

Codice progetto/prodotto:

# ***FM574 – FM587 – FM589***

Descrizione:

## **Protocollo Comunicazione ModBus**

Tipo di documento:

## **Descrizione Tabella dei Registri**

Versioni di riferimento:

**FM574v3xx – FM574v32x**

**F M587v3xx – FM587v4xx**

**FM589v3xx – FM589v4xx**

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## Protocollo ModBus

L'azionamento è dotato di una porta RS232 utilizzata per la configurazione dell'azionamento ed il controllo remoto.

La comunicazione seriale è basata sul protocollo standard ModBus in modalità RTU (per informazioni consultare il sito [www.modbus.org](http://www.modbus.org)). Sono supportate solo alcune delle funzioni standard:

1. il buffer di ricezione/trasmissione è di soli 50bytes, questo limita il numero di registri trasferibili in un'unica transazione ModBus, si consiglia non più di 10.
2. sono riconosciute solo le seguenti funzioni standard:

Codice Funzione	Nome Funzione
03h	Read Holding Registers
04h	Read Input Registers
06h	Write Single Register
10h	Write Multiple Register

3. sono definite alcune funzioni speciali:

Cod.Funzione	Nome
41h	Richiesta di trasmissione del record di identificazione apparecchiatura. Riporta codici e numeri di versione di hardware e software.

Le impostazioni di comunicazione sono:

<b>Baudrate</b>	19200bps
<b>Byte</b>	8bit
<b>Parità</b>	Pari
<b>Stop</b>	1bit

**Nota:** Ogni registro trasporta un parametro delle dimensioni di 2bytes, secondo le indicazioni dello standard ModBus. Il trasporto di parametri di tipo "long" è ottenuto sfruttando due registri contigui con trasmissione in ordine Lo-Hi.

**Attenzione:** È a disposizione un software che consente l'accesso facilitato a tutte le opzioni ed i parametri, di grande aiuto nella fase di installazione. Si raccomanda l'utilizzo dello stesso in quanto contiene funzioni di validazione dei valori introdotti che minimizzano possibili errori.

## Nota sulle unità di misura

Unità	Descrizione
Frac16	Rappresentazione in virgola fissa di un numero frazionario compreso tra -1.0 e +1.0, corrispondente a -32768 e 32767. $\text{reg} = \text{value} * 32768$ $\text{value} = \text{reg} / 32768$
Base 2 Exp.	Termine esponenziale in base 2 di un numero composto da una mantissa Frac16: $\text{Frac16} * 2^{\text{exp}}$
stp	Numero di step elementari del motore. Su un singolo giro il motore compie 65536 passi elementari.
[unit] .../10 .../100	Ogni unità del registro corrisponde a 1/10 o 1/100 etc... dell'unità di misura indicata. V/10 = decimi di Volt s/100 = centesimi di Secondo
bit-field	Significa che il contenuto del registro assume significato bit per bit.
CanStdID	Si tratta di un indirizzo CAN standard, identificatore a 11bit.
non specificato	Significa che si tratta di numeri puri. <ul style="list-style-type: none"> <li>• conteggio di elementi</li> <li>• indici predefiniti</li> <li>• fattori di rapporti numerici</li> </ul>

## ModBus Registers Table (Data Model)

### Drive setup:

I registri sopraelencati raccolgono i parametri fondamentali per la configurazione dell'azionamento.

I registri sono allocati in RAM quindi si tratta di impostazioni immediatamente recepite ma volatili. Ad ogni registro volatile elencato corrisponde un registro permanente allocato in EEPROM con indirizzo pari a quello del registro volatile +200 (il cui valore viene caricato solo in fase di start-up).

Esempio: il registro 201 conterrà la versione permanente del parametro "Main supply voltage".

Reg.	Unit	Description		Device					
				FM574 3.xx	FM574 3.2x	FM587 3.xx	FM587 4.xx	FM589 3.xx	FM589 4.xx
1	V/10	Main supply voltage		0	0				
2	bit-field	Configuration flags	Vedi Tabella Dettagli	0	0	0	0	0	0
3	ms	Brake OFF delay		0	0			0	0
4	ms	Brake ON delay		0	0			0	0
5	Frac16	Analog reference offset		0	0			0	0
6	Frac16	Armature offset						0	0
9	ohm/10	RxI Compensation						0	0
10		Type of motor	0="PMSM (sin-brushless)" 1="BLDC (dc-brushless)" 2="ACIM (asynchronous)" 3="DCM (brush-dc motor)"	0	0			0	0
11	V/10	Nominal rms phase voltage		0	0			0	0
12	A/10	Nominal rms phase current		0	0			0	0
12	A/10	Holding phase current				0	0		
13	A/10	Maximum rms phase current		0	0			0	0
13	A/10	Peak phase current				0	0		
14	A/10	Magnetizing current		0	0			0	0
15	rpm	Nominal speed		0	0			0	0
16	rpm	Maximum speed		0	0	0	0	0	0
17		Motor poles number		0	0			0	0
17		Motor step/revolution				0	0		
18	Lr/Rr Frac16 * s	Motor time constant		0	0			0	0
19	s	Max current timeout		0	0			0	0
19	s/1000	Holding current delay				0	0		
20	pulse/rev	Main encoder pulse/rev.		0	0	0	0	0	0
21	bit-field	Main encoder options	bit0=Reverse encoder	0	0	0	0	0	0
22	pulse/rev	Secondary encoder pulse/rev.		0	0				
23	bit-field	Secondary encoder options	bit0=Reverse encoder	0	0				
24	bit-field	Hall-Effect options	Vedi Tabella Dettagli	0	0			0	0
25		Resolver poles number		0	0			0	0
26	bit-field	Resolver options	bit0=Reverse resolver	0	0			0	0
27	stp	Field alignment offset		0	0			0	0

Reg.	Unit	Description		Device					
				FM574 3.xx	FM574 3.2x	FM587 3.xx	FM587 4.xx	FM589 3.xx	FM589 4.xx
30		Ramp generator input	0=Zero 1=Primary digital 2=Analog input 3=Internal value 4=Loop ramp output 5=Position controller output 6=Speed feedback	0	0	0	0	0	0
31		Position displacement source	0=Resolver 1=Main Encoder 2=Secondary Encoder 3=Hall-Effect 4=Stepping motor position 5=Analog input 6=External position index	0	0	0	0	0	0
32		Position target source	0=Positioning profile 1=Internal position index 2=Position feedback	0	0	0	0	0	0
33		Position feedback source	0=Resolver 1=Main Encoder 2=Secondary Encoder 3=Hall-Effect 4=Stepping motor position 5=Analog input	0	0	0	0	0	0
34		Speed reference source	0=Zero 1=Primary digital 2=Analog input 3=Internal speed index 4=Ramp generator 5=Position controller output 6=Speed feedback 7=Resolver 8=Main Encoder 9=Secondary Encoder 10=Hall-Effect	0	0	0	0	0	0
35		Speed feedback source	0=Resolver 1=Main Encoder 2=Secondary Encoder 3=Hall-Effect 4=Stepping motor position 5=Analog input 6=Armature feedback	0	0	0	0	0	0
36		Current reference source	0=Zero 1=Primary digital 2=Analog input 3=Speed controller output	0	0			0	0
37		Current limit source	0=Zero 1=Secondary digital 2=Analog input 3=Peak current limit 4=I2T current limit	0	0			0	0
38		Phase generation source	0=Resolver 1=Main Encoder 2=Hall-Effect	0	0			0	0
40	Frac16	Zero speed max		0	0	0	0	0	0

Reg.	Unit	Description	Device					
			FM574 3.xx	FM574 3.2x	FM587 3.xx	FM587 4.xx	FM589 3.xx	FM589 4.xx
41	Frac16	Zero speed min	0	0	0	0	0	0
42		Zero timeout	0	0	0	0	0	0
43-44 (Lo-Hi long)	stp	Max position limit	0	0	0	0	0	0
45-46 (Lo-Hi long)	stp	Min position limit	0	0	0	0	0	0
47		Elect Axis Gear numerator	0	0	0	0	0	0
48		Elect Axis Gear denominator	0	0	0	0	0	0
50	s/100	Acceleration ramp time	0	0	0	0	0	0
51	s/100	Deceleration ramp time	0	0	0	0	0	0
52	s/100	Positioning acceleration	0	0	0	0	0	0
53	s/100	Positioning deceleration	0	0	0	0	0	0
54	Frac16	Positioning speed	0	0	0	0	0	0
55-56 (Lo-Hi long)	stp	Positioning target	0	0	0	0	0	0
62	Frac16	Elect Axis P Gain	0	0	0	0	0	0
63	Frac16	Elect Axis I Gain	0	0	0	0	0	0
64	Frac16	Elect Axis D Gain	0	0	0	0	0	0
65	Base 2 Exp.	Elect Axis P Scale	0		0	0	0	
65	Frac16	Elect Axis I Correction		0				0
66	Base 2 Exp.	Elect Axis I Scale	0		0	0	0	
67	Base 2 Exp.	Elect Axis D Scale	0		0	0	0	
68	Frac16	Elect Axis Feed-Forward gain	0	0	0	0	0	0
69	Base 2 Exp.	Elect Axis Feed-Forward scale	0	0	0	0	0	0
70	Frac16	Field loop P Gain	0	0			0	0
71	Frac16	Field loop I Gain	0	0			0	0
72	Base 2 Exp.	Field loop P scale	0				0	
72	Frac16	Field loop I Correction		0				0
73	Base 2 Exp.	Field loop I scale	0				0	
74	stp	Positioning window	0	0	0	0	0	0
75	Frac16	Position loop P Gain	0	0	0	0	0	0
76	Frac16	Position loop I Gain	0	0	0	0	0	0
77	Frac16	Position loop D Gain	0	0	0	0	0	0
78	Base 2 Exp.	Position loop P scale	0		0	0	0	
78	Frac16	Position loop I Correction		0				0
79	Base 2 Exp.	Position loop I scale	0		0	0	0	
80	Base 2 Exp.	Position loop D scale	0		0	0	0	
81	Frac16	Position Feed-Forward gain	0		0	0	0	
82	Base 2 Exp.	Position Feed-Forward scale	0		0	0	0	
83	Frac16	Zero speed window	0	0	0	0	0	0
84	Frac16	Speed loop P Gain	0	0			0	0
85	Frac16	Speed loop I Gain	0	0			0	0
86	Base 2 Exp.	Speed loop P scale	0				0	
86	Frac16	Speed loop I Correction		0				0
87	Base 2 Exp.	Speed loop I scale	0				0	
88	Frac16	Speed Feed-Forward Gain	0	0			0	0
89	Frac16	SQ current loop P Gain	0	0			0	0



Reg.	Unit	Description		Device					
				FM574 3.xx	FM574 3.2x	FM587 3.xx	FM587 4.xx	FM589 3.xx	FM589 4.xx
90	Frac16	SQ current loop I Gain		0	0			0	0
91	Base 2 Exp.	SQ current loop P scale		0				0	
91	Frac16	SQ current loop I Correction			0				0
92	Base 2 Exp.	SQ current loop I scale		0				0	
93	Frac16	SD current loop P Gain		0	0			0	0
94	Frac16	SD current loop I Gain		0	0			0	0
95	Base 2 Exp.	SD current loop P scale		0				0	
95	Frac16	SD current loop I Correction			0				0
96	Base 2 Exp.	SD current loop I scale		0				0	
99		Next predefined position		0	0				
100	bit-field	Option flags	Vedi Tabella Dettagli	0	0	0	0	0	0
110		ModBus Baudrate	0=600bps 1=1200bps 2=2400bps 3=4800bps 4=7200bps 5=9600bps 6=14400bps 7=19200bps 8=28800bps 9=38400bps 10=57600bps 11=76800bps 12=115200bps 13=230400bps	0	0	0	0		
111		ModBus Address		0	0	0	0		
112		Microstep Number				0	0		
118	CanStdID	Standard Rx CAN ID address, standard ID operation only					0		0
119	CanStdID	Standard Tx CAN ID address, standard ID operation only					0		0
120		CAN-Bus baudrate setup	0=10Kbps 1=20Kbps 2=50Kbps 3=125Kbps 4=250Kbps 5=500Kbps 6=800Kbps 7=1Mbps	0	0	0	8=333Kbps	0	8=333Kbps
121		CAN-Bus slave address identifier		0	0	0	0	0	0
122		1] Reg. cycle write	Registri che compongono il pacchetto CAN ciclico in scrittura.	0	0	0	0	0	0
123		2] Reg. cycle write		0	0	0	0	0	0
124		3] Reg. cycle write		0	0	0	0	0	0
125		4] Reg. cycle write		0	0	0	0	0	0
126		1] Reg. cycle read	Registri che compongono il pacchetto CAN ciclico in lettura.	0	0	0	0	0	0
127		2] Reg. cycle read		0	0	0	0	0	0
128		3] Reg. cycle read		0	0	0	0	0	0
129		4] Reg. cycle read		0	0	0	0	0	0
149		Predefined positions number		0	0				

**Commands:**

I registri che seguono consentono di comandare tramite comunicazione seriale l'azionamento.

Reg.	Unit	Description		Device		
				FM574 3.xx / 3.2x	FM587 3.xx / 4.xx	FM589 3.xx / 4.xx
101	bit-field	Drive commands	bit0=Reset position bit1=Find zero... (HomeSwitch) bit2=Set forced position bit4=Synchronization signal bit15=Make Field Alignment / Armature Offset	0	0	0
102	bit-field	Remote virtual input	bit0=Enable drive bit1=Reset alarms	0	0	0
103	Frac16	Primary digital reference		0	0	0
104	Frac16	Secondary digital reference		0	0	0
105-106 (Lo-Hi long)	stp	Elect axis position index		0	0	0
107	stp/ms	Elect axis speed index		0	0	0
108-109 (Lo-Hi long)	stp	Force Actual Position		0	0	0

**Position preset:**

Esiste la possibilità di definire un preset di posizioni o di movimenti, fino a 10, da poter richiamare al volo semplicemente assegnando l'opportuno valore ai registri 99 e 149.

Reg.	Unit	Description	Device		
			FM574 3.xx / 3.2x	FM587 3.xx / 4.xx	FM589 3.xx / 4.xx
150	s/100	Positioning Acceleration	0		
151	s/100	Positioning Deceleration	0		
152	Frac16	Positioning Speed	0		
153-154 (Lo-Hi long)	stp	Positioning Target	0		
155	s/100	Positioning Acceleration	0		
156	s/100	Positioning Deceleration	0		
157	Frac16	Positioning Speed	0		
158-159 (Lo-Hi long)	stp	Positioning Target	0		
160	s/100	Positioning Acceleration	0		
161	s/100	Positioning Deceleration	0		
162	Frac16	Positioning Speed	0		
163-164 (Lo-Hi long)	stp	Positioning Target	0		
165	s/100	Positioning Acceleration	0		
166	s/100	Positioning Deceleration	0		
167	Frac16	Positioning Speed	0		
168-169 (Lo-Hi long)	stp	Positioning Target	0		
170	s/100	Positioning Acceleration	0		
171	s/100	Positioning Deceleration	0		
172	Frac16	Positioning Speed	0		
173-174 (Lo-Hi long)	stp	Positioning Target	0		
175	s/100	Positioning Acceleration	0		
176	s/100	Positioning Deceleration	0		
177	Frac16	Positioning Speed	0		
178-179 (Lo-Hi long)	stp	Positioning Target	0		
180	s/100	Positioning Acceleration	0		
181	s/100	Positioning Deceleration	0		
182	Frac16	Positioning Speed	0		
183-184 (Lo-Hi long)	stp	Positioning Target	0		
185	s/100	Positioning Acceleration	0		
186	s/100	Positioning Deceleration	0		
187	Frac16	Positioning Speed	0		
188-189 (Lo-Hi long)	stp	Positioning Target	0		
190	s/100	Positioning Acceleration	0		
191	s/100	Positioning Deceleration	0		
192	Frac16	Positioning Speed	0		

Reg.	Unit	Description	Device		
			FM574 3.xx / 3.2x	FM587 3.xx / 4.xx	FM589 3.xx / 4.xx
<b>193-194</b> (Lo-Hi long)	stp	Positioning Target	O		
<b>195</b>	s/100	Positioning Acceleration	O		
<b>196</b>	s/100	Positioning Deceleration	O		
<b>197</b>	Frac16	Positioning Speed	O		
<b>198-199</b> (Lo-Hi long)	stp	Positioning Target	O		

**State and Alarms:**

Sono registri in sola lettura che forniscono una rappresentazione dello stato di funzionamento.

Reg.	Unit	Description		Device		
				FM574 3.xx / 3.2x	FM587 3.xx / 4.xx	FM589 3.xx / 4.xx
400	V/10	Supply voltage limit		0	0	0
401	A/10	Maximum continuous current		0	0	0
402	A/10	Hardware current limit		0	0	0
403	bit-field	Hardware input	bit0=DriveEnable bit1=HomeSwitch bit2=CwSwitch bit3=CcwSwitch	0	0	0
404	Frac16	Analog reference		0		0
405	V/10	DC-Bus voltage		0	0	0
406	Hz/10	Output frequency		0		0
407	V/10	Output voltage		0		0
408	A/10	Current value		0	0	0
409	rpm	Motor speed		0	0	0
410	bit-field	Control loop state	bit0=Speed reached bit1=End profile bit2=Position reached bit3=Stopped (speed is zero)	0	0	0
411	V/10	Armature voltage				0
420-421 (Lo-Hi long)	stp	Actual position		0	0	0
440	bit-field	Previous Fault	Vedi Tabella Dettagli	0	0	0
441	bit-field	Previous Warning		0	0	0
442	bit-field	Actual Fault		0	0	0
443	bit-field	Actual Warning		0	0	0

## Tabelle dettagli registri

<b>Reg.2</b>				
<b>FM574</b> 3.xx / 3.2x	<b>FM587</b> 3.xx	<b>FM587</b> 4.xx	<b>FM589</b> 3.xx	<b>FM589</b> 4.xx
bit0=Enable source 0=From hardware input 1=Command from field-bus				
bit1=Temperature sense 0=Without temp. sensor 1=With temp. sensor	bit1=Stepping source 0=From hardware input 1=Command from field-bus			
bit2=Software limits 0=Disabled 1=Enabled				
bit3=Hardware limits 0=Disabled 1=Enabled			bit3=Hardware limits 0=Disabled 1=Enabled	
bit4=Zeroing active level 0=Active Low 1=Active High				
bit5=Zeroing direction 0=--Inactive- 0 ---Active--> 1=--Active--- 0 Inactive-->				
bit6=Output relay 0=Mechanical brake 1=Alarm signal				
		bit11=CAN protocol type select 0=Extend addr. operation (dflt) 1=Standard addr. operation		bit11=CAN protocol type select 0=Extend addr. operation (dflt) 1=Standard addr. operation
bit12=Communitation timeout 0=Enabled 1=Disabled				
bit13=Deceleration behavior 0=Four Quadrants (generator) 1=Two Quadrants (free-wheel,only positive torque)			bit13=Deceleration behavior 0=Four Quadrants (generator) 1=Two Quadrants (free-wheel,only positive torque)	
bit14=Auto calibration 0=Auto calibrate I and V 1=No calibration			bit14=Auto calibration 0=Auto calibrate I and V 1=No calibration	

<b>Reg.24</b>		
<b>FM574</b> <b>3.xx / 3.2x</b>	<b>FM587</b> <b>3.xx / 4.xx</b>	<b>FM589</b> <b>3.xx / 4.xx</b>
bit0=Reverse hall-effect sense bit1=Active level High (else active level i low)		bit0=Sensor sequence reverse bit1=Sensor input exchange U / W bit2=Active level High (else active level i low) bit3=Speed filtering enable bit4=BEMF commutation, zero / peak aligned bit5=Motor phase sequence U-W-V / U-V-W

<b>Reg.100</b>		
<b>FM574</b> <b>3.xx / 3.2x</b>	<b>FM587</b> <b>3.xx / 4.xx</b>	<b>FM589</b> <b>3.xx / 4.xx</b>
bit0 – bit3=Control mode 0=Current loop 1=Speed loop 2=Electrical axis 3=Absolute positioning 4=Absolute predefined positioning 5=Relative positioning 6=Relative predefined positioning 15=User free mode  bit4=Stop mode 0=Stop free wheel 1=Stop with ramp bit5=Reference synchronization 0=Auto sync. on change 1=Wait sync. Signal  bit7=End switch brake 0=Current limit brake 1=Free-Wheel release bit8=Field weakening 0=Disabled 1=Enabled	bit0 – bit3=Control mode 0=Current loop 1=Speed loop 2=Electrical axis 3=Absolute positioning 4=Absolute predefined positioning 5=Relative positioning 6=Relative predefined positioning 15=User free mode  bit4=Stop mode 0=Stop free wheel 1=Stop with ramp bit5=Reference synchronization 0=Auto sync. on change 1=Wait sync. Signal	bit0 – bit3=Control mode 0=Current loop 1=Speed loop 2=Electrical axis 3=Absolute positioning 4=Absolute predefined positioning 5=Relative positioning 6=Relative predefined positioning 15=User free mode  bit4=Stop mode 0=Stop free wheel 1=Stop with ramp bit5=Reference synchronization 0=Auto sync. on change 1=Wait sync. Signal  bit7=End switch brake 0=Current limit brake 1=Free-Wheel release bit8=Field weakening 0=Disabled 1=Enabled

<b>Reg.440 – 442</b>		
<b>FM574</b> <b>3.xx / 3.2x</b>	<b>FM587</b> <b>3.xx / 4.xx</b>	<b>FM589</b> <b>3.xx / 4.xx</b>
bit0=Over Voltage bit1=Over Current bit2=Under Voltage bit3=Wrong Configuration bit4=Power Overheat bit5=IxT Power protect bit6=Motor Overheat bit7=I <sup>2</sup> T Motor protect bit8=Short / Power Fault bit9=Initial position error bit10=Zeroing timeout bit11=Hall-effect disconnected bit12=Resolver loss of signal bit13=Resolver loss of tracking bit14=Communication timeout bit15=CAN-BUS error	bit0=Over Voltage bit1=Over Current bit2=Under Voltage bit3=Wrong Configuration bit4=Power Overheat  bit6=Motor Overheat  bit8=Short / Power Fault  bit10=Zeroing timeout  bit14=Communication timeout bit15=CAN-BUS error	bit0=Over Voltage bit1=Over Current bit2=Under Voltage bit3=Wrong Configuration bit4=Power Overheat bit5=IxT Power protect bit6=Motor Overheat bit7=I <sup>2</sup> T Motor protect bit8=Short / Power Fault bit9=Initial position error bit10=Zeroing timeout bit11=Hall-effect disconnected  bit14=Communication timeout bit15=CAN-BUS error

<b>Reg.441 – 443</b>		
<b>FM574</b> <b>3.xx / 3.2x</b>	<b>FM587</b> <b>3.xx / 4.xx</b>	<b>FM589</b> <b>3.xx / 4.xx</b>
bit0=Power-Up Sequence bit1=Invalid Zeroing bit2=Max software limit bit3=Min software limit bit4=Max hardware limit bit5=Min hardware limit bit6=Resolver adjusted bit7=Resolver adjust error	bit0=Power-Up Sequence bit1=Invalid Zeroing bit2=Max software limit bit3=Min software limit bit4=Max hardware limit bit5=Min hardware limit	bit0=Power-Up Sequence bit1=Invalid Zeroing bit2=Max software limit bit3=Min software limit bit4=Max hardware limit bit5=Min hardware limit

## Protocollo CAN

Sugli azionamenti in oggetto è implementato un protocollo di comunicazione su CAN-Bus. Si tratta di un protocollo proprietario, molto semplice e snello. L'accesso ai parametri è basato sulla stessa tabella di registri definita per il ModBus descritta in questo documento.

Caratteristiche e modalità di funzionamento del protocollo CAN sono descritte nel documento "FM\_DRIVE\_CanBus".