Autostart AS732 Generator Controller V2.1.0
RS485 MODBUS® communication protocol

mi6344
revision B, 10th Sept 2007
catalogue section 75

General

This document details the RS485 communication protocol for the AS732 generator controller. Further information about the specification, programming and operation may be found in the following documents:-

Doc. ref.	*Title*
ms6127	AS731 bulletin
ms6343	AS732 bulletin
mi6128	AS731/732 installation A: panel mounting and electrical connection
mi6129	AS731/732 installation B: programming/configuration
mi6243	AS731/732 installation C: AS730 to AS731/AS732 retrofitting
mi6130	AS731/732 operation
mi6131	AS731/732 communications and PC software model AS7CN
mi6263	AS731/732 RS232 communication protocol

Initiating Communications

With RS485 connection, set communication speed to 9600 baud, 8 bits, 1 stop bit, no parity. The communication protocol follows MODBUS® RTU conventions, with the following function codes:-

Code	*Function*	*Response*
03	MODBUS input registers	Read only registers, status upload
04	MODBUS holding registers	Read only registers, program profile
05	MODBUS force coils	Write-only registers, remote control

Full information on the MODBUS RTU can be found in the on-line reference guide, available at http://www.modicon.com/techpubs/techpubnew/pi_mbus_300.pdf

MODBUS® is a registered trademark of AEG Schneider Automation.

FRANK W. MURPHY LTD.
Church Rd, Laverstock,
Salisbury, SP1 1QZ, United Kingdom
tel: +44 1722 410055
fax: +44 1722 410088
email: sales@fwmurphy.co.uk
web: www.fwmurphy.co.uk

FW MURPHY
PO Box 470248
Tulsa, Oklahoma 74147, USA
tel: +1 918 317 4100
fax: +1 918 317 4266
email: sales@fwmurphy.com
web: www.fwmurphy.com

Function code queries and responses

Function code 03: Modbus input registers, status upload

Register address (decimal)	Parameter	Total no. of bytes	Units	Range	Notes
30000	Fault code	2		0 - 255	03-01
30001	State	2		0 - 5	
30002	Start attempt number	2		1 - 9	
30003	Output status word 1	2		0 - 255	03-09
30004	Timeout flags #1	2		0 - 255	03-02
30005	Timeout flags #2	2		0 - 255	03-02
30006	General purpose flags byte #1	2		0 - 255	03-03
30007	General purpose flags byte #2	2		0 - 255	03-03
30008	General purpose flags byte #3	2		0 - 255	03-03
30009	General purpose flags byte #4	2		0 - 255	03-03
30010	General purpose flags byte #5	2		0 - 255	03-03
30011	General purpose flags byte #6	2		0 - 255	03-03
30012	General purpose flags byte #7	2		0 - 255	03-03
30013	General purpose flags byte #8	2		0 - 255	03-03
30014	Input status byte	2		0 - 255	03-04
30015	Generator AC frequency	2	Hz	0 - 99	
30016	Output status word 1	2		0 -255	03-09
30017	Seconds run #4	2	Seconds	0 - 255	
30018	Analog oil pressure	2	psi	0 - 100	03-05
30019	Analog engine temperature	2	°C	40 - 140	03-05
30020	Load release fault	2		0 - 255	
30021	Engine speed	2	rpm	0 - 5000	
30022	Start delay timer	2	Seconds X 10	0 - 5990	
30023	Preheat timer	2	Seconds X 10	0 - 590	
30024	Crank timer	2	Seconds X 10	0 - 590	
30025	Crank cool timer	2	Seconds X 10	0 - 590	
30026	Override timer	2	Seconds X 10	0 - 590	
30027	Warmup timer	2	Seconds X 10	0 - 590	
30028	Restoration timer	2	Seconds X 10	0 - 36000	
30029	Cooldown timer	2	Seconds X 10	0 - 36000	
30030	Energise-to-stop timer	2	Seconds X 10	0 - 590	
30031	Seconds run #0 & #1	2			
30032	Seconds run #2 & #3	2			
30033	Generator AC phase 1 voltage	2	V	0 - 600	03-06
30034	Generator AC phase 2 voltage	2	V	0 - 600	03-06
30035	Generator AC phase 3 voltage	2	V	0 - 600	03-06
30036	Generator AC phase 1 current	2	A	0 - 10000	03-07
30037	Generator AC phase 2 current	2	A	0 - 10000	03-07
30038	Generator AC phase 3 current	2	A	0 - 10000	03-07
30039	Generator AC over current IDMT value	2		0 - 65535	
30040	Generator AC over current IDMT count value	2		0 - 65536	
30041	Battery DC voltage	2	V X 10	0 - 420	03-08
30042	Contactor timer	2	Seconds X 10	0 - 590	

Function code 03: status upload notes:

03-01 Fault codes

Code (Hex)	Description
07	No speed signal
08	Engine not stopped (speed signal present)
09	Bad oil pressure
0C	Generator AC over volts
0D	Engine under speed / generator AC under frequency
0E	Engine failed to start
0F	Engine overspeed / generator AC over frequency
10	Emergency stop
11	Low oil pressure shutdown (switch input)
12	High engine temperature (switch input)
17	Charge failure
1C	Generator AC under volts
38	Generator AC over-current (tripped)
44	Generator AC over-current (IDMT timeout)
57	Oil sender open-circuit fault (analog sender only)

03-01 (cont.) Fault codes (cont.)

58	Engine not stopped (WL voltage present)
59	Magnetic-pickup sensor failure
B8	High engine temperature warning (analog sender input)
B9	High engine temperature shutdown (analog sender input)
BC	Generator AC over-current (warning)
BD	Low oil pressure warning (analog sender input)
BE	Low oil pressure shutdown (analog sender input)
C6	High battery voltage
C7	Low battery voltage
F0	Input 3
F1	Input 4
F2	Input 5

03-02 Timeout flags

Timeout flags byte #1

Bit	Description
0	Start delay
1	Preheat
2	Crank
3	Crank cool
4	Override time
5	Warm-up delay
6	Restoration delay
7	Cool-down time

Timeout flags byte #2

Bit	Description
0	Loss of speed signal timer
1	Energize to stop timer
2	-
3	-
4	-
5	-
6	-
7	-

03-03 General purpose flags

Byte #1

Bit	Description
0	1= -
1	1= -
2	1= Magnetic pickup reading valid
3	1= Warning fault active
4	1= Shutdown fault active
5	1= Low oil pressure true
6	1= In AUTO mode
7	1= In MANUAL mode

Byte #2

Bit	Description
0	1= In OFF mode
1	1= Emergency stop active
2	1= -
3	1= -
4	1= Generator AC voltage OK
5	1= Remote start input active
6	1= Generator frequency above crank-cut value (Engine running)
7	1= Generator frequency below crank-cut value (Engine stopped)

03-03 (cont.) General purpose flags (cont.)

Byte #3

Bit	Description
0	1= Generator frequency within limits
1	1= Overspeed detected
2	1= Maximum number of start attempts expired
3	-
4	1= Start sequence under way
5	1= Generator has been on load
6	1= Load-in-manual mode software switch true
7	1= Shutdown fault is active

Byte #4

Bit	Description
0	1= Load release condition true
1	1 = In program mode
2	1= Warning currently being displayed
3	1= No preheat state required
4	1= Energize-to-stop output being used
5	1= Energised to stop output true
6	1= Last Battery voltage measurement was below limit
7	1= Last Battery voltage measurement was above limit

Byte #5

Bit	Description
0	1= Generator AC current below high limit
1	1= Charge fail input true
2	-
3	1= Test off load programmable input true
4	-
5	1= Manual restoration programmable input true
6	1= Generator contactor output used
7	-

Byte #6

Bit	Description
0	1= Magnetic pickup fitted
1	-
2	-
3	-
4	1= Analog LOP alarm
5	1= Analog HET alarm
6	-
7	1= Oil pressure in psi, 0= Oil pressure in bar

Byte #7

Bit	Description
0	1= Analog LOP sensor selected
1	1= Analog HET sensor selected
2	-
3	-
4	1= Battery charger fitted 0= Charge-alternator fitted
5	1= Charge-alternator WL voltage above crank-cut level
6	-
7	-

Byte #8

Bit	Description
0	-
1	-
2	1= Test start required
3	-
4	-
5	-
6	-
7	-

03-04 Input status byte

Bit	Description
0	-
1	-
2	Low Oil pressure (switch)
3	High Engine temperature (switch)
4	Input 3
5	Input 4
6	Input 5
7	-

03-05 Oil pressure & engine temperature (from analog senders)

To convert oil pressure from Psi to Bar:-

Bar = Psi / 14.493

To convert engine temperature from ^{o}C to F:-

F = C x 9/5 + 32

03-06 AC generator-voltage

To convert the ADC reading to generator AC voltage:-

V = (ADC MSB) x 256 + (ADC LSB)

03-07 AC generator current

To convert AC current to decimal:-

$I_{decimal}$ = (ADC MSB) x 256 + (ADC LSB)

03-08 Battery DC voltage

To convert the ADC reading to voltage:-

V = ((ADC value MSB) x 256 + (ADC value LSB)) / 10

03-09 Output status word 1

Bit	Description
0	Programmable output #4
1	Programmable output #3
2	Programmable output #2
3	Programmable output #1
4	Fuel relay
5	Crank relay
6	-
7	-

Function code 04: Modbus holding registers, program profile

Register address (decimal)	Parameter	Total no. of bytes	Units	Range	Additional notes
40000	Start delay	2	Seconds X 10	0 - 599S	04-01
40001	Preheat time	2	Seconds X 10	0 - 59S	04-01
40002	Crank time	2	Seconds X 10	3 - 59S	04-01
40003	Crank-cool time	2	Seconds X 10	3 - 59S	04-01
40004	Override time	2	Seconds X 10	2 - 59S	04-01
40005	Warmup delay	2	Seconds X 10	0 - 59S	04-01
40006	Restoration time	2	Seconds X 10	0 - 3600S	04-01
40007	Engine cool time	2	Seconds X 10	0 - 3600S	04-01
40008	Speed-signal delay	2	Seconds X 10	1 - 59S	04-01
40009	Energise to stop period	2	Seconds X 10	5 - 59S	04-01
40010	Bad oil pressure' timeout (Reserved)				04-01
40011	Communication timeout (Reserved)				04-01
40012	Key-repeat timer (Reserved)				04-01
40013	Contactor delay	2	Seconds X 10	0 - 59S	04-01
40014	Display flash timer (Reserved)				04-01
40015	Aux timer (Reserved)				04-01
40016	No. of flywheel teeth	2		1 - 250	04-01
40017	Crank-cut speed	2	RPM	100 - 1500	04-02
40018	Overspeed	2	RPM	500 - 5400	04-02
40019	Underspeed	2	RPM	500 - 3550	04-02

40020	Crank-cut frequency	2	Hz	5 - 25	04-02
40021	Over frequency	2	Hz	50 -70	04-02
40022	Under frequency	2	Hz	40 - 60	04-02
40023	Battery voltage high	2	VDC	12 -35	04-02
40024	Battery voltage low	2	VDC	10 -30	04-02
40025	No. of start attempts	2		1 - 9	04-02
40026	Generator under voltage level	2	VAC	50 - 600	04-02
40027	Generator voltage OK level	2	VAC	50 - 600	04-02
40028	CT ratio	2	x:5A	10 - 5000	04-02
40029	Full load current level	2	A	2 - 5000	04-02
40030	Mains-fail qualify time	2	Sec	1 - 30	
40031	Charge-start voltage level	2	VDC	0 - 26	
40032	Over current IDMT constant	2		10 - 50	04-02
40033	Over current instant trip factor	2	X 10	10 - 30	04-02
40034	LOP (low oil pressure) warning value	2	psi	10 -100	04-02
40035	LOP (low oil pressure) shutdown value	2	psi	10 -100	04-02
40036	HET (high engine temp) warning value	2	°C	80 - 140	04-02
40037	HET (high engine temp) shutdown value	2	°C	80 - 140	04-02
40038	Charge-start period	2	mins	1 - 60	
40039	RS485 address	2		0 - 15	
40040	Generator over-voltage level	2	VAC	50 - 600	04-02
40041	Overspeed override	2	%	0 - 25	04-02
40042	No. of generator phases	2		1 - 3	04-02
40043	Remote test time	2	mins	1 - 240	04-02
40044-40047	Spare				
40048	Load in manual switch (yes / no)	2		0 - 1	
40049	Under-voltage action (Dump-load / Shutdown)	2		0 - 1	
40050	Charge-fail input selection	2		0 - 2	
40051	Oil pressure units (psi / bar)	2		0 - 1	
40052	Temperature units (°C / F)	2		0 - 1	
40053	Remote start polarity (close to / open from +VE)	2		0 - 1	
40054	WL crank-cut enable (yes / no)	2		0 - 1	
40055	Hours-run enable (yes / no)	2		0 - 1	
40056	MPU fitted (yes / no)	2		0 - 1	
40057	AC generator fitted (yes / no)	2		0 - 1	
40058	Over-current action (load-dump / shutdown)	2		0 - 1	
40059	Under speed / frequency action (load-dump / shutdown)	2		0 - 1	
40060	Switch-off delay (yes / no)	2		0 - 1	
40061	Phase or line voltage display	2		0 - 1	
40062	Load engaged in Remote (yes / no)	2		0 - 1	
40063	Load engaged in test (yes / no)	2		0 - 1	
40064	Programmable input 3 function	2		0 - 15	04-03
40065	Programmable input 4 function	2		0 - 15	04-03
40066	Programmable input 5 function	2		0 - 15	04-03
40067	Modem phone-out condition	2		0 - 2	
40068	Programmable input 3 polarity (close / open)	2		0 - 1	
40069	Programmable input 4 polarity (close / open)	2		0 - 1	
40070	Programmable input 5 polarity (close / open)	2		0 - 1	
40071	Analog sender fail enable (yes / no)	2		0 - 1	
40072	Programmable output 1 config byte	2		0 - 51	04-04
40073	Programmable output 2 config byte	2		0 - 51	04-04
40074	Programmable output 3 config byte	2		0 - 51	04-04
40075	Programmable output 4 config byte	2		0 - 51	04-04
40076-40079	Spare				
40080-40095	Input 3 programmable message		ASCII		04-05
40096-40111	Input 4 programmable message		ASCII		04-05
40112-40127	Input 5 programmable message		ASCII		04-05
40128-40143	Programmable site name		ASCII		04-05
40144-40159	MODEM phone-out number		ASCII		04-06
40160-40175	Power-up message		ASCII		04-05
40176-40191	Spare				
40192-40207	Spare				
40208	LOP sensor select	2		0 - 5	04-07
40209	HET sensor select	2		0 -5	04-08
40210-40215	Spare				
40216	Switch on PIN No.	2	BCD		
40217	Program mode PIN No.	2	BCD		
40218	Remote access PIN No.	2	BCD		
40219	Mode-change PIN No.	2	BCD		
40220-40236	Instrument ID string		ASCII		

Function code 04: program profile notes:

04-01 Timers are stored as 16-bit unsigned multiples of 100mS i.e. If a timer is set to 3 minutes then timer value returned will be 3 x 60 x 10 = 1800 (0708h MSB = 07, LSB = 08). Timers marked 'reserved' are not intended to be user programmable.

04-02 System values are stored as 16-bit unsigned integers e.g. 300 flywheel teeth will be stored as 012Ch (MSB = 01 LSB = 2C).

04-03 Programmable input 3, 4 & 5 setting

Value	Input Action
00	Not used
01	Shutdown (overridden)
02	Shutdown (no override)
03	Warning (overridden)
04	Warning (no override)
05	Display only (overridden)
06	Display only (no override)
07	Load release
08	Lamp test
09	Manual load-restore
0A	Test: off load
0B	Alarm mute
0C	Load reset
0D	Remote MAN/AUTO mode
0E	External MAN start
0F	External MAN stop

04-04 Programmable output 1 - 4 setting

Value	Output action
00	Not used
01	Auto mode selected
02	Manual mode selected
03	Auto or Man mode selected
04	Start warning
05	Engine active
06	Engine running
07	External alarm enable
08	Generator available
09	Engine cooling
0A	Preheat mode 1
0B	Preheat mode 2
0C	Preheat mode 3
0D	Preheat mode 4
0E	Energise to stop
0F	Generator contactor
10	Field flashing
11	Louvre control
12	Charger isolate
13	Lamp test
14	Common alarm
15	Alarm (muteable)
16	Shutdown fault
17	Warning fault
18	Start fail
19	Over-speed / over-frequency
1A	Under-speed / under-frequency
1B	Generator under-volts
1C	Generator over-volts
1D	High current warning
1E	High current shutdown
1F	Generator out of limits
20	No speed signal
21	Magnetic pickup failure
22	Emergency stop
23	LOP shutdown
24	LOP warning
25	HET shutdown
26	HET warning
27	Input 3
28	Input 4
29	Input 5

04-04 (cont.) Programmable output 1 - 4 setting (cont.)

Value	Output action
2A	Charge-failure
2B	Battery voltage low
2C	Battery voltage high
2D	Battery voltage out of limits
2E	PC control A mode 1
2F	PC control A mode 2
30	PC control B mode 1
31	PC control B mode 2
32	Remote test
33	Mains contactor open

04-05 16 character messages should only include the standard ASCII character set (ASCII 00 – ASCII 7F) characters outside this range will cause the LCD to display unpredictable characters.

04-06 The MODEM phone-out number should only use characters: 0 1 2 3 4 5 6 7 8 9 and ,

04-07 (Low) Oil pressure sender/switch selection

Value	Sender type
00	Switch: close to negative
01	Switch: open from negative
02	Analog: Datcon
03	Analog: VDO 7-bar
04	Analog: Murphy
05	Analog: VDO 5-bar

04-08 (High) Engine temperature sender/switch selection

Value	Sender type
00	Switch: close to negative
01	Switch: open from negative
02	Analog: Datcon
03	Analog: VDO
04	Analog: Murphy
05	Analog: BMI

Function code 05: MODBUS force coil, control features

Register address (decimal)	Parameter	Coil value
0	Reset AS732	0xFF
1	Test start	0xFF
2	Test stop	0xFF
3	Reload generator	0xFF
4	Toggle PC output 'A'	0xFF
5	Toggle PC output 'B'	0xFF
6	Remote test	0xFF
7	Cancel remote test	0xFF
8	Select Manual mode	0xFF
9	Select Auto mode	0xFF
10	Man Start button	0xFF
11	Man Stop button	0xFF

MURPHY

FRANK W. MURPHY LTD.
Church Rd, Laverstock,
Salisbury, SP1 1QZ, United Kingdom
tel: +44 1722 410055
fax: +44 1722 410088
email: sales@fwmurphy.co.uk
web: www.fwmurphy.co.uk

FW MURPHY
PO Box 470248
Tulsa, Oklahoma 74147, USA
tel: +1 918 317 4100
fax: +1 918 317 4266
email: sales@fwmurphy.com
web: www.fwmurphy.com

USA - ISO9001:2000 FM 28221
UK - ISO9001:2000 FM 29422