot for servicing.

8.1 Repair Guide

Materials Required:

- Bench test card reader;
- Diagnostic / service card
- Bench test coin chute;
- Bench test battery pack;
- JETT handheld running MacKay MT-CE Handheld Application Version [TBD] or greater;
- RF Probe Interface device ;
- # 2 Philips screw driver;

Required Setup for In-Shop Repairs/Testing:

- [TBD]
-

Please Note: It is assumed that a stock of replacement card readers and coin chutes are on hand for repair and that all faulty components will get swapped for good ones with the designated service technician.

8.2 Final Test

Before the Solo can be considered ready for the street, it must be [TBD]

- 1) TBD

8.3 Common Faults

The following outlines the more common faults and most likely repairs.

8.3.1 TBD

Problem TBD

Solution

- 1) TBD

9. Maintenance and Repair

This section deals with: testing a new battery pack, replacing meter battery packs on-street, in-shop repairs, replacing a coin chute and card readers, testing a reassembled meter, annual, monthly and weekly maintenance, handling, storage and transportation of meters and how to read and interpret the meter status message of the **MacKay Guardian™** Solo.

9.1 Testing a New Battery Pack

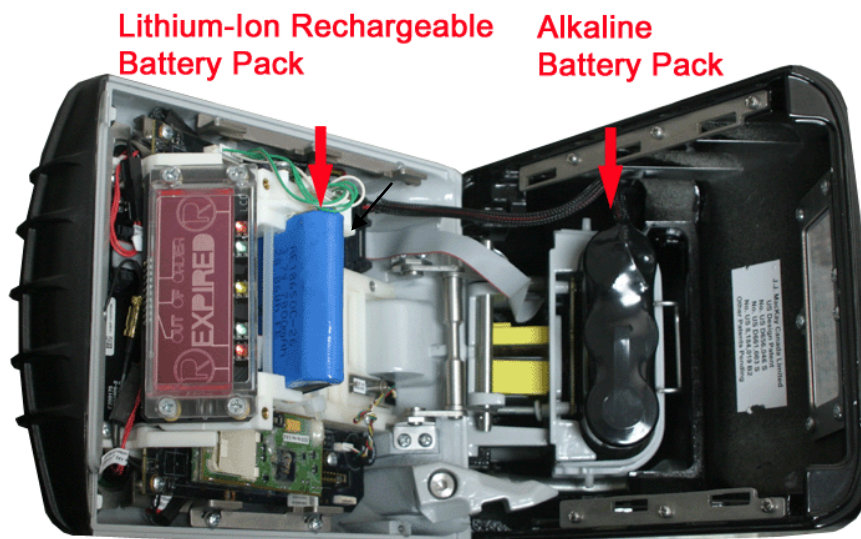
- 1) Using a digital multi-meter (DMM) set to the proper voltage range (10V DC) test the terminal voltage of the new alkaline battery pack. Insert the positive and negative leads of the multi-meter into the battery connector. A fresh unused alkaline battery pack has a measured voltage of 9.0V DC or higher.
- 2) The Solo will signal a low battery condition when the battery pack voltage is at approximately TBD volts DC. It is recommended that a battery pack be considered at or near its “low battery” threshold, and should not be used, if it has a measured, unloaded (open terminal) battery voltage of approximately TBD volts or below.

9.2 Replacing Meter Battery Packs

To replace the battery pack on a meter that has indicated that it is in a low battery condition (If the display is not blank, i.e. showing time/out of order/zeros) or the battery pack installation date is more than 12 months old, do the following:

Note: Avoid replacing the battery pack when it is active (i.e. during a reset sequence).

- 1) Unlock and swing open the Solo top cover from the back cover. There is no need to remove the meter from the housing during Solo battery changes.
- 2) Unplug the battery harness from the main board by first gently squeezing the connector interlock tab and then lifting up on the connector. The battery harness cable /connector should pull clear of the main controller board connector.
- 3) Remove the Solo battery pack.



• Figure 21 – Opened MacKay Guardian™ Solo with battery packs

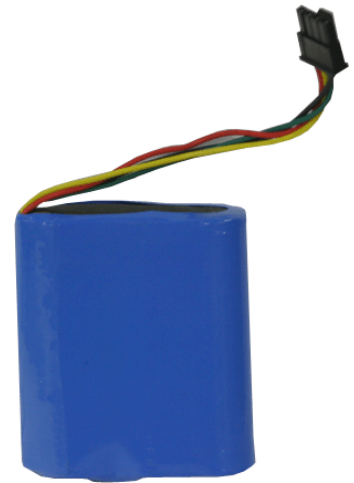


• Figure 22 – MacKay Guardian™ Solo Alkaline Battery Pack

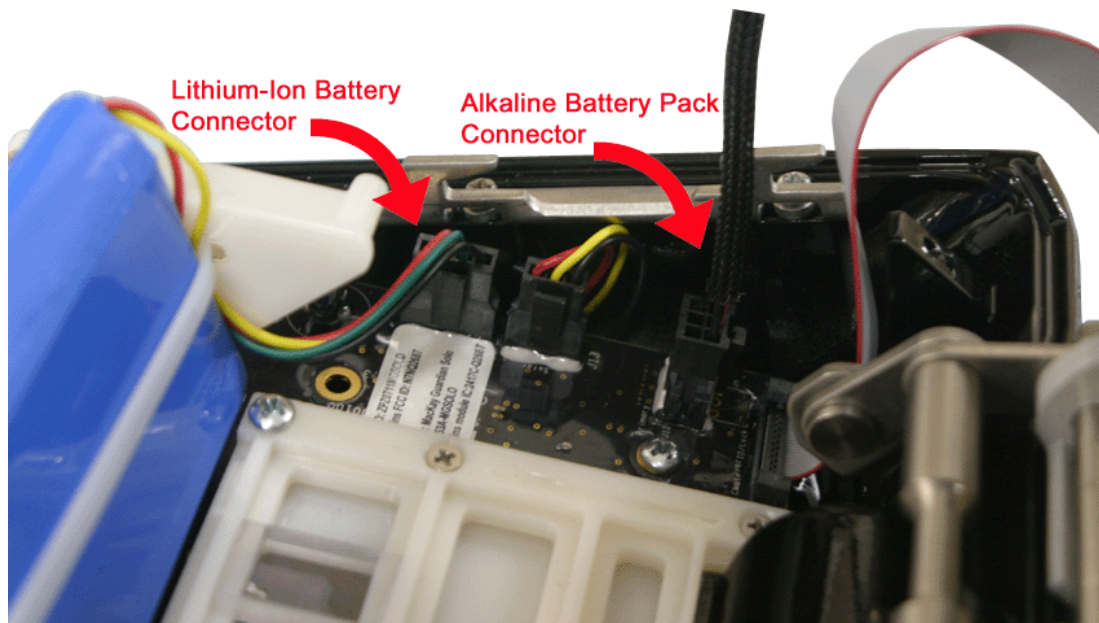
- 4) Once the battery pack is disconnected, it normally takes 1-2 seconds for the removal to be detected, and the meter display to go blank. **DO NOT DISCONNECT AND THEN IMMEDIATELY RECONNECT THE BATTERY PACK!** Wait at least 5 seconds before replacing or reconnecting a battery pack to the meter.

- 5) Remove any protective insulating tape around the end of the new replacement battery pack connector. Apply a very small amount of dielectric grease to the exposed metal contacts on both exposed mating ends of the battery connectors (Dow Corning 4 Electrical Insulating Compound).

- Figure 23 – MacKay Guardian™ Solo Lithium-Ion Rechargeable Battery Pack



- 6) Attach the new, previously tested, replacement battery pack by connecting the mating battery connector to the MCB. **DO NOT CONNECT AND THEN IMMEDIATELY DISCONNECT THE BATTERY PACK!** Wait until the meter lamp test has completed (if replacing a dead battery) or at least 5 seconds before disconnecting a newly replaced battery pack from the meter.



- 7) Place the battery pack back into the meter battery compartment, ensuring that the wiring harness is routed on the same side as the connector. The “INSTALLED DATE” label on the battery pack should be facing outwards and the repairperson replacing the battery should write the current date on the label using either a pencil or waterproof permanent marker.

- 8) Press and release the reset button located on the left hand side of the meter next to the card reader. If the meter was in operation prior to the battery replacement, and the new replacement battery was replaced within 3 to 5 minutes of the old battery being disconnected, the meter should be operational after completion of the meter's reset sequence (in most cases this is noted by the graphics display indicating "EXPIRED"). If the previous battery was fully discharged or the new battery replacement took longer than 3 to 5 minutes, the meter will not be operational (will normally indicate "OUT OF ORDER") until the correct time/date have been set in the meter by using the handheld/PDT or automatically as it successfully connects to the cellular network.
- 9) Once the meter is operational, after pressing reset, a coin and card test should be conducted to ensure that the meter is operating properly. Insert cards and sufficient coins in various denominations to bring the meter to its maximum time. Note that this coin and card testing will not register in the meter's audit memory if the coins and cards used for testing are inserted into the meter within 60 seconds of pressing reset. The meter will automatically revert to registering all coin and card transactions in its audit memory after more than 60 seconds have elapsed since the last coin or card was inserted into the meter.
- 10) Close the meter front cover and lock the meter.

Note: When a battery is changed in the meter, a Battery Event is recorded in the meter's maintenance record. However, the meter is designed so that any abnormal change in battery voltage since the meter's last health check is interpreted as a Battery Event. If a review of the meter's maintenance records indicates repeated unexplained Battery Events, the meter should be returned to MacKay for evaluation and repair.

9.3 Meters Returned to Meter Repair Depot for Repair

- 1) Remove the faulty meter from its transit case/carton. Review the fault sticker/label and begin to trouble shoot the problem. Carefully inspect the meter for physical damage or any obvious reason for the failure. Check the battery pack for proper voltage and secure connection. Check the card reader assembly, coin chute and reset button for jams, foreign material or a stuck condition. Connect the meter under repair to a test e-lock and housing setup. Using the PDT and RF Probe, install the meter into this test setup using the proper procedures (see Section 8), and ensure that the meter date and time are set.
- 2) If the meter cannot be fixed at your workshop, arrange a return merchandise authorization, "R.M.A." number with the local repair depot or MacKay. Package the meter carefully and return as instructed. The entire meter, less the battery, should be returned. Do not return partially dismantled or loose parts to the repair depot.
- 3) Once the meter has been repaired by MacKay and returned, coin check and check with a test card (if used) and return it to stock for future use.

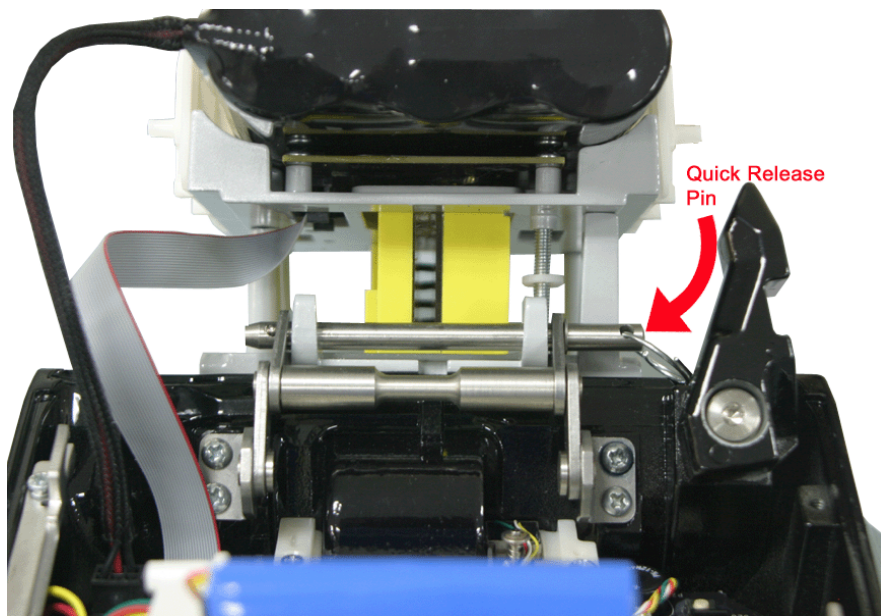
9.4 Disassembly

The following are step-by-step instructions for the disassembly of the Solo. Depending on the component being replaced, not all steps of the disassembly procedure will need to be performed. As the disassembly involves electronic components, the work area must be clean and have appropriate anti-static measures in place with anti-static mats, pads, wrist-straps, and any other appropriate anti-static equipment. A #2 Phillips screwdriver (with magnetic tip) is the primary tool required for disassembly and re-assembly of the Solo.

Note: All disassembly and reassembly should be performed with the battery packs disconnected or removed. Please refer to Figure 7 of this manual showing the exploded view of all meter components.

9.5 Disassembly of Lower Coin Chute Assembly

- 1) Separate the coin chute assembly from the main meter frame.
 - i) Disconnect ribbon cable that electrically connects the coin chute assembly to the main board by depressing the two eject tabs on the MCB connector.
 - ii) While supporting both the coin chute assembly and the main meter frame, pull out the quick release pin located on the linkage assembly. This will separate the main meter from the coin chute assembly.



• Figure 24 - Quick Release Pin

- iii) Unscrew the lower two captive screws found at the lower back of the coin chute assembly. Note that these screws are self-retaining and will remain on the main frame when unscrewed from the coin chute front.

- iv) Pull the coin chute front forward of the zinc frame part. This will fully expose the coin chute.
 - v) To remove the coin slot from the coin chute front, insert the tip of a flat bladed screwdriver into the coin slot and lift up on the coin slot.
- 2) Remove the SmartChute™ coin discriminator (coin chute).
- i) Gently pull the coin chute straight forward and away from the back frame assembly. You will note that on the back frame assembly there is a male header connector for connection with a female connector on the coin discriminator. It may be necessary to rock the coin discriminator assembly slightly while pulling the coin discriminator away from the back frame assembly.
- 3) Remove the battery holder and battery pack (if not previously done) by removing the two screws that hold the battery cover in place.
- 4) Remove the back plane board by removing the four retaining screws.
- ii) Remove the ribbon cable from the back plane board by pressing on the ejectors of the mating connector on the back plane board.

9.6 Replacing Coin Discriminator

If a coin discriminator cannot be cleaned out or becomes damaged it will be necessary to replace the coin discriminator. Use the following procedure to replace the coin discriminator:

- 1) Separate the coin chute assembly front from the main meter frame as previously described in Section 9.5.
- 2) Using a Phillips #2 screwdriver, unscrew the long front screw from the face of the Solo coin chute front zinc part, until it is no longer connected to the rear zinc part. Note that the screw will not actually fall free as it is retained by a small plastic retaining washer that prevents the screw from falling away from the zinc frame and becoming lost.
- 3) Unscrew the lower two captive screws found at the lower back of the coin chute assembly. Note that these screws are self-retaining and will remain on the rear zinc frame when unscrewed from the coin chute front zinc.
- 4) Pull the coin chute zinc front forward and clear of the main meter frame. This will fully expose the coin discriminator.
- 5) To remove the coin slot from the coin-card front, insert the tip of a flat bladed screwdriver into the coin slot and lift up on the coin slot.
- 6) Remove the coin discriminator from the plug to which it is attached.

- 7) Spray a squirt of ProGold™ XPG5 conditioning treatment on the connectors and re-install a coin discriminator into the mating header.
- 8) Assemble the parts previously removed.
- 9) Press the reset button and ensure that the meter is in service. Drop a coin 10 or more times through the meter and observe for proper acceptance.

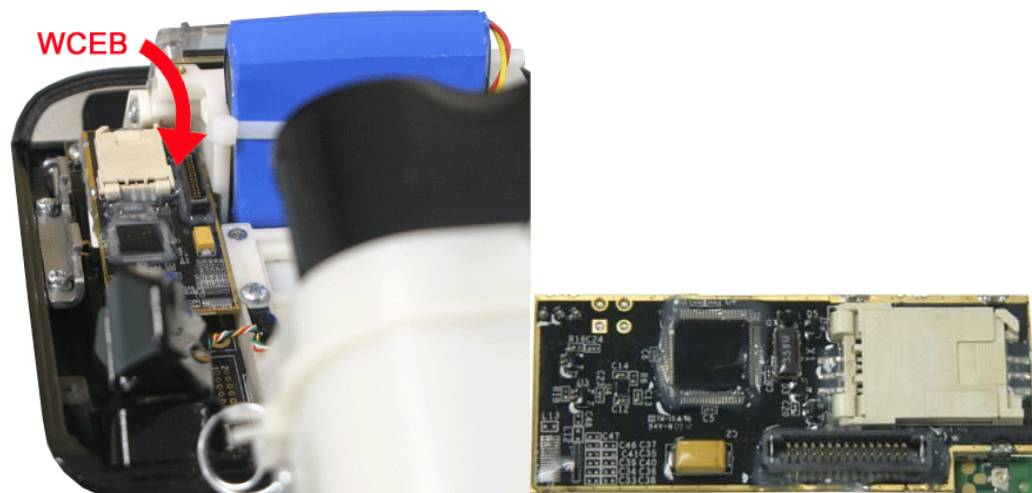
WARNING! SHARP METAL OBJECTS SHOULD NOT BE USED AT ANY TIME TO SERVICE OR CLEAR COIN JAMS FROM THE COIN DISCRIMINATOR ASSEMBLY.

9.7 Removal of the Main Control Board (MCB) Assembly

- 1) Disconnect and remove the main battery as previously described
- 2) Disconnect the lower coin chute assembly as previously described
- 3) Remove the two lower MCB retaining screws (see illustration)
- 4) Remove the two upper MCB from mount screws (see illustration)

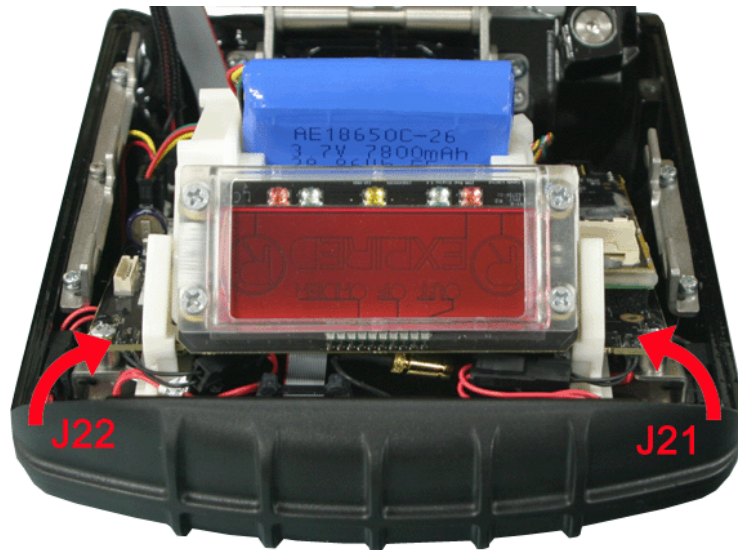
9.8 Removal of the wireless cellular expansion board (WCEB)

- 1) Unplug the wireless cellular expansion board (WCEB) by gently lifting up on the board until it pulls free of the two mating connectors on the MCB. If the WCEB or the antenna cover is not being replaced, there is no need to disconnect the antenna coax cable attached to it, and the WCEB can be swung out of the way and placed next to the meter front cover with the antenna coax still attached. (See illustration).



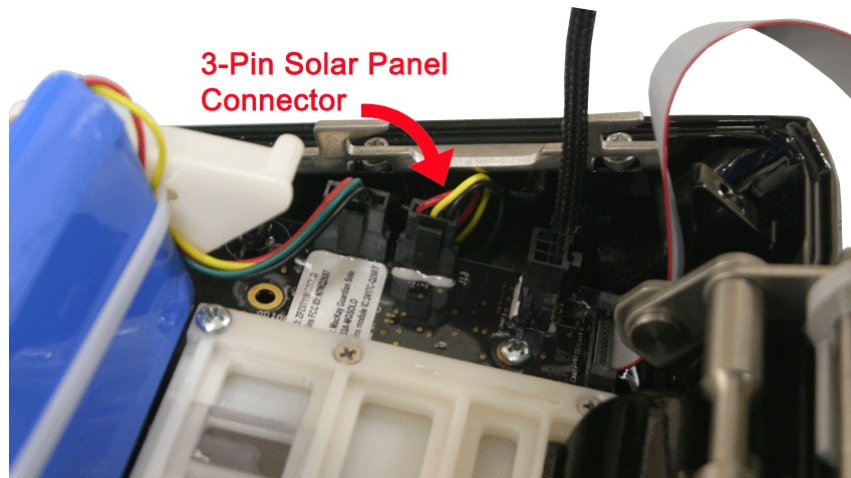
• Figure 25 - Wireless Cellular Expansion Board

- 2) Disconnect the two button flex cables by gently pressing down on the retaining latches on the end of each flex cable, and then gently sliding the flex connectors out of the mating connectors (J21, J22) on the MCB (see illustration).



• Figure 26 - button flex cable connectors on MCB

- 3) Disconnect the 3-pin solar panel harness from the MCB by pressing on the release tabs of the coax connector and lifting it clear of the MCB.



• Figure 27 - 3-Pin solar panel connector

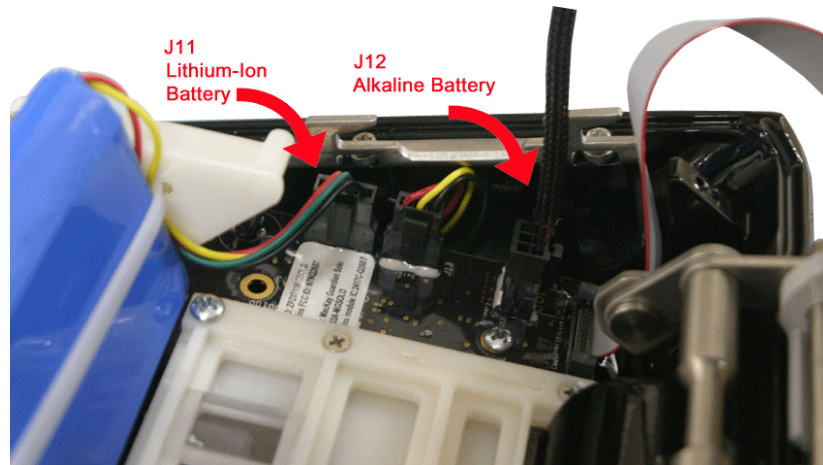
- 4) Gently lift the MCB clear of the main front cover zinc assembly.

Re-assembly is reverse of the above.

*Removal and handling of the Solo circuit boards requires that proper anti-static handling procedures be followed at all times. Never handle circuit boards without the proper ESD equipment (grounded wrist straps, antistatic, etc.)

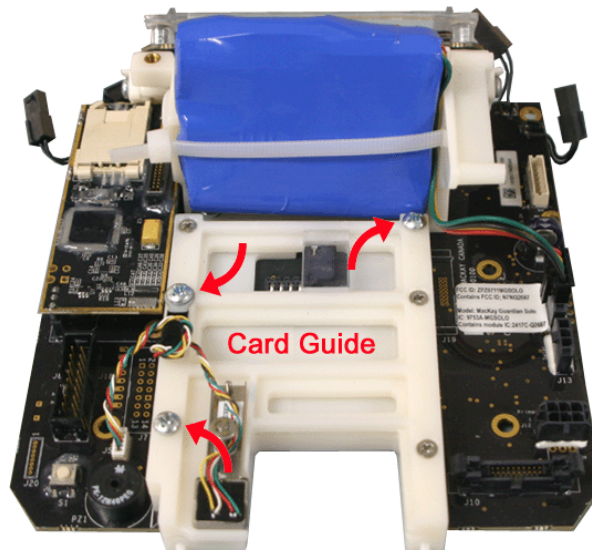
9.9 Replacing a Card Guide/MAG Head Assembly

- 1) Disconnect power from the MCB - remove plugs J11 & J12 (see illustration)



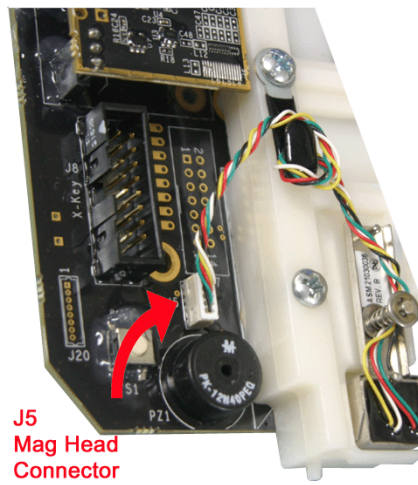
• Figure 28 - Battery Pack Connectors (J11 and J12)

- 2) Remove the three card guide/mag head assembly retaining screws (see illustration)



• Figure 29 - card guide/mag head assembly

- 3) Unplug the Mag Head reader from the MCB connector J5 (see illustration)

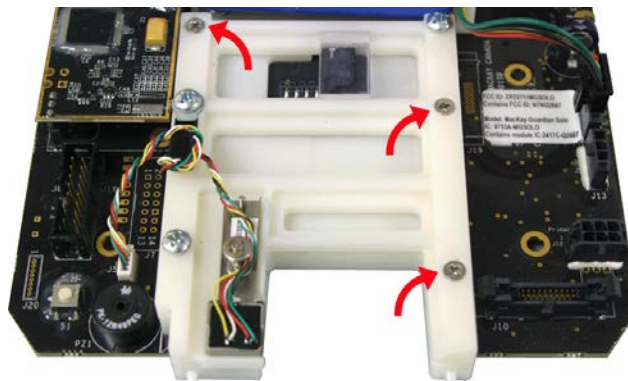


• Figure 30 – J5 - Magnetic Head Connector on MCB

- 4) Lift out the card guide. Reassembly is in the reverse order.
- 5) Prior to fully tightening the card guide/Mag Head assembly retaining screws, insert a test card fully into the solo meter. This ensures that the card guide & chip card reader are in alignment. Tighten the four retaining screws and insert and remove the test card a few times to ensure that the card can be inserted freely without binding/stiffness.

9.10 Replacing a Chip Card Reader Board

- 1) Disconnect power from the MCB - remove plugs J11 & J12 (see Figure 28)
- 2) Remove the three chip card reader board retaining screws

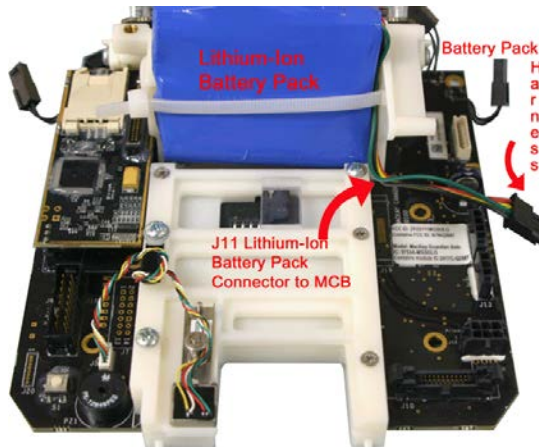


• Figure 31 - chip card reader board retaining screws

- 3) Lift the board clear of the MCB
- 4) Inspect/clean/repair/replace the chip card reader board as necessary
- 5) Reassemble the chip card reader in reverse order
- 6) Prior to fully tightening the four retaining screws, insert a test card fully into the Solo card slot. This helps ensure that the chip card reader and card guide are in alignment. Tighten the four retaining screws while ensuring that the test card can be inserted/removed without bending/stiffness.

9.11 Replacement/Removal of Lithium ion Battery

- 1) The Lithium Ion battery is retained in place by a heavy plastic tie wrap. The tie wrap will normally allow the battery to be removed/replaced without having to cut the tie wrap. The tie wrap should be replaced if the battery is loose or not being secured in place properly. (see illustration)



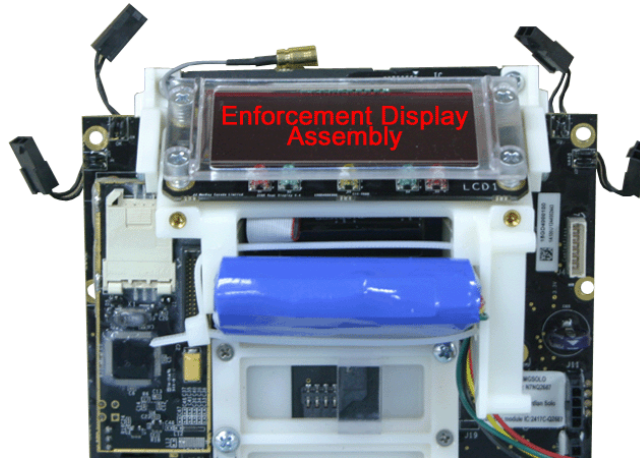
• Figure 32 - Lithium-Ion battery pack, harness, and MCB connector

- 2) Unplug the main battery pack harness connectors from J12 (See Figure 28)
- 3) Unplug the Lithium Ion battery pack harness connectors from J11 (See Figure 32)
- 4) Carefully slide the Lithium Ion battery up and clear of the plastic tie wrap that secures it. If the plastic tie wrap is too tight to allow this, cut the plastic tie wrap after first ensuring that you have a replacement tie wrap.
- 5) If the tie wrap is being replaced, feed the end of the tie wrap through the available holes in the enforcement bracket and then loosely attach the ends of the tie wrap.
- 6) Insert the Lithium Ion battery into the opening for the battery and tighten the tie wrap such that it securely holds the Lithium Ion battery in place. Trim any excess material from the tie wrap.

- 7) Reattach the connectors to the MCB for both the Lithium Ion battery and the main alkaline battery pack.

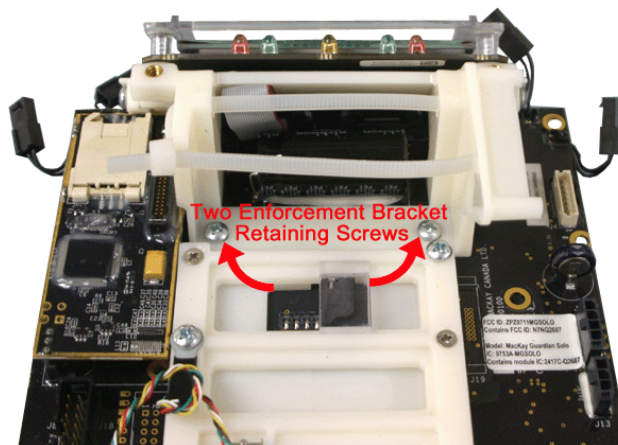
9.12 Replacing the Rear Enforcement Display Assembly

*Before the disassembly note the position of the ribbon cables on this assembly (see illustration)



• Figure 33 - Enforcement Display Assembly

- 1) Remove the MCB from the front frame and assembly as previously described.
- 2) Remove the rechargeable lithium ion battery as previously described
- 3) Remove the left & right front display board assembly retaining screws from the rear enforcement bracket
- 4) Remove the two enforcement bracket retaining screws which secure it to the MCB (see illustration)

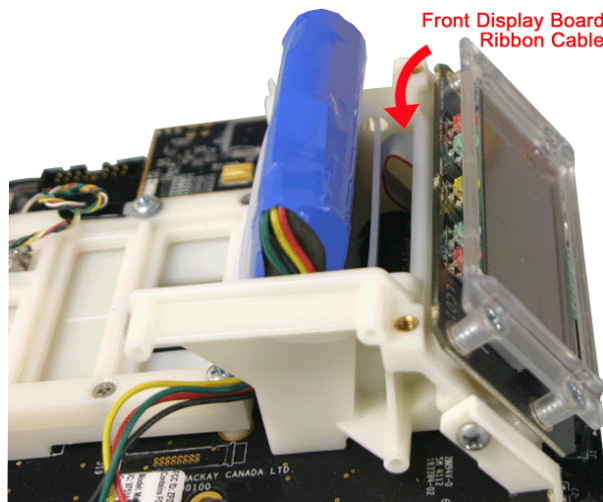


• Figure 34 - Two enforcement bracket retaining screws

- 5) Lift the enforcement display assembly up slightly and then disconnect the MCB to enforcement display ribbon cable of the MCB by depressing the eject tabs in the mating connector
- 6) Lift the enforcement display assembly clear
- 7) Insert/adjust/repair/replace the rear enforcement display assembly as necessary
- 8) Reassemble the rear enforcement display assembly in the reverse order described above. Ensure that the ribbon cable is reconnected and the ribbon cable is positioned such that it does not interfere with the spring loaded movement of the enforcement display (see illustration).

9.13 Replacing the Front Display

- 1) Remove the MCB assembly as previously described
- 2) Remove the rear enforcement display assembly as previously described
- 3) Gently slide the front display board assembly upwards until it clears the MCB



• Figure 35 - Front Display Board Ribbon Cable

- 4) Unplug the front display board ribbon cable from the MCB by pressing on the ejector tabs on the MCB connector. Note the position of the ribbon cable (see illustration)
- 5) Inspect/repair/replace the front display board assembly as necessary
- 6) Re-assemble by following the above in the reverse order. Ensure that the ribbon cables for both the front & rear display assemblies do not interfere with the spring mounted movement of the rear enforcement display.

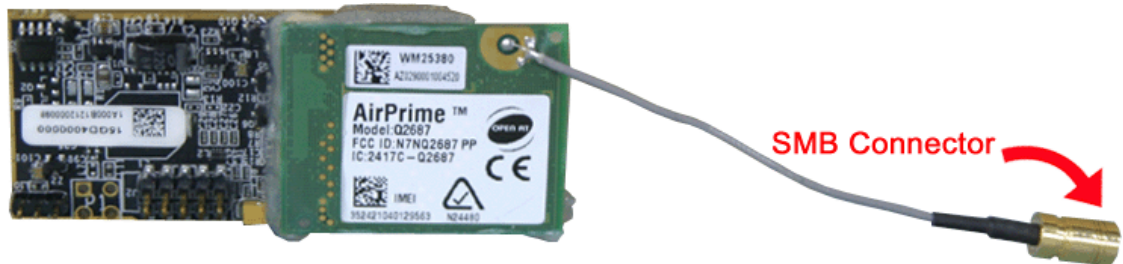
9.14 Replacing the Solar Panel

- 1) Disconnect both battery packs from the MCB at J11/J12
- 2) Disconnect the lower coin chute assembly as previously described
- 3) Unplug the WCEB as previously described
- 4) Remove the MCB assembly as previously described
- 5) Locate the four solar panel bezel retaining nuts on the inside of the front cover (see illustration) Remove these four nuts and the lock washers
- 6) Remove the front metal bezel by pushing on the four bezel retaining studs
- 7) Remove the solar panel protective Lexan by prying it upwards away from the front cover. Note the silicone used to seal the solar panel cavity may make it stubborn to remove
- 8) Remove the solar panel from the pocket/cavity in the front cover
- 9) Clean/remove any sealing silicone/gasket material from the front cover
- 10) Inspect /repair/replace the solar panel as appropriate
- 11) Apply a small amount of silicone around the solar panel wire harness cavity in the front cover (see illustration)
- 12) Install the solar panel ensuring that the wire harness passes through to the inside of the front cover and that the panel lays flat within the metal cavity
- 13) Apply a new solar panel gasket or a bead of silicone around the perimeter of the solar panel cavity, as well as around the four stud holes
- 14) Place a new/clean Lexan protective cover over the solar panel ensuring that it sits flush and that silicon is visible on all four sides of the Lexan
- 15) Reattach the metal bezel onto the front cover and attach the lock washers & nuts previously removed. Securely tighten all four nuts.
- 16) Wipe/clean/remove any excess gasket/silicone material
- 17) Reassemble the meter in reverse order of disassembly

9.15 Replacing the Antenna Cover Assembly

- 1) Disconnect all batteries to MCB at J11/J12

- 2) Remove lower coin chute assembly
- 3) Remove WCEB assembly by carefully separating the two SMB connectors between the WCEB Assembly to the SMB connector to the antenna.



• Figure 36 -

- 4) Remove the MCB assembly
- 5) Loosen/remove the four retaining nuts and lock washers from the inside top of the front cover
- 6) Pull the antenna assembly up and away from the front cover metal until the studs and coax cable are clear of the front cover
- 7) There are no reusable/repairable parts in the antenna cover assembly and this assembly must be replaced if damaged or not functional
- 8) Clean/remove any gasket/silicone material from the top of the front cover where the replacement antenna assembly will sit
- 9) Apply new gasket material or a bead of silicone around the perimeter of the top cover
- 10) Put the new antenna assembly in place by first inserting the coax connector through its access hole in the front cover (see illustration) and then reattach the lock washers & nuts to the four retaining studs and securely tighten.
- 11) Reassemble the meter in reverse order of the above steps

Note: Re attachment of the coax UFL type connector to the WCEB is done by carefully placing the end of the UFL connector on top of the mating connector on the WCEB and applying gentle force/pressure downwards. The UFL connector should pop into place, and it should still be possible to rotate the coax cable on the mating UFL connector on the WCEB

9.16 Testing a Reassembled Meter

- 1) Press the "Reset" button and check that the LCD displays the correct information.
- 2) Using several coins of each type accepted, check that all coins pass freely through the meter and register correctly. Using a test card, check that the meter operates correctly.

9.17 Annual Maintenance

A general inspection of all components should be carried out yearly. This inspection should include the following:

- 1) The displays are to be checked for any damaged or abnormalities.
- 2) The coin chute is to be checked for any foreign substances such as glue, any sticky sugary substances, spider webs, insect larva and jammed material (i.e. paper, wood, etc.).
- 3) Overall appearance of decals and any other instruction plates. Replace as needed.
- 4) Inspect the LCD/LED's to insure display is highly visible without excessive dust or dirt build up. Clean as required.
- 5) Check card reader for debris and/or damage. Clear debris or replace if necessary.
- 6) Check for corrosion on battery leads. Replace if necessary.
- 7) The alkaline battery pack should be replaced if the battery pack installation date is more than 12 months old.

9.18 Monthly Maintenance

If the card reader is accessed frequently (high usage), they should be cleaned at a minimum of once per month, even with the benefit from a "self cleaning" action created every time a card is inserted into the card reader. Neglect of proper card reader cleaning can result in card reader failure, inconsistent card functionality and premature card failure. Maintenance records must be maintained to preserve warranty.

The following is a recommended procedure for card reader maintenance using a PRESAT™ *Smart Card Reader Double-Sided Cleaning Card* which can be purchased from MacKay. The card reader cleaner is long enough so that both ends of the card reader can be used for cleaning.

- 1) Remove the card reader cleaner from its wrapper, holding it by its edges. The cleaner should feel wet when it comes out of the package.
- 2) Quickly insert and remove the card reader cleaner in the meter three times to provide maximum cleaning action.
- 3) Generally, up to eight card readers can be cleaned effectively with one card, alternating each end of the card reader as each meter is completed (clean one meter then flip the cleaner around, clean another meter then flip the cleaner around again). The precise number of readers that can be cleaned by a single card before it dries out and needs to be remoistened with the cleaning solution is dependent on the condition of the card readers in the field.

- 4) The cleaning solution from the card cleaner manufacturer (PRESAT) can be purchased in volume. It should be put into a spray bottle and applied to the end of the card reader cleaner as required to keep them moist and effective. Normal isopropyl alcohol should not be used as it contains a large percentage of water and will damage the card readers with extended use.
- 5) Service technicians must pay close attention to the cleaners and their condition as they work. If excessive dirt and grime build-up is present, the card reader can be cleaned with a rag and more cleaning solution applied. If the card reader cleaner card is extremely dirty or worn, it should be discarded and a new cleaner used.

Equally effective is the LPS® CFC Free Electro Contact Cleaner. The LPS® brand contact cleaner is sold in an aerosol format and can be sprayed onto a dry cleaner card. LPS® products are widely available.

9.19 Weekly Maintenance

Meters that have a high card usage benefit from a “self cleaning” action created every time a card is inserted into the card reader. However, lack of card use allows dust, dirt, moisture and other environmental elements to build on the cards readers causing premature corrosion. This corrosion can cause serious card reader as well as card system problems.

High card usage failures can be expected on meters equipped with card readers that have been in service for an extended period without cards being used. Meters that utilize cards and are located in areas where usage is very low or non-existent should have the card readers checked and cleaned weekly.

9.20 Handling, Transportation and Storage of Meters

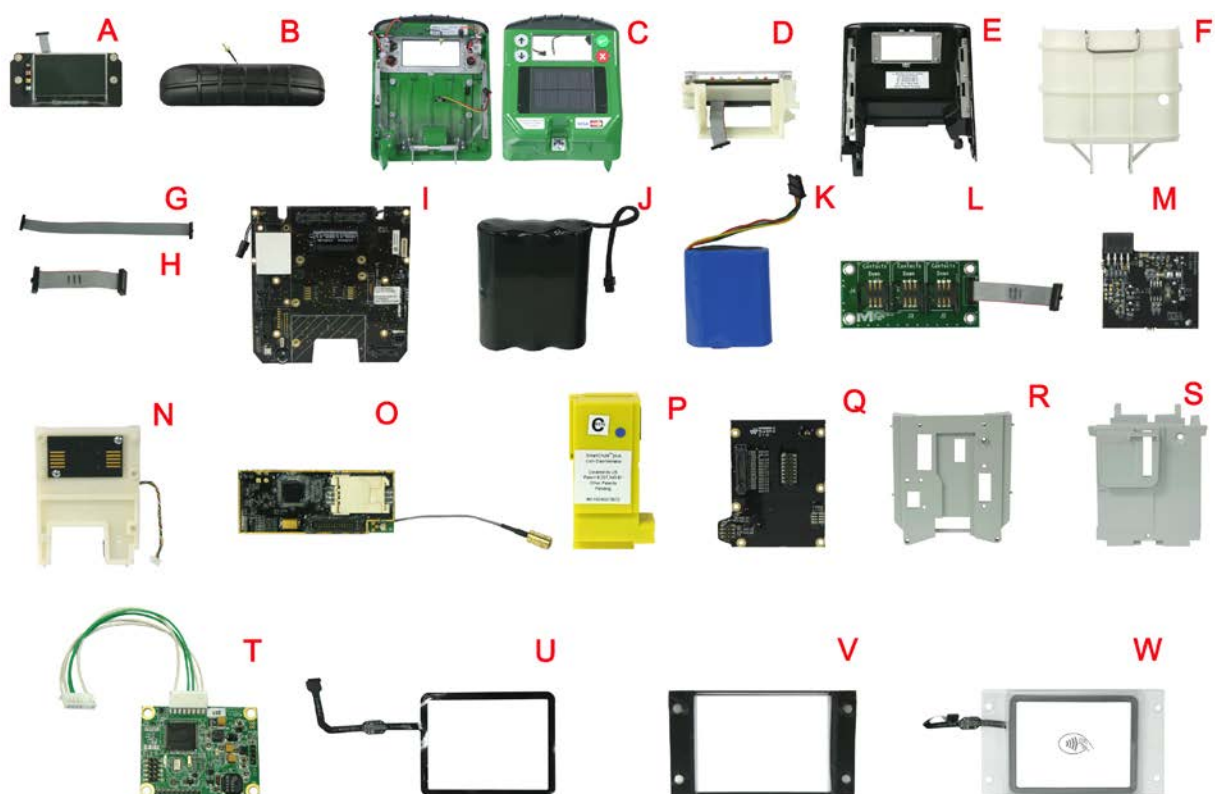
While the meter is designed to withstand many of the day-to-day situations that may arise, precaution should be taken when transporting meters from one area to another. Damage can result from improper handling, and when not transported and/or stored properly.

- Care should be taken while handling the meter once outside of the protective housing. The meter should never be held or grabbed by the LCD display. Grabbing the meter by the LCD display may result in damage to the display and will void the product warranty. The display can be damaged causing confusing messages from the display. ***Always avoid contact with the LCD when handling a meter.***
- Avoid dropping the meter while handling. Dropping onto a hard surface may cause damage to both the main board and the coin chute.
- When removing parking meters from a post, or when removing the post/parking space, never leave the complete housing/meter combination attached to the post. Doing so could result in serious damage to the Solo and the housing itself. If a parking space is eliminated or removed, first remove the Solo from the housing, placing it in a safe container for transport. Next, remove the housing from the post,

placing the housing in a secure container for transport keeping the Solo and the housing separate.

- It is recommended that the meter be transported from one area to another using the meter boxes supplied or a container of equal or better quality. Meters should never be permitted to roll around in the back of a utility vehicle or piled one on top of the other in a shop environment.
- Spare meters should be stored safely on shelves where they are easily accessible and placed in secure containers for transporting.

Note: Some parts are not exactly as shown above.



• Figure 37 – MacKay Guardian™ Solo "Exploded View"

9.21 MacKay Guardian™ Solo Meter Parts List

| PART NUMBER | PPA | PART DESCRIPTION |
|----------------------------------|------------|--------------------------|
| Solo Front Cover Assembly | | |
| 10GD4000000 | 1 | Front Cover |
| 10GD4000150 | 1 | Active Locking Leg |
| 15GD4000000 | 1 | Cellular Expansion Board |
| 15GD4000100 | 1 | Main Controller Board |
| 15GD4000250 | 1 | Chip Card Reader Board |
| 15GD4000350 | 1 | Front Display Board |
| 30GD3000100 | 1 | Radio Module |
| 30GD4000125 | 1 | Ok and X Button |
| 30GD4000135 | 1 | Up and Down Button |
| 30GD4000200 | 1 | Solar Panel |
| 30GD4000400 | 1 | Lithium-Ion Battery Pack |

| | | |
|---------------------------------|----|--|
| 30GD4000700 | 1 | Front Display to MCB Cable |
| 35GD4000100 | 1 | Lithium-Ion Battery Pack Cable Tie (14" Natural) |
| 35GD4000130 | 7 | Pan Head Tapping Screw #6 x 1/4" |
| 35GD4000140 | 2 | Pan Head Tapping Screw #6 x 1/2" |
| 35GD4000180 | 6 | Pan Head Machine Screw Type 2-Inch No.6-32-0.250 |
| 35GD4000210 | 4 | Star Washer |
| 35GD4000220 | 4 | Hex Machine Screw Nut - Inch 10-32 |
| 35GD4000260 | 14 | Fillister Phillips 6-32 -5/16" |
| 35PD4000330 | 2 | Pan Head Machine Screw 6-32 UNC-0.375 |
| 35PD4000335 | 6 | Pan Head Machine Screw 6-32 x .625" |
| 35GD4000350 | 1 | Guardian Solo CEB Foam Spacer (1-1/4" x 1-1/2" x .325) |
| 35GD4000725 | 1 | Solar Panel Gasket A |
| 35GD4000735 | 1 | Solar Panel Gasket B |
| 35GD4000750 | 1 | Front Display Backet Plate Gasket |
| 35GD4000760 | 1 | Solar Pen Gasket |
| 37GD4000275 | 1 | Main LCD Mount Bracket A |
| 37GD4000285 | 1 | Main LCD Mount Bracket B |
| 38GD4000025 | 1 | Front Display Cover |
| 38GD4000050 | 1 | Solar Display Cover |
| 39GD4000000 | 1 | Front Cover Label Right (Credit Card Type Info) |
| 39GD4000010 | 1 | Front Cover Label Left (Insert Card and Coin Info) |
| 39GD4000050 | 1 | Credit Card Label (Chip/ Bar Direction Info) |
| 45GD4000150 | 1 | Front Display Backer Plate c/w clinch nuts |
| 45GD4000200 | 1 | Solar Panel Bezel w/ Studs |
| 45GD4000225 | 1 | Front Cover Locking Latch Left |
| 45GD4000250 | 1 | Front Cover Locking Latch Right |
| TBD | 1 | Meter ID label |
| TBD | 1 | Active Locking Leg Bolt |
| TBD | 1 | Active Locking Leg Sleeve |
| TBD | 1 | Active Locking Leg Spring |
| | | |
| Solo Rear Cover Assembly | | |
| 10GD4000100 | 1 | Rear Cover |
| 35GD4000120 | 7 | Pan Head Machine Screw #6 X 1/8" |
| 35GD4000260 | 6 | Fillister Phillips 6-32 -5/16" |
| 35GD4000700 | 1 | Rear Display Backer Plate Gasket |
| 38GD4000200 | 1 | Rear Display Cover |
| 45GD4000025 | 1 | Rear Cover Locking Slide Left |

| | | |
|-----------------------------------|---|--|
| 45GD4000050 | 1 | Rear Cover Locking Slide Right |
| 45GD4000140 | 1 | Rear Display Backer Plate HD |
| TBD | 2 | P - Sticker (Option) |
| | | |
| Solo Mech Front Assembly | | |
| 10GD4000020 | 1 | Front Frame |
| 10GD4000050 | 1 | Center Mount |
| 15GD4000450 | 1 | Back Plane Board |
| 20GD0000025 | 1 | Smart Chute Assy |
| 30GD4000175 | 1 | Back Plane Board Cable |
| 30GD4000425 | 1 | D Cell Battery Pack |
| 32K80000060 | 1 | Coin Slot N.A. |
| 35EP0000025 | 1 | Plastic Screw Retainer |
| 35GD4000130 | 6 | Pan Head Tapping Screw #6 x 1/4" |
| 35GD4000140 | 2 | Pan Head Tapping Screw #6 x 1/2 |
| 35K80000425 | 1 | 6-32 UNC, 1.75" Phillips Flat Countersunk TS |
| 37GD4000250 | 1 | D-Cell Battery Holder |
| 45GD4000000 | 1 | Front Cover Main Link Assy |
| TBD | 1 | Maintenance Hook |
| TBD | 1 | Mech Frame Coins Label |
| TBD | 1 | FCC label (Mech front) |
| TBD | 1 | Mech Front_Quick Release Pin |
| TBD | 1 | Quick Release Pin Cotter Ring ZP |
| | | |
| Solo Card Guide Assembly | | |
| 35GD4000250 | 1 | Mag Stripe Reader_Low Profile Beam Arm |
| 35GD4000400 | 1 | Head Pin spring |
| 35GD4000410 | 1 | Pin_Low Profile Head |
| 35GD4000420 | 1 | Pin_Low Profile Pivot |
| 35GD4000430 | 1 | Head Pin Circlip (spaenaur # 98407A114) |
| 35GD4000440 | 1 | Head Pin Washer |
| 37GD4000150 | 1 | Card Guide Top |
| 37GD4000160 | 1 | Card Guide Bottom |
| TBD | 1 | Pivot Pin - plastic keeper |
| | | |
| Solo Rear Enforcement Assy | | |
| 15GD4000300 | 1 | Rear Display Board |
| 35GD4000180 | 4 | Pan Head Machine Screw Type 2-Inch No.6-32- |

| | | |
|---------------------------------|---|---|
| | | 0.250 |
| 35GD4000190 | 4 | Flat Countersunk Head Machine Screw 6-32 x 7/8 |
| 35GD4000270 | 4 | Rear Enforcement Bracket Springs |
| 37GD4000200 | 1 | Rear Display Protective Guard |
| 37GD4000225 | 1 | Rear Display Mounting Bracket |
| TBD | 4 | #6 s/s washer |
| | | |
| Solo Antenna Assembly | | |
| 30GD4000325 | 1 | Flex Antenna |
| 30GD4000525 | 1 | Antenna Ground Shield |
| 35GD4000210 | 4 | Star Washer |
| 35GD4000220 | 4 | Hex Machine Screw Nut - Inch 10-32 |
| 35GD4000800 | 1 | Antenna Cover Gasket |
| 37GD4000300 | 1 | Antenna Cover |
| TBD | 2 | Spacer-Antenna Cover) - 2.54x17cm 3M VHB Tape white |
| | | |
| Solo Options | | |
| 15GD4000400 | 1 | RFID Board |
| 15GD4000500 | 1 | 1 Sam Board |
| 15GD4000525 | 1 | 3 Sam Board |
| 15GD4000600 | 1 | UIC Controller Board |
| 35GD4000340 | 4 | Pan Head Machine Screw 6-32 x 7/8" |
| 37GD4000350 | 1 | Rain Cover |
| 37GD4000375 | 1 | Rain Cover Hook |
| TBD | 1 | Back Cover V2 (Duncan/POM) |
| | | |
| Vault Door Sensor Option | | |
| 35PD0000860 | 2 | M3 x 4 screw |
| 45HS0000082* | 1 | Modified Lock Bar |
| 45HS0000090* | 1 | Modified Right Housing Bracket |
| TBD | 1 | Sensor Retainer Bracket, 1/16" stainless |
| TBD | 1 | Hamlin Magnet operated sensor w 300mm leads |
| TBD | 1 | Magnet, 0.25" OD x 0.1" thick, rare-earth permanent |
| TBD | 1 | Sensor to Automotive connector 3Pin, FEMALE |
| TBD | 1 | Backplane PCB to Automotive connector 3Pin, MALE |

• Table 1 – MacKay Guardian™ Solo Parts List

10. Returning a Meter to MacKay

- 1) Contact the Product Support Technician at MacKay for a 'Return Merchandise Authorization Number (RMA#)';

Phone: (888) 462-2529

Fax: (902) 752-5955

- 2) Send the meter(s), noting the RMA# clearly on the packing slip, to the following address:

[TBD]

- 3) Please help us get your product back to you as soon as possible by including a detailed description of the problem. If possible, please provide the following information:
 - The PDT date and time the incident occurred.
 - The meter ID number, location ID number, profile group, profile and meter software version.
 - A description of what was being done with the meter when the problem occurred, or what state the meter was found in. This includes a description of what was showing on the display, if anything, and if any LED were lit or flashing.

Notes

[illegible]

