EM Motorsport Ltd
The Stables, Church Farm House
Holton
Oxford. OX33 1PR

Tel: +44 (0) 1865 875946

Micro ADR Installation Manual

Revision	Reason	Author	Date	Check by
0.1	Draft Release	J Durbin	18/12/2012	V. Dariol
1.0	Correction on the CAN rate	V. Dariol	20/12/2012	S. Watt
2.0	LED visibility and “Download connector” added	J.Durbin	16/01/12	
2.1	Minor typo corrections and photos included	S. Watt	18/10/13	
2.2	Yaw rate in CAN protocol corrected	S. Watt	18/10/13	
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2.4	Contact Details Updated	G. Smith	15/04/2014	
2.5	CAN 0x81, 0x84 and 0x85 updated	G. Smith	28/04/2014	
3.0	LED colour description table added	C. Acurcio	25/07/2014	
3.1	Data Structure and Accident Data added	G. Smith	13/08/2014	
3.2	ID 0x220 X and Y accelerations and Gyro Z removed.	G. Smith	14/08/2014	
3.3	Contact details updated	C.Acurcio	20/01/2015	

CONTENTS

1 Introduction

The EM Motorsport Micro ADR system is designed to log data in the event of an accident at a rate of up to 1KHz and uses inbuilt 3-axis +/-400g accelerometer and 3-axis gyroscope. The unit also consists of a 5Hz GPS receiver (L1 +SBAS), a battery backed RTC (Real Time Clock), an internal Flash memory disk and a rechargeable energy storage to perform the disk house-keeping in case of power failure. Built into the top face of the unit is a RGB LED which can be programmed to indicate various situations, like unit working, potential incident recorded and other status.

This document is designed to instruct the user on the correct installation of the Micro ADR to ensure the best performance.

2 System Components and Architecture

The Micro ADR system consists of following items, arranged as shown in Figure 2.1:

- Micro ADR
- GPS Antenna
- Car Looms
  - GPS Antenna Loom
  - Chassis Loom

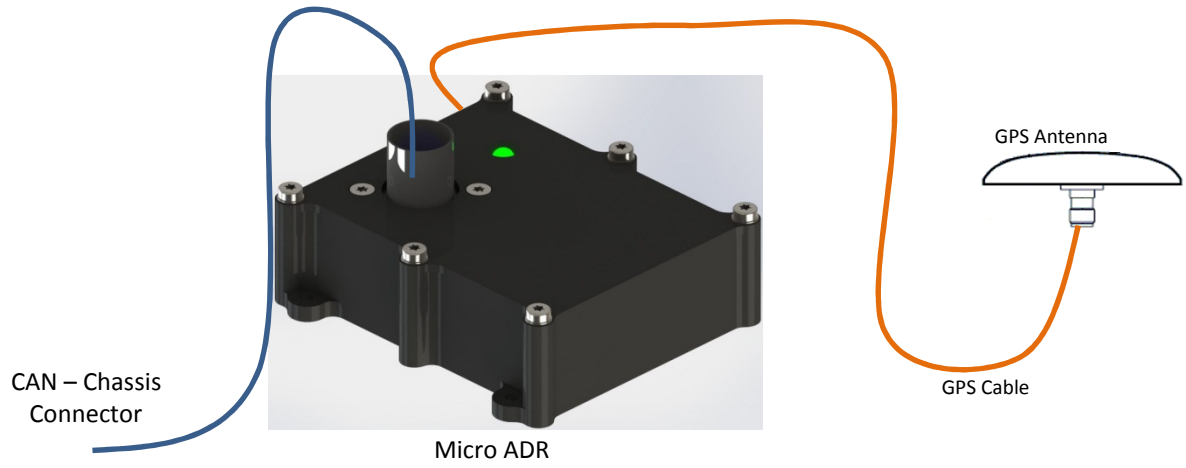


Figure 2.1 - Car architecture

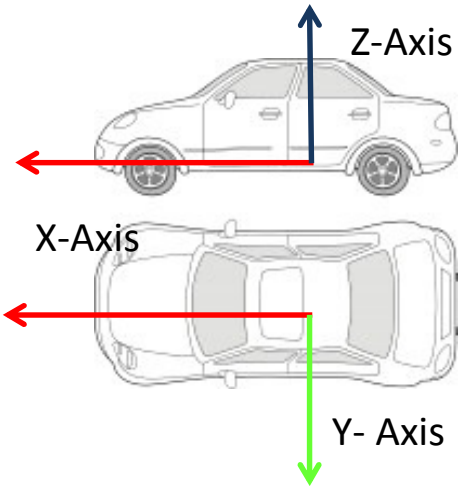
3 Installation Guide

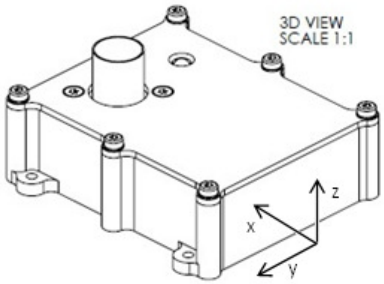
3.1 Micro ADR Equipment

The Micro ADR must be fitted in such a position that it is readily accessible and possible to change between sessions without the need to remove any major components of the car. The unit should also be mounted where the LED can be easily seen by the operator; if this is not possible, a remote LED need to be wired to the appropriate output pin.

The Micro ADR is intended to be mounted directly to the chassis in order to give the best measurement of accident forces; however the unit must not be mounted close to sources of extreme vibration such as around the engine or gearbox.

The desired mounting and orientation of the Micro ADR is one that is in alignment with the axis shown below and inside the driver "safety cell". It is important that care is taken to ensure that the MicroADR does not create an additional hazard to the driver during an accident.





The Unit has a built in LED to show the unit has recorded an accident. For this reason it is desirable that the unit is mounted in an easily visible location. If this cannot be achieved, the output 100mA LS should be connected to an external LED mounted in a visible location. The built-in LED also provides relevant diagnostics to the user with the following description:

LED colour	Meaning
Flashing Blue	Starting up
Flashing Purple	Internal battery charging
Flashing Red	Logging
Flashing Green	PC connected
Flashing between Red and Purple	Boot/programming mode active. The unit is currently powered via VBATT and USB. (will timeout after 10 seconds)

It is recommended that the RS232 and USB connectors are taken to an easily accessible “Download connector” so that accident data can be easily downloaded by the interested parties.

The Micro ADR case is IP65 rated provided the correct connectors are used and proper sealing of the connecters are achieved and maintained. The unit has a pressure compensation valve and uses a Hydrophobic and Oleo phobic membrane to avoid moisture ingress. Special care must be taken to avoid the possibility that any fluid or object will cover these holes continuously.

The Micro ADR internal temperature utilization range is -10℃ - +60℃, every care should be taken to maintain a temperature within the operating temperature range and so the Micro ADR should be mounted away from areas of extreme heat, such as around the engine, gearbox, exhaust, braking components or radiators.

It is expressly **prohibited** to affix or mount any item to the Micro ADR or modify the Micro ADR equipment in any way.

3.2 Car Looms

3.2.1 GPS Antenna Loom

- The connection at the Micro ADR is a SMA female Jack (cable connector is a SMA male plug).
- Do not exceed minimum dynamic bending radius of the cables specified on the manufacturer's data sheet.

NB: If the Micro ADR is being connected to a GPS antenna that is shared with a system already on the car, then a power isolating splitter should be used to ensure that the two antenna power supplies are not connected together.

3.2.2 Chassis Loom

The Micro ADR needs to be powered form the car power supply, with power consumption averaging less than 2.5W. During super capacitor charging phase, currents will temporarily be higher so car wiring should be designed to supply up to 500mA.
A CAN link to the ECU is not essential, but is desirable; the CAN protocol is described in chapter 5. The uADR is able to receive ECU channels (e.g. steering angle, brake pressure) in order to further enhance accident data. The uADR also makes available via CAN the GPS, accelerometer and gyro data so that it can be read and used by the team systems on the car.

4 Technical Description

4.1 Micro ADR Technical Information

Power Supply

- Voltage ..... +9 - +18 V
- Nominal Current @13v ..... 150 mA
- Peak Current @13v ..... 500 mA (during charging phase)

Environmental

- Operating Temperature Ranges
  - Internal ..... -10 - +60°c
- Protection Class IP65
- Max impact survival ..... >100G

Mechanical

- Height (max incl. connector) ..... 40.7 mm
- Width (max) 77mm
- Length (max) 85mm
- Weight ..... <175g
- Main Connector ..... Deutsch(AS2-10-35 PN)
- GPS Antenna Connector ..... SMA Female

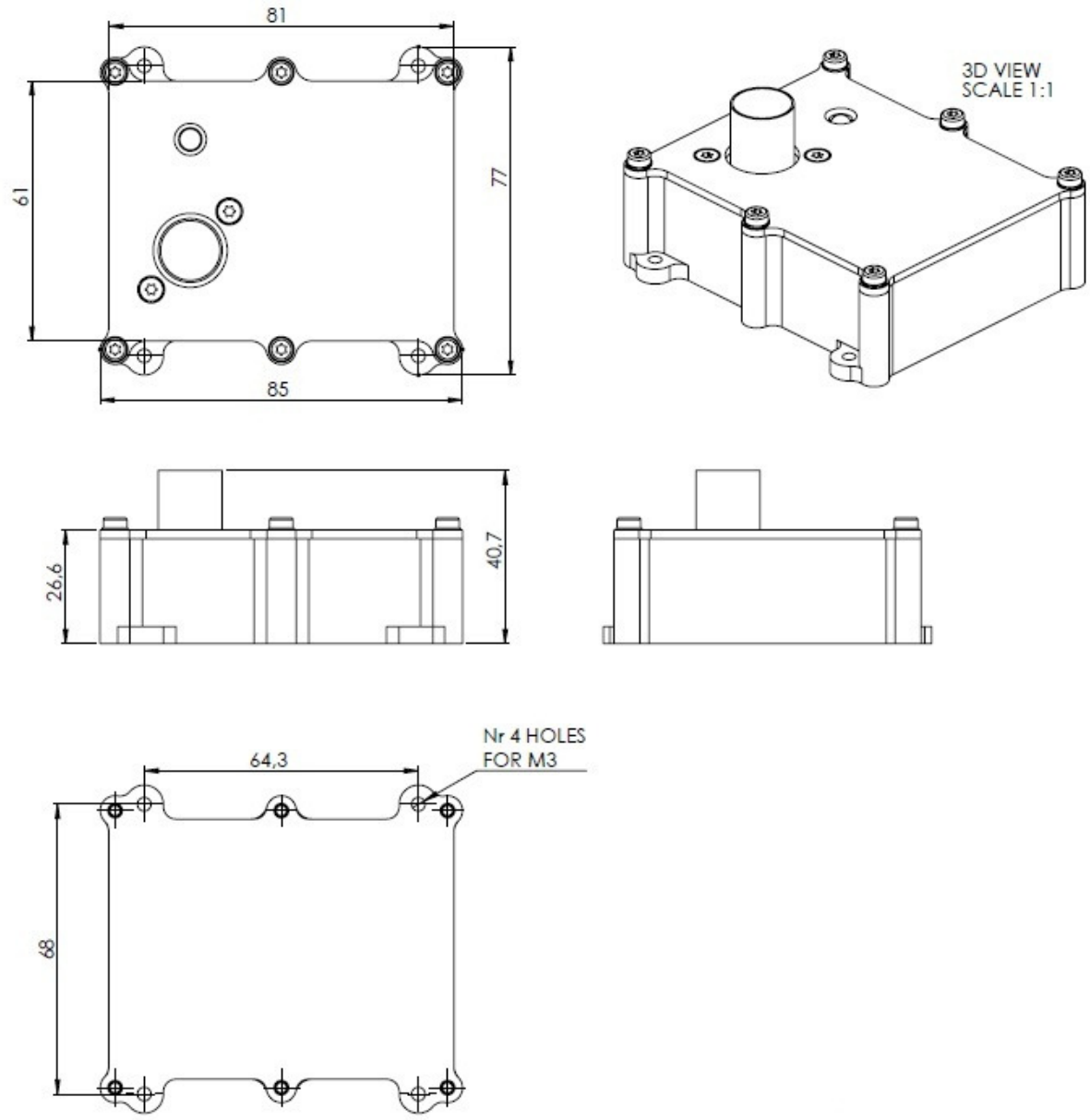


Figure 4.1 – Micro ADR drawing

PROVISIONAL NOTE - SMA connector on top face not yet shown.

4.2 Micro ADR System Loom Technical Data

4.2.1 Micro ADR terminal

Micro ADR Connector AS 2 10-35 PN
Harness connector AS 6 10-35 SN

Pin	Function
1	RS232-RX Serial
2	CAN-N-EOL
3	CAN-P
4	CAN-N
5	Output 100mA LS
6	USB_VBUS-N
7	USB_VBUS-P
8	USB_D-P
9	USB_D-N
10	RS232-TX Serial
11	CAN-P-EOL
12	VBATT +
13	GND

Table 4.3.1 – Micro ADR Pin out

5 Can protocol

5.1 Input packets

5.1.1 ECU to uADR (CAN ID 0x204)

Message ID: **0x204**
Message rate: **f=100Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-1	Vehicle speed	0.1 km/h/bit	16-bit unsigned
2-3	Steer angle	°/bit	16-bit signed
4-5	Throttle pedal position	0.1 %/bit	16-bit signed
6-7	Pit Lane + Lap number	Pit Lane*0x8000 + Lap	16-bit unsigned

Message 1: ID 0x204, rate > 100Hz

5.1.2 ECU to uADR (CAN ID 0x200)

Message ID: **0x200**
Message rate: **f = 100Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-1	Engine RPM	rpm/bit	16-bit unsigned
2-3	Brake pressure	bar/bit	16-bit signed
4-5	Lap distance	0.1m/bit	16-bit unsigned
6-7	Throttle actuator position	0.1 %/bit	16-bit signed

Message 2: ID 0x200, rate > 100Hz

5.2 Output packets

5.2.1 uADR to ECU (CAN ID 0x84)

Message ID: **0x84**
Message rate: **f= 5 Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-3	GPS latitude coordinate	Degrees * 10^7	32-bit signed[1]
4-7	GPS week time (GMT)	Ms since Monday 00:00	32-bit unsigned

Message 3: ID 0x84, rate 5Hz

5.2.2 uADR to ECU (CAN ID 0x85)

Message ID: **0x85**
Message rate: **f =5 Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-3	GPS longitude coordinate	Degrees * 10^7	32-bit signed[2]
4-7	GPS week time (GMT)	Ms since Monday 00:00	32-bit unsigned

Message 4: ID 0x85, rate 5Hz

[1] Positive if North, negative if South

[2] Positive if East, negative if West

5.2.3 uADR to ECU (CAN ID 0x86)

Message ID: **0x86**
Message rate: **f = 5 Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0	GPS status	bit 0-2 0= No Fix, 1=dead reckoning, 2=2-D Fix, 3=3-D Fix, 4=GPS+DR, 5= Time only fix bit 4 GPS antenna Low current bit 5 GPS antenna High current bit 6 No time pulse bit 7 System Fault	bitmapped
1	unused		
2-3	GPS speed	0.1 km/h/bit	16-bit unsigned
4-5	GPS heading	0.01 degree/bit	16-bit unsigned
6-7	unused		

Message 5: ID 0x86, rate 5Hz

5.2.4 uADR to ECU (CAN ID 0x220)

Message ID: **0x220**
Message rate: **f = 100Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-1	uADR Status	See Table	bitmapped

Message 6: ID 0x220, rate 100Hz

Bit	Description	Note
0	Logging in progress	1 if logger is in LOGGING state, else 0.
1	Logging config OK	1 if a configuration table is good, else 0.
2	CAN Team OK	1 if uADR is receiving CAN messages from ECU, else 0.
3	Accident stored	1 if an accident is stored in memory, else 0.
4-15	0	Always zero

Table 5.2.1: uADR Status

5.2.5 uADR to ECU (CAN ID 0x7B)

Message ID: **0x7B**
Message rate: **f = 10Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0	Accident Severity Index	0-255	8-bit unsigned
1	unused	-	-
2	unused	-	-
3	00	-	16-bit unsigned
4-5	uADR serial number	-	16-bit unsigned
6-7	CAR ID MSB	-	16-bit unsigned

Message 7: ID 0x7B, rate 10Hz

5.2.6 uADR to ECU (CAN ID 0x81)

Message ID: **0x81**
Message rate: **f = 100Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-1	Rate yaw	8.75 mdps/s/bit	16-bit unsigned
2-3	Acc Y (G-Lateral)	98/16 mg/bit	16-bit unsigned
4-5	Acc X (G-Longitudinal)	98/16 mg/bit	16-bit unsigned
6-7	Acc Z (G-Vertical)	98/16 mg/bit	16-bit unsigned

Message 8: ID 0x81, rate 100Hz

6 Data Management

6.1 Data Structure

Data should be organised in directories which are named by date and inside the directory there are the data files organised by the minute. The uADR logs continuously, saving the data in 1 minute csv files which are named Fhhmm.csv or Ahhmm.csv, where hhmm is the hour and minute when the file started and A* indicate a file in which the car had experienced an acceleration over a g-threshold for a time defined by a time-threshold (default are 20g 20ms). In the root of the disk there is a conversion sheet that is an excel spreadsheet that has a reading macro; this macro open the file and copy the value into the excel sheet and present the acceleration data in Excel graphs.

6.2 Accident Data

When an accident occurs an accident data file will be created. The data folder labelled with the date the accident occurred will contain a file of format “Ahhmm” (notice the change from “F” to “A”). This contains the accident data. It should be downloaded along with the files 2-3 minutes before and after the accident to fully analyse the data.

7 Contact Details

For further information, please contact the following;

EM Motorsport Ltd.
The Stables, Church Farm House
Holton
Oxford
OX33 1PR
U.K.

Tel: +44 – (0)1865 875946

Email : support@emmotorsport.com
Technical Director: Vaifro Dariol: vdariol@emmotorsport.com
Test and Validation Engineer: Celso Acurcio: cacurcio@emmotorsport.com