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Title: MX3 Locator Technical Description
Number: P010027-03
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Contents:

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Overview Summary:

The MX3 is a Proximity Monitoring System for Miner Machines, Carts, and other devices. The complete system is made up of multiple man-deployed MX3 Locator transceivers and machine-mounted MX3 Coils and Controllers. The Transceivers detect modulated magnetic signals from the Coils, and relate their findings to the Controllers using a low power 2.4 GHz digital radio link. The Controllers determine if preset proximity limits have been violated and instruct the various Machines to shut down and stop movement.

The IS MX3 Locator is the focus of this submission.

Locator Summary:

The MX3 Locator receives a periodic magnetic signal from the Coils mounted on a Mining Machine or other mobile device. This magnetic transmission is processed inside the Locator and converted to a radio information packet. This packet is detected by receivers installed on the moving machine and in other locations. The information in the digital radio packet is used to calculate the relative proximity of all devices and personnel working within an area. The Locator also contains an ID function which may be used to report its status to the receivers of other compatible ID systems.

The Locator is intended to be worn by a single miner at all times while they are in the mine, including areas where the device needs to be permissible. The circuit inside the housing is intrinsically safe.

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Intrinsic Safety:

Refer to schematic drawing Number: P010027-14, page 2. Fuse F1 on the power board provides a 750mA current limit to the internal rechargeable cells during both charging and discharging. Fuse F1 is placed near the battery on the main board and provides the IS protection component for the battery. The cells have welded tabs that are soldered onto the power board to avoid user replacement of the cells.

The Locator shall use Li-Ion cells for maximum run time on a single charge. The standard Li-Ion protection circuit (U8 and connected parts) is placed near the battery on the main board. While this circuit interrupts the negative battery line by way of Q1 and Q3, it is not an IS protection device. It is used to comply with UL standards for Li-Ion cell usage.

The Locator is to be charged in clean air only, therefore the maximum internal voltage is that of the rechargeable cells. Using Li-Ion cells, a maximum voltage of 4.2V is achievable immediately following a charging cycle. All resistors are sized to avoid thermal ignition at 4.2V given their value.

On schematic drawing Number: P010027-14, page 3, Fuse F2 provides a 500mA max current limit at the positive charging contact and D1 protects the contact from reverse voltage. As these contacts are only used in clean air, these parts are not IS.

Refer to schematic drawing Number: P010027-14, page 6. The inductive coils used for magnetic reception and the inductors in the analog filters are protected from DC current by 480 ohms of total of series resistance. These resistors are R2, R16, R18, R33, R69, and R50. These are 250mW resistors that would see no more than 19mW with 4.2 volts across the input network. There are additional inductors in the low-pass filter that are protected by the 62mA fuse F2 on the main board. As this fuse limits current into the entire analog section, F2 is the only IS component in this section.

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Refer to schematic drawing Number: P010027-14, page 5. There is an OLED display that runs on 12 volts and 3.0 volts. The 12 volt power for this display has a 62mA fuse (F1 on the main board) with an internal resistance of 5.2 ohms. There are triple 13 volt clamping Zener diodes on the 12 volt supply. The input power for the 12 volt regulator comes from the 3.0 volt supply. The display draws a max current of 10mA. The regulator provides a constant power transformation of the voltage / current ratio between its input and output.

Because of this 1:4 ratio and the efficiency of the converter, the input current for the regulator is a max of 50mA.

Because of the limiting action of the series resistance of the fuse, the regulator cannot output more than 13mA at 12 volts.

The voltage drops quickly at current levels above this limit and the very fast fuse will blow in less than 10 seconds. Any leakage paths in this area will feed back to the pre-fused input of the regulator. Because of the self-feedback of any leakage path, there is no way to elevate the 3.0 volt source without quickly blowing the fuse.

The total inductance and capacitance of all boards inside the Locator are sufficiently under the levels indicated in ACRI2001 figures 11.2 and 11.4 respectively.

The enclosure of the Locator is dust tight. Components in the charging circuit may be subjected to the battery fuse current at the maximum battery voltage. Under fault conditions, no component will exceed 500ºC given a maximum ambient of 40ºC as per the manufacturers' thermal specifications.

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Specifications:

Peak RF Output Power:	0.08 watts @ 2.4GHz
Average RF output power	0.004 watts @ 2.4 GHz