

# TM4 Smartmotion™ AC-S1 Low-Voltage Inverters

## Controller for AC Induction Motor

Dana TM4 inverters provide advanced control of AC induction motors for traction or pump functions of any electrical vehicle working with speed or torque control algorithms.

## Mobile Machine Management

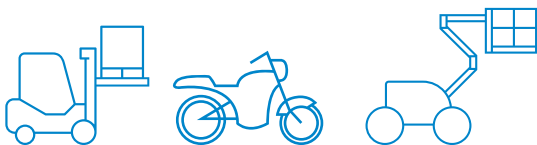
SmartMotion is an integrated controller which can manage multi-function and fully configurable I/O pins for any I/O functions like digital & analogue inputs and outputs, capable of driving fans, relays' and hydraulic valves' coils, contactors, negative brakes and many others inductive/resistive loads.

## Vehicle Application Development

Users develop AC-S1 applications with the TM4 TAU™ Software: All features are offered as standard (“one fits all” philosophy). Virtually everything can be changed with one click in an intuitive graphical tuning environment. The clone file technology allows uploads, downloads and modifications of your configuration. With TM4 TAU system, a first run for a wired vehicle can be made in minutes (not days).



Ideal for Off-Highway Applications.



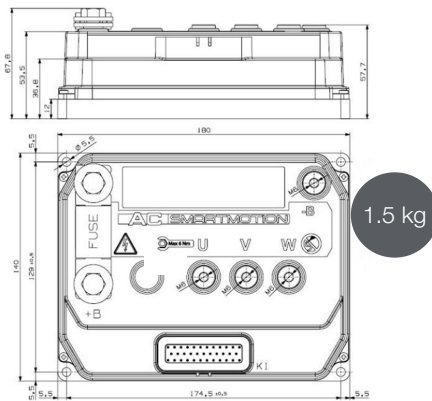
# TM4 Smartmotion™ AC-S1 Low-Voltage Inverter

## AC motor control features:

- Indirect Field Oriented Control (FOC) with unsurpassed dynamic and performance in full speed range by decoupling and regulating flux and torque vectors of stator current components
- Advanced Space Vector Modulation (SVM) technique for high system efficiency reducing motor harmonics and losses
- Accurate Rotor Flux Model and Fully Developed Field Weakening technique for high motor efficiency and dynamic across full speed range
- Motor model fully compatible with IEEE Standard in order to get the parameters of motor's equivalent circuit from no-load and blocked rotor tests; it can work with all AC motors of all manufactures
- Quick and easy selection between Torque Control and Speed Control

## General features

- Fully configurable through supplied GUI TM4 TAU™ called SmartView, which reduces abruptly the time to market start-up of the system
- Flexible configuration of I/O in order to couple them to any provided functions
- Standard and same firmware for all inverter series (easily extendable to future models)
- Robust, safe and self-diagnostic (both for hardware and software fault conditions)
- CAN Open and serial interfaces
- Powerful logging of all sensible working variables
- Fulfills automotive EMC standard ECE R10-05, Annex 7-8-9-10
- Optional DC Motor Control



AC-S1	24V			36-48V			72-80V
Nom. voltage (Vdc)	24			36-48			72-80
Input voltage range (Vdc)	11-32.4			22-64.8			42-108
Cont. current (Arms)	38	75	150	38	100	150	32
Nom. current S2- 2 min (Arms)	75	150	300	75	200	300	63
Option plus DC motor driver max current S2 - 2 min [A]	-	200	300	-	-	-	-
Output voltage (VAC)	3 x 0 to 16 (@24 VDC)			3 x 0 to 24 (@36 VDC) 3 x 0 to 32 (@ 48 VDC)			3 x 0 to 47 (@72 VDC) 3 x 0 to 53 (@80 VDC)
Power terminals	M6(U/V/W/-B), M8(+B)						

## Specifications

Switching frequency	9Khz
Efficiency	>95%
Output frequency	0-300 Hz
Ambient temperature range	-40°C to 55°C
Maximum heat-sin temp @ Full current @ linear de-rated current (down to 50%) @ 50% current	80°C 80°C- 95°C 95°C- 100°C
Signal line connectors	AMPSEAL 35 pins
IP protection	IP65
EMC	EN12895 / ECE R10-05, Annex 7-8-9-10
Safety	EN 1175-1
Vibration IEC 60068-2-6 Shock IEC 60068-2-27 Bump IEC 60068-2-29	5g, 10 – 500 Hz, 3 axes +/-30g +/-10g
UL	Designed to meet UL583

Interface	Number	Product part number	
Digital input	12	AC-S1 24V 75A SWS	ACS1P07000000
Analog input unipolar 0...10V	4	AC-S1 24V 150A SWS	ACS1P15000000
		AC-S1 24V 150A + 200DC SWS	ACS1P15C20000
		AC-S1 24V 300A SWS	ACS1P30000000
Digital output	2	AC-S1 24V 300A + 300DC SWS	ACS1P30C30000
PWM output	3		
Motor temp sensor	1	AC-S1 36/48V 75A SWS	ACS1Q07000A00
Incremental encoder	1	AC-S1 36/48V 200A SWS	ACS1Q20000000
		AC-S1 36/48V 300 A SWS	ACS1Q30000000
5V sensor power supply	1	AC-S1 72/80V 63A SWS	ACS1R06000A00
12V sensor power supply	1		
CAN interface	1		
Serial Interface RS232	1		
LIN Bus	1		

\*Plate-Type Heat Sink. For other heat sink type please contact us

Related product part number	
AMPSEAL 35 pin Mating Connector Bag	900KC0000013
Thermal Pad for AC-S1	768VR457A00

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### Application Policy

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# TM4 Smartmotion™ AC-M1 Low-Voltage Inverters

## Controller for AC Induction Motor

Dana TM4 inverters provide advanced control of AC induction motors for traction or pump functions of any electrical vehicle working with speed or torque control algorithms.

## Mobile Machine Management

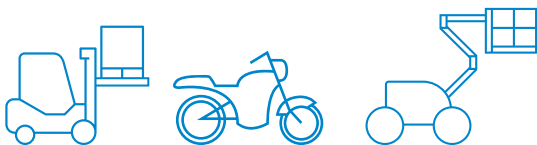
SmartMotion is an integrated controller which can manage multi-function and fully configurable I/O pins for any I/O functions like digital & analogue inputs and outputs, capable of driving fans, relays' and hydraulic valves' coils, contactors, negative brakes and many others inductive/resistive loads.

## Vehicle Application Development

Users develop AC-M1 applications with the TM4 TAU™ System: All features are offered as standard ("one fits all" philosophy). Virtually everything can be changed with one click in an intuitive graphical tuning environment. The clone file technology allows uploads, downloads and modifications of your configuration. With TM4 TAU system, a first run for a wired vehicle can be made in minutes (not days).



Ideal for Off-Highway Applications.



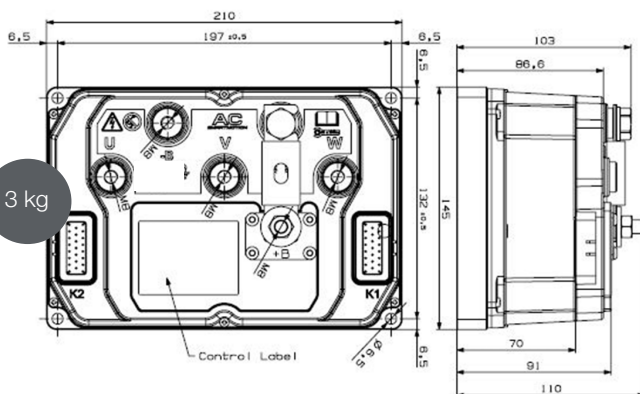
# TM4 Smartmotion™ AC-M1 Low-Voltage Inverter

## AC motor control features:

- Indirect Field Oriented Control (FOC) with unsurpassed dynamic and performance in full speed range by decoupling and regulating flux and torque vectors of stator current components
- Advanced Space Vector Modulation (SVM) technique for high system efficiency reducing motor harmonics and losses
- Accurate Rotor Flux Model and Fully Developed Field Weakening technique for high motor efficiency and dynamic across full speed range
- Motor model fully compatible with IEEE Standard in order to get the parameters of motor's equivalent circuit from no-load and blocked rotor tests; it can work with all AC motors of all manufactures
- Quick and easy selection between Torque Control and Speed Control

## General features

- Fully configurable through supplied GUI TM4 TAU™ called SmartView™, which reduces abruptly the time to market start-up of the system
- Flexible configuration of I/O in order to couple them to any provided functions
- Standard and same firmware for all inverter series (easily extendable to future models)
- Robust, safe and self-diagnostic (both for hardware and software fault conditions)
- CAN Open and serial interfaces
- Powerful logging of all sensible working variables
- Fulfills automotive EMC standard ECE R10-05, Annex 7-8-9-10



AC-M1	24V	36-48V	72-80V
Nom. voltage (Vdc)	24	36-48	72-80
Input voltage range (Vdc)	11-32.4	22-64.8	42-108
Cont. current (Arms)	175 225	188 250	175 225
Nom. current S2- 2 min (Arms)	350 450	375 500	350 450
Output voltage (VAC)	3 x 0...16 V (@24 VDC)	3 x to 24 (@36 VDC) 3 x 0 to 32 (@ 48 VDC)	3 x 0 to 47 (@72 VDC) 3 x 0 to 53 (@80 VDC)
Power terminals	M8(U/V/W/-B), M10(+B)		

Specifications	
Switching frequency	9Khz
Efficiency	95%
Output frequency	0-300 Hz
Ambient temperature range	-40°C to 55°C
Maximum heat-sin temp @ Full current @ linear de-rated current (down to 50%) @ 50% current	80°C 80°C- 95°C 95°C- 100°C
Signal line connectors	2x AMPSEAL 23 pins
IP protection	IP65
EMC	EN12895 / ECE R10-05, Annex 7-8-9-10
Safety	EN 1175-1
Vibration IEC 60068-2-6 Shock IEC 60068-2-27 Bump IEC 60068-2-29	5g, 10 – 500 Hz, 3 axes +/-30g +/-10g
UL	Designed to meet UL583

Interface	Number	Product part number
Digital input	19	<b>AC-M1 24V 350A SWS</b> ACM1P35000000
Analog input unipolar 0...10V	8	<b>AC-M1 24V 450A SWS</b> ACM1P45000000
Analog input bipolar ± 10V	0	<b>AC-M1 36/48V 375A SWS</b> ACM1Q37000E00
		<b>AC-M1 36/48V 500A SWS</b> ACM1Q50000E00
Digital output	2	<b>AC-M1 72/80V 350A SWS</b> ACM1R35000000
PWM output	3	<b>AC-M1 72/80V 450A SWS</b> ACM1R45000Y00
Motor temp sensor	1	
Incremental encoder	1	
5V sensor power supply	1	
12V sensor power supply	1	
CAN interface	1	
Serial Interface RS232	1	
LIN Bus	1	

\*Plate-Type Heat Sink. For other heat sink type please contact us

Related product part number	
<b>AMPSEAL 23 pin Mating Connector Bag</b>	900KC0000019
<b>Fuse 300A</b>	744EFCNL300
<b>Fuse 400A</b>	744EFCNL400
<b>Fuse 500A</b>	744EFCNL500
<b>Kit Fuse Support for AC-M1</b>	900KC0000022
<b>Thermal Pad for AC-M1</b>	768VR455A00

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### Application Policy

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# TM4 Smartmotion™ AC-M2 Low-Voltage Inverters

## Dual Controller for AC Induction Motor

Dana TM4 inverters provide advanced control of AC induction motors for traction or pump functions of any electrical vehicle working with speed or torque control algorithms.

## Mobile Machine Management

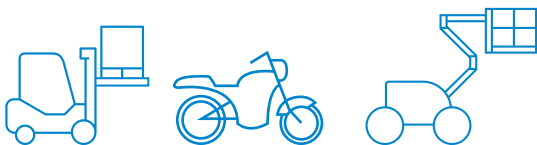
SmartMotion is an integrated controller which can manage multi-function and fully configurable I/O pins for any I/O functions like digital & analogue inputs and outputs, capable of driving fans, relays' and hydraulic valves' coils, contactors, negative brakes and many others inductive/resistive loads.

## Vehicle Application Development

Users develop AC-M2 applications with the TM4 TAU™ System: All features are offered as standard ("one fits all" philosophy). Virtually everything can be changed with one click in an intuitive graphical tuning environment. The clone file technology allows uploads, downloads and modifications of your configuration. With TM4 TAU™ system, a first run for a wired vehicle can be made in minutes (not days).



Ideal for Off-Highway Applications.



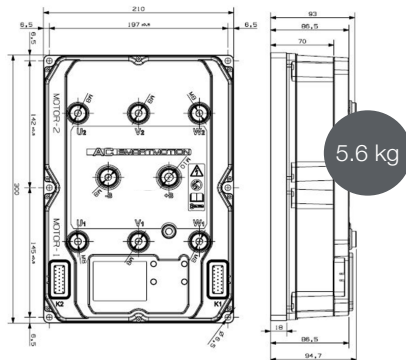
# TM4 Smartmotion™ AC-M2 Low-Voltage Inverter

## AC motor control features:

- Indirect Field Oriented Control (FOC) with unsurpassed dynamic and performance in full speed range by decoupling and regulating flux and torque vectors of stator current components
- Advanced Space Vector Modulation (SVM) technique for high system efficiency reducing motor harmonics and losses
- Accurate Rotor Flux Model and Fully Developed Field Weakening technique for high motor efficiency and dynamic across full speed range
- Motor model fully compatible with IEEE Standard in order to get the parameters of motor's equivalent circuit from no-load and blocked rotor tests; it can work with all AC motors of all manufactures
- Quick and easy selection between Torque Control and Speed Control

## General features

- Fully configurable through supplied GUI TM4 TAU™ called SmartView, which reduces abruptly the time to market start-up of the system
- Flexible configuration of I/O in order to couple them to any provided functions
- Standard and same firmware for all inverter series (easily extendable to future models)
- Robust, safe and self-diagnostic (both for hardware and software fault conditions)
- CAN Open and serial interfaces
- Powerful logging of all sensible working variables
- Fulfills automotive EMC standard ECE R10-05, Annex 7-8-9-10
- Advanced control of two AC induction motors working in independent mode or in dual drive applications with differential function.



AC-M2	24V	36-48V		72-80V	
Nom. voltage (Vdc)	24	36-48		72-80	
Input voltage range (Vdc)	11-32.4	22-64.8		42-108	
Cont. current (Arms)	300 +300	188 +188	250 +250	175 +175	225 +255
Nom. current S2- 2 min (Arms)	600 +600	375 +375	500 +500	350 +350	450 +450
Output voltage (VAC)	3 x 0 to 16 (@24 VDC)	6 x 0 to 24 (@36 VDC)	6 x 0 to 32 (@ 48 VDC)	6 x 0 to 47 (@72 VDC) 6 x 0 to 53 (@80 VDC)	
Power terminals	M8(U/V/W/-B), M10(+B)				

Specifications	
Switching frequency	9Khz
Efficiency	>95%
Output frequency	0-300 Hz
Ambient temperature range	-40°C to 55°C
Maximum heat-sin temp @ Full current @ linear de-rated current (down to 50%) @ 50% current	80°C 80°C– 95°C 95°C– 100°C
Signal line connectors	2x AMPSEAL 23 pins
IP protection	IP65
EMC	EN12895 / ECE R10-05, Annex 7-8-9-10
Safety	EN 1175-1
Vibration IEC 60068-2-6 Shock IEC 60068-2-27 Bump IEC 60068-2-29	5g, 10 – 500 Hz, 3 axes +/-30g +/-10g
UL	Designed to meet UL583

Interface	Number	Product part number	
Digital input	17	<b>AC-M2 24V 600A+600A SWS</b>	ACM2P60A60000
Analog input unipolar 0...10V	8	<b>AC-M2 36/48V 375A+375A SWS</b>	ACM2Q37A37000
Analog input bipolar ± 10V	0	<b>AC-M2 36/48V 500A+500A SWS</b>	ACM2Q50A50000
Digital output	2	<b>AC-M2 72/80V 350A+350A SWS</b>	ACM2R35A35000
PWM output	3	<b>AC-M2 72/80V 450A+450A SWS</b>	ACM2R45A45000
Motor temp sensor	2		
Incremental encoder	2		
5V sensor power supply	1		
12V sensor power supply	1		
CAN interface	1		
Serial Interface RS232	1		
LIN Bus	1		

\*Plate-Type Heat Sink. For other heat sink type please contact us

Related product part number	
<b>AMPSEAL 23 pin Mating Connector Bag</b>	900KC0000019
<b>Fuse 500A</b>	744EFCNL500
<b>Fuse 700A</b>	744EFCNL700
<b>Thermal Pad</b>	768VR456A00

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# TM4 Smartmotion™ AC-L1 Low-Voltage Inverters

## Controller for AC Induction Motor

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## Mobile Machine Management

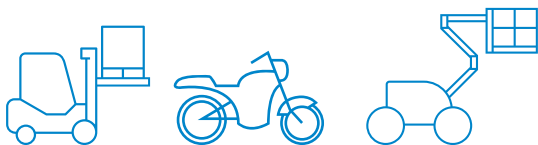
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## Vehicle Application Development

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Ideal for Off-Highway Applications.



# TM4 Smartmotion™ AC-L1 Low-Voltage Inverter

Including the latest technology in power electronics, control & interface technology and algorithms, Smartmotion series of inverters provide advanced control of AC asynchronous motors.

## AC motor control features:

- Indirect Field Oriented Control (IFOC) with unsurpassed dynamic and performance in full speed range by decoupling and regulating flux and torque vectors of stator current components
- Advanced Space Vector Modulation (SVM) technique for high system efficiency reducing motor harmonics and losses
- Accurate Rotor Flux Model and Fully Developed Field Weakening technique for high motor efficiency and dynamic across full speed range
- Motor model fully compatible with IEEE Standard in order to get the parameters of motor's equivalent circuit from no-load and blocked rotor tests; it can work with all AC motors of all manufactures
- Quick and easy selection between Torque Control and Speed Control

## General features

- Fully configurable through supplied GUI TM4 TAU™ called SmartView™, which reduces abruptly the time to market start-up of the system
- Flexible configuration of I/O in order to couple them to any provided functions
- Standard and same firmware for all inverter series (easily extendable to future models)
- Robust, safe and self-diagnostic (both for hardware and software fault conditions)
- CAN Open and serial interfaces
- Powerful logging of all sensible working variables
- Fulfills automotive EMC standard ECE R10-05, Annex 7-8-9-10

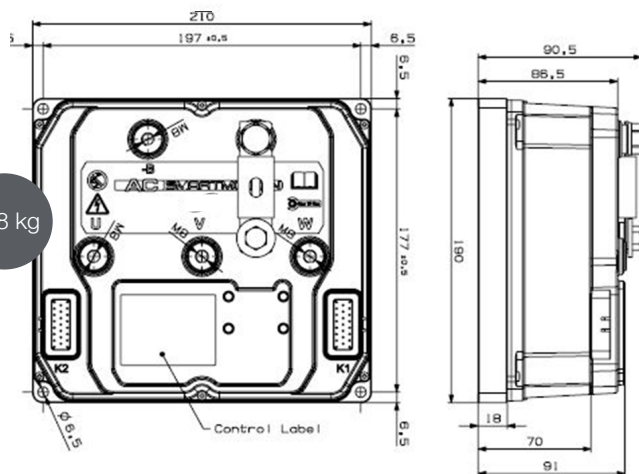
AC-L1	
Nom. voltage (Vdc)	36-48
Input voltage range (Vdc)	22-64.8
Cont. current (Arms)	313 375
Nom. current S2- 2 min (Arms)	625 750
Output voltage (VAC)	3 x 0 to 24 (@36 VDC) 3 x 0 to 32 (@48 VDC)
Power terminals	M8(U/V/W-B), M10(+B)
Switching frequency	9Khz
Efficiency	>95%
Output frequency	0-300 Hz
Ambient temperature range	-40°C to 55°C
Maximum heat-sin temp @ Full current @ linear de-rated current (down to 50%) @ 50% current	80°C 80°C- 95°C 95°C- 100°C
Signal line connectors	2x AMPSEAL 23 pins
IP protection	IP65
EMC	EN12895 / ECE R10-05, Annex 7-8-9-10
Safety	EN 1175-1
Vibration IEC 60068-2-6 Shock IEC 60068-2-27 Bump IEC 60068-2-29	5g, 10 - 500 Hz, 3 axes +/-30g +/-10g
UL	Designed to meet UL583

Interface	Number	Product part number
Digital input	19	<b>AC-L1 36/48V 625A SWS</b> Plate-type heat sink* ACL1Q62000000
Analog input unipolar 0...10V	8	<b>AC-L1 36/48V 750A SWS</b> Plate-type heat sink* ACL1Q75000000
Analog input bipolar ± 10V	0	
Digital output	2	
PWM output	3	
Motor temp sensor	1	
Incremental encoder	1	
5V sensor power supply	1	
12V sensor power supply	1	
CAN interface (isolated)	1	
Serial Interface RS232	1	
LIN Bus	1	

\*Plate-Type Heat Sink. For other heat sink type please contact us

## Related product part number

<b>AMPSEAL 23 pin Mating Connector Bag</b>	900KC0000019
<b>Fuse 500A</b>	744EFCNL500
<b>Fuse 700A</b>	744EFCNL700
<b>Thermal Pad for AC-L1</b>	768VR461A00



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