MQ12Di Engine & Chassis Controller

Introduction

The MQ12Di is a high-performance engine management system. Its two microprocessors, one dedicated to engine control and the other to data collection, and three Field Programmable Gate Arrays (FPGAs) provide class leading performance in a cost-effective package.

Eight configurable GDI injector drivers, sixteen configurable injector/PWM drivers, combined with eight IGBT ignition outputs and twelve logic level coil driving outputs make this ECU capable of multiple-pulse GDI fuelling on engines up to eight cylinders or fully sequential port injection fuelling on normally aspirated, turbo and supercharged engines up to twelve cylinders. Combined GDI and PFI fuelling is supported for engines up to eight cylinders. Fly-by-wire capability is also included along with provision for Stepper and DC motors.

The MQ12Di crank and camshaft pattern recognition system allows the ECU to be used with virtually any OEM timing wheel. This sophisticated pattern recognition algorithm also facilitates synchronisation during slow and uneven cranking conditions.

The MQ12Di has multiple functions for many of its pins:

- Unused injector and IGBT ignition outputs can be used as digital outputs;
- Unused digital inputs can be used as 12 bit analogue inputs;
- H-bridge outputs can be used in either full or half bridge mode;
- H-bridge outputs can be combined to drive a stepper motor or used to provide additional high or low-side drive capability.

All of these features are enabled by software configuration.

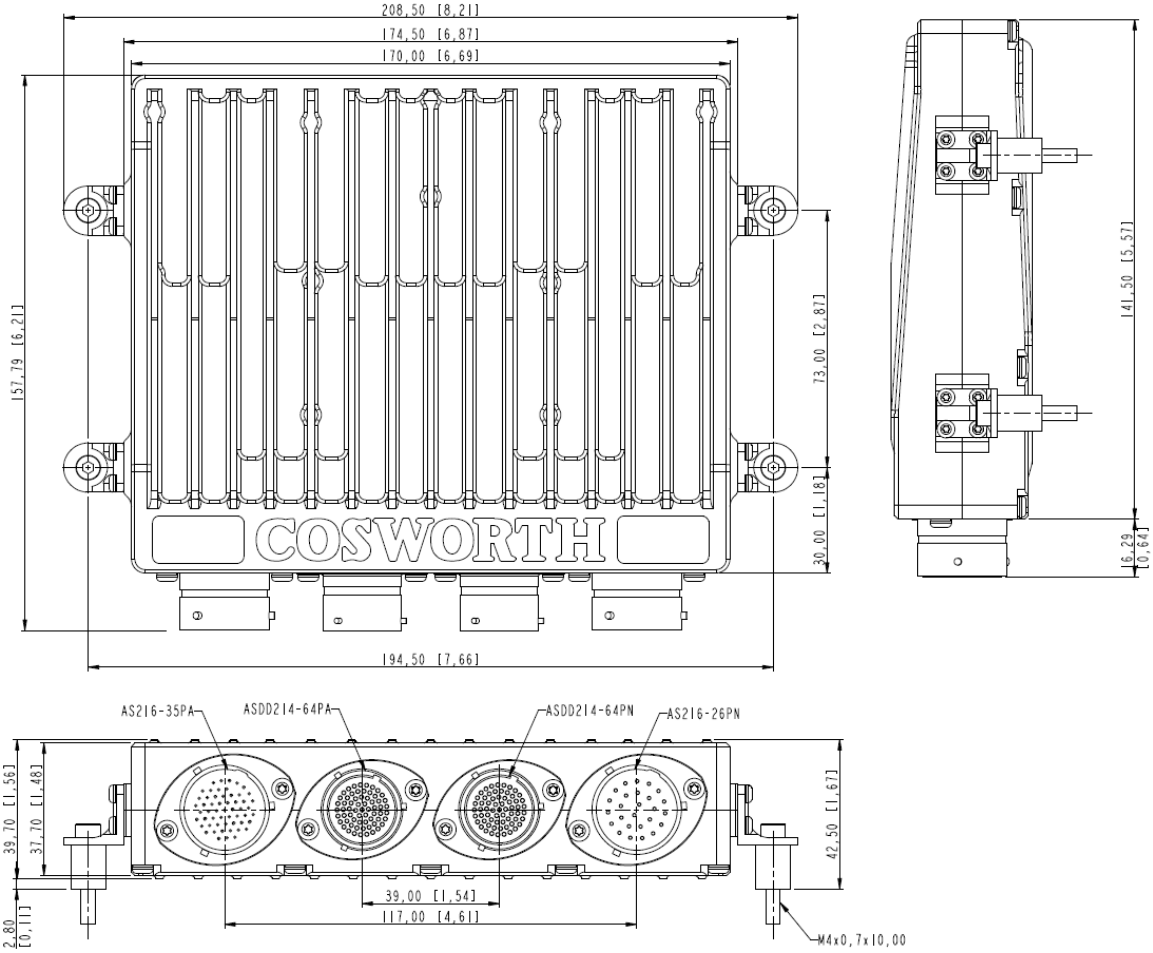
The MQ12Di includes reverse-battery, over-voltage and load dump protection built in as standard. Sensor supply and signal ground pins are also protected against shorts to battery positive and negative.

Advanced software features include closed loop knock control, traction control, launch control, gearshift strategies, variable valve timing of up to 4 camshafts (including BMW VANOS), high speed data logging and scrutineering modes for single make championships.

The MQ12Di is designed to function up to a maximum RPM of 16,000rpm when running GDI, or 22,000rpm when running with port fuelling only. There are two lambda sensor inputs, which will accept NTK/Bosch style wideband sensors. There are also eight specialised knock inputs with a software enabled gain stage.

The wide range of functionality makes the MQ12Di capable of working with almost any combination of coil, injector, OEM sensor and actuator to deliver optimal engine performance.

Dimensions



When installing the MQ12Di:

- Ensure unit is protected against severe vibrations by mounting using supplied AV mounting kit. Also ensure unit is not fouling other structures which may experience severe vibrations.
- Ensure unit is positioned in an area with an ambient temperature of less than 70℃ or with sufficient cooling air flow to prevent over heating.
- Ensure unit is mounted away from sources of electrical interference
- Ensure unit is mounted in position where unit will not come into contact with water
- Do not ground the case, use the power pins provided

Ordering information

Product	Part Number
MQ12Di ECU	01E-501085
Download lead, AutoSport to Ethernet 1.5m	60E-500905
Download lead, AutoSport to Ethernet 10m	60E-500906

Specifications

Description	Value
Processors	1x for engine control 1x for data collection
Supply voltage	+8V to +18V Reverse battery, over-voltage and load dump protection (see Notes below)
Engine configuration	1 to 8 Cylinders (GDI) 1 to 12 Cylinders (PFI) 4 stroke, 2 stroke or rotary Natural or forced induction
Digital outputs	12 x logic level driven 16 x PWM alternate function (5A) 7 x PWM low side (4A)
Digital inputs	16 x dedicated, can also be configured as analogue inputs
Data logging	1000 samples/second 1GB internal storage
Crank and cam sensor	Dual crank input, Single dedicated cam input, Hall effect or inductive
GDI Injector drivers	8 x GDI outputs with boosted voltage (14A peak current)
PFI Injector / PWM drivers	16 x peak and hold (5A peak 2.5A hold)

Description	Value
Thermocouple inputs	3 x k-type (12-bit)
EMC	Refer to DoC
Analogue inputs	37 x dedicated (12-bit) 2 x wide band lambda (12-bit) 8 x knock sensor (12-bit) with configurable gain stage (see Note 4) 16 x digital configured as analogue
Auxiliary outputs	3 x full bridge (10A peak) 3 x stepper motor alternate function
Ignition drivers	8 x IGBT internal clamp (+40V,20A) 12 x logic level driven
Internal sensors	4 x internal temperature 1 x battery voltage
Comms ports	2 x RS232 (RXD/TXD port) 4 x CAN 2.0B 2 x Ethernet (100baseT)
Case operating temp	-25 ^{0}C to +70 ^{0}C
Environmental	IP67
Weight	1020 grams

Quoted currents are peak rating

Note 1: The ECU will allow the battery voltage to drop to +7 V during cranking without tripping /or resetting.

Note 2: If the power dissipation of the ECU is high, airflow must be used to maintain the case temperature below +70 ℃

Note 3: The data collection processor and associated SD card are available for development of custom logging and control applications.

Note 4: If any of the Knock inputs are unused for Knock sensors, they can be used as DC-coupled analogue inputs.

Connector Information

C1 - (Yellow)

Connector	Mating Connector
AS216-35PA-943B	AS616-35SA

Pin	Function	Signal Description
8	IGNT1/PWM 46	12 x logic level Ignition outputs Source 5V @ 25mA Sink 0V @ 1A PWM56 may be used for Crank output PWM57 may be used for Cam output
9	IGNT2/PWM 47	
16	IGNT3/PWM 48	
24	IGNT4/PWM 49	
23	IGNT5/PWM 50	
31	IGNT6/PWM 51	
38	IGNT7/PWM 52	
45	IGNT8/PWM 53	
22	IGNT9/PWM 54	
30	IGNT10/PWM 55	
37	IGNT11/PWM 56	
50	IGNT12/PWM 57	
15	HB1A/PWM 32	2 x full-H bridge or 4 x half-H bridge outputs 2 Channels may be used to form a stepper motor output (4 pins) Maximum current 10A, Maximum operating frequency 10kHz Current measurement in A channels
14	HB1B/PWM 33	
33	HB2A/PWM 34	
49	HB2B/PWM 35	
2	INJHS1	8 x GDI Injector high-side outputs Must be paired with corresponding low-side output when driving GDI injectors E.g. Injector 1 would use INJHS1 and INJ1 pins Maximum boost current 14A, maximum hold current 4A
17	INJHS2	
25	INJHS3	
32	INJHS4	
39	INJHS5	
47	INJHS6	
51	INJHS7	
55	INJHS8	
1	INJ1/PWM 1	8 x GDI Injector low-side outputs Current monitoring Maximum 7.5A (per pin)
5	INJ2/PWM 2	
4	INJ3/PWM 3	
10	INJ4/PWM 4	
46	INJ5/PWM 5	
53	INJ6/PWM 6	
40	INJ7/PWM 7	
48	INJ8/PWM 8	
13	INJ9/PWM 9	16 x Standard PFI injector (low-side drive) or PWM outputs Current monitoring Maximum peak current 5A, Maximum hold current 2.5A Software controlled recirculation diode
6	INJ10/PWM 10	
3	INJ11/PWM 11	
7	INJ12/PWM 12	
19	INJ13/PWM 13	
11	INJ14/PWM 14	

Pin	Function	Signal Description
26	INJ15/PWM 15	
18	INJ16/PWM 16	
34	INJ17/PWM 17	
12	INJ18/PWM 18	
42	INJ19/PWM 19	
20	INJ20/PWM 20	
36	INJ21/PWM 21	Use PWM21 & PWM22 for GDI Pump outputs
21	INJ22/PWM 22	
43	INJ23/PWM 23	Use PWM23 & PWM24 for Lambda heater outputs
28	INJ24/PWM 24	
29	PWM 25	7 x PWM low-side outputs No peak and hold, or pull-up options Maximum 4A
52	PWM 26	
44	PWM 27	
54	PWM 28	
35	PWM 29	
27	PWM 30	
41	PWM 31	

C2 - (Yellow)

Connector	Mating Connector
ASDD214-64PA-970M	ASDD614-64SA

Pin	Function	Signal Description
29	LOG_RS232_TX	Logger serial RS232, dash display drive etc.
5	LOG_RS232_RX	
28	ECU_RS232_TX	ECU serial RS232 connection (firmware loading)
4	ECU_RS232_RX	
1	CANA_L	CANA - PC, DB1, general communication CANB - general communication (Logger CAN1) CANC - general communication Software configurable 120Ω termination
26	CANA_H	
24	CANB_L	
44	CANB_H	
18	CANC_L	
39	CANC_H	
22	CAND_L	CAND – general communication (Logger CAN2) Software configurable 120Ω termination
42	CAND_H	
20	ECU_ETH_TX+	Primary Ethernet port (calibration tool, logger setup & offload etc.)
40	ECU_ETH_TX-	
21	ECU_ETH_RX+	
41	ECU_ETH_RX-	
10	LOG_ETH_TX+	Secondary Ethernet port (Uses MQ12Di's internal Ethernet Switch)
9	LOG_ETH_TX-	
12	LOG_ETH_RX+	
11	LOG_ETH_RX-	

Pin	Function	Signal Description
30	CRANK1	Hall effect or inductive engine position inputs
31	CRANK2	
51	CAM	
43	DIN1	4 x Digital inputs with VCAM capability Rate measurement (wheel, shaft etc.) Software controlled 3kΩ pull-up to 5V 0-5V analogue alternate function (12 bit, 480Hz cut off)
56	DIN2	
57	DIN3	
45	DIN4	
55	DIN5	12 x Digital inputs Rate measurement (wheel, shaft etc) Software controlled 3kΩ pull-up to 5V 0-5V analogue alternate function (12 bit, 480Hz cut off)
63	DIN6	
62	DIN7	
25	DIN8	
23	DIN9	
58	DIN10	
64	DIN11	
27	DIN12	
59	DIN13	
19	DIN14	
61	DIN15	
54	DIN16	
60	KNOCK1	8 x Dedicated Knock inputs Software controlled gain (x1 or x30)
50	KNOCK2	
38	KNOCK3	
49	KNOCK4	
16	KNOCK5	
15	KNOCK6	
37	KNOCK7	
14	KNOCK8	
47	LAM1I	2 x Wideband lambda sensor inputs Use PWM23 & 24 for Lambda sensor heater outputs
2	LAM1V	
48	LAM2I	
3	LAM2V	
6	5V12PSU1	3 x Software selectable 5V/VBAT supply outputs 50mA @ 5V, 500mA @ VBAT
46	5V12PSU2	
52	5V12PSU3	
35	5VPSU5	6 x Fixed 5V supply outputs 20mA @ 5V
34	5VPSU6	
33	5VPSU7	
32	5VPSU8	
8	5VPSU9	
7	5VPSU10	
53	EXTGND9	4 x Protected sensor ground outputs, 1A maximum (per pin) Ground offset with increased current (0.5V per Amp)
17	EXTGND10	
36	EXTGND11	
13	EXTGND12	

C3 - (Red)

Connector	Mating Connector
ASDD214-64PN-970M	ASDD614-64SN

Pin	Function	Signal Description
21	AIN1	28 x analogue inputs (12 bit) Software controlled 3KΩ pull-up to 5V 250 Hz low pass filter
22	AIN2	
23	AIN3	
24	AIN4	
53	AIN5	
52	AIN6	
51	AIN7	
61	AIN8	
60	AIN9	
47	AIN10	
45	AIN11	
26	AIN12	
44	AIN13	
64	AIN14	
19	AIN15	
39	AIN16	
62	AIN17	
63	AIN18	
56	AIN19	
32	AIN20	
9	AIN21	
8	AIN22	
7	AIN23	
50	AIN24	
49	AIN25	
31	AIN26	
48	AIN27	
46	AIN28	
2	AIN29	4 x analogue inputs (12 bit) Software controlled 3KΩ pull-up to 5V 2500 Hz low pass filter
1	AIN30	
25	AIN31	
59	AIN32	
58	AIN33	4 x analogue inputs (12 bit) Software controlled 3KΩ and 240Ω pull-up to 5V 250 Hz low pass filter
38	AIN34	
54	AIN35	
18	AIN36	
40	AIN37	Analogue input (12 bit), software controlled 3KΩ pull-up to 5V, 250 Hz LPF
20	TC1POS	3 x K type thermocouple inputs for exhaust temperature measurement

Pin	Function	Signal Description
55	TC1NEG	
57	TC2POS	
43	TC2NEG	
42	TC3POS	
41	TC3NEG	
15	NC	Do not connect
16	NC	
14	NC	
17	NC	
13	5V12PSU4	5 x Software selectable 5V/VBAT supply outputs 50mA @5V, 700mA at VBAT
37	5V12PSU5	
12	5V12PSU6	
36	5V12PSU7	
35	5V12PSU8	
34	5VPSU1	4 x Fixed 5V supply outputs 50mA @ 5V
11	5VPSU2	
33	5VPSU3	
10	5VPSU4	
30	EXTGND1	8 x Protected sensor ground outputs, 1A maximum (per pin) Ground offset with increased current (0.5V per Amp)
6	EXTGND2	
29	EXTGND3	
5	EXTGND4	
28	EXTGND5	
4	EXTGND6	
27	EXTGND7	
3	EXTGND8	

C4 - (Red)

Connector	Mating Connector
AS216-26PN-943B	AS616-26SN

Pin	Function	Signal Description
12	HB3A	full-H bridge or 2 x half-H bridge outputs Maximum current 10A, Max freq 10kHz, Current measurement in A channel
13	HB3B	
9	IGN1	8 x IGBT Ignition outputs 20A peak, 3A continuous
8	IGN2	
11	IGN3	
10	IGN4	
5	IGN5	
4	IGN6	
3	IGN7	
2	IGN8	
21	BATPOS	Battery positive (connect all)

Pin	Function	Signal Description
22	BATPOS	
23	BATPOS	
24	BATPOS	
25	BATPOS	
26	BATPOS	
1	BATNEG	Battery negative (connect all)
6	BATNEG	
7	BATNEG	
14	BATNEG	
15	BATNEG	
16	BATNEG	
17	BATNEG	
18	BATNEG	
19	BATNEG	
20	BATNEG	

Recycling and Environmental Protection

Cosworth Electronics is committed to conducting its business in an environmentally responsible manner and to strive for high environmental standards.

Manufacture

Cosworth products comply with the appropriate requirements of the Restriction of Hazardous Substances (RoHS) directive (where applicable).

Disposal

Electronic equipment should be disposed of in accordance with regulations in force and in particular in accordance with the Waste in Electrical and Electronic Equipment directive (WEEE).

Battery

This equipment contains a rechargeable battery (type TBD).

The equipment may be returned to Cosworth Electronics for a replacement battery. (A charge will be made for this service).

Removal of the battery by the user may void any warranty on the equipment.

To remove the battery for recycling:

Remove the case cover(s).
Remove the printed circuit boards from the case.
Remove the battery from the printed circuit board.

Dispose of the battery in accordance with regulations in force.

Declaration of Conformity

We, the undersigned,

Cosworth Electronics Limited
Brookfield Technology Centre,
Cottenham,
Cambridgeshire, CB24 8PS
United Kingdom

Certify and declare under our sole responsibility that the following equipment:

MQ12Di ECU – part number 01E-501085; 01E-501085-PLUS; 01E-501085-PRO;
– 01E-501085-UG1; 01E-501085-UG2; 01E-501085-UG3;
– 01E-501085-ULTRA

An ECU for use only in motorsport applications

Conforms to the following EC directives including applicable amendments:

EMC Directive 89/336/EEC, 72/245/EEC (last amended 2004/104/EC)

The following standards have been applied:

2004/104/EC

Cottenham, 12 November 2013

T. A. Buckler

Thomas Buckler : Business Unit Leader