

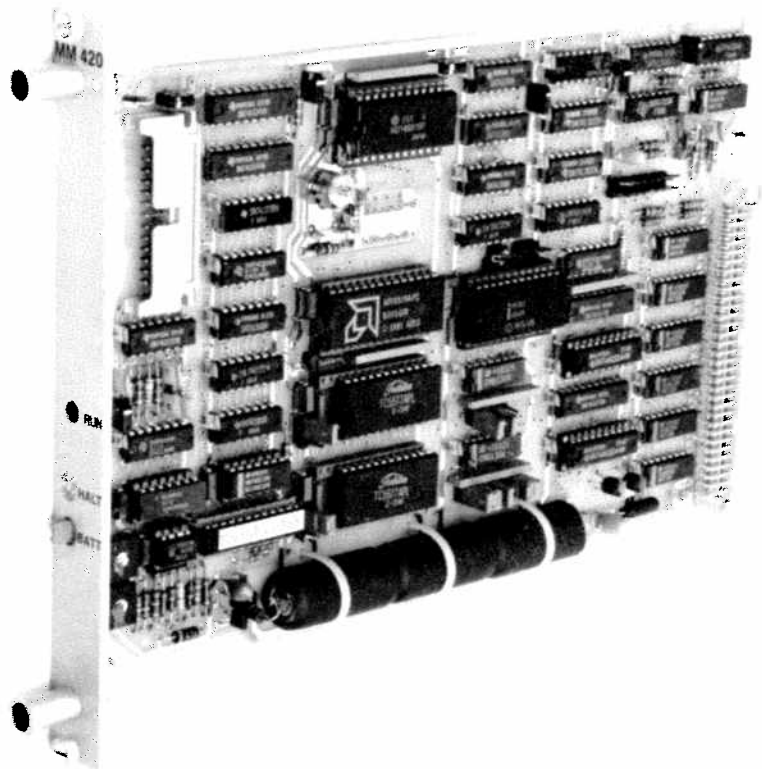
OPERATING INSTRUCTIONS

MULTIFUNCTION MODULE

MM 420

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1. INTRODUCTION

The MM 420 is a function module conforming to the "BS 420" bus.

2. FEATURES

- RAM memory, 2k words or 8k words, back-up battery
- Three 16 bit timers with interrupts at any desired programmable vector address
- Real time clock – Clock with calendar, back-up battery
 - Alarm function
 - periodic interrupt
- Interrupt controller with any desired programmable vector address and interrupt masks
- Power up/down protocol logic for LSI 11 systems
- Line time clock can be switched on and off by the software
- Console interface for CS 420
- Run indicator
- Halt jumper
- Watchdog

3. SPECIFICATION

- Order Nr. BG 512 780 -T
- Diagram BG 541 184 -S (packed with unit)
- Layout BG 512 781 -Z (in appendix to these instructions)
- Board format SC 420 format
- slots required 1 slot
- Voltage supply $V_{CC} = +5\text{ V} \pm 5\%$ / typical 1 A
- Bus interface:
 - Bus load 1 DC load
1 AC load
- Address space:
 - a) Memory entire address space in 4k or 16k byte blocks, selected with address jumpers
 - b) I/O devices: whole I/O page in 256 byte blocks, selected with address jumpers
- RAM:
 - 2k words: 2 CMOS RAM's 5517 APL or
 - 8k words: 2 CMOS RAM's 5564 PL
- TIMER:
 - 3 x 16 bit counters for producing time intervals of 61 μs ... 1s or 488 μs ... 16'384 s
- INTERRUPT CONTROLLER:
 - 6 interrupt inputs
 - programmable vector addresses
 - interrupt inputs can be masked

- REAL-TIME-CLOCK:
 - clock with seconds, minutes, hours, days, months, years and days of the week, battery back-up
 - periodic interrupt with 15 different time intervals from 30.5 μ s to 500 ms programmable
 - alarm clock (once a day)
 - programmable clock signal output "SQW" (for timer)
- LINE-TIME-CLOCK "LTC":
 - 50 Hz or 60 Hz (line frequency or from timer)
 - enable/disable by software
- BUS POWER PROTOCOL:
 - Power up/down protocol as per LSI 11 bus specification
- CONSOLE INTERFACE:
 - Connection for CS 420 with display and keyboard
- WATCHDOG:
 - with jumper 0.5; 1.0; 4.0; 8.0 seconds or disable
- BATTERY BACK-UP:
 - Normal operation

U_{+5VB}	=	$V_{CC} - 0.25$ V min.
I_{+5VB}	=	260 mA max.
 - Standby operation

U_{+5VB}	=	4.26 V max. / 3.6 V typical
R_i	=	33 Ohm
 - Storage capacity: 275 mAh max.
 - Min. charging time: 10 h
 - Consumption by the MM 420: I_{BAT} = 500 μ A max.
 - Back-up time: 500 h min without extra load at +5 VB (refer to section 4.2.7)

4. DESCRIPTION

4.1 Memory

The memory is a CMOS RAM with battery back-up. The memory capacity can be selected as either 2k or 8k words through installation of the appropriate part.

The RAM is organized according to byte and can be addressed with byte or word instructions.

If the RAM is not used, it can be blocked with a jumper so that the address space can be used for other purposes (refer to section 5.2.1).

4.2 I/O devices

4.2.1 Timer

The timer consists of three independent programmable 16 bit counters with separate clock signal inputs and outputs. Two clock signal variants are possible: a fixed basic frequency (32.768 kHz), or a real time clock with programmable division factor. The selection is made by appropriate wiring as described in section 5.2.3. Three "interrupt lines" on jumpers are available for evaluation of the output signal. These interrupt lines go to the interrupt controller where the data is processed accordingly.

4.2.2 Interrupt controller

The interrupt controller handles the interrupts to the processor for several peripheral units. It does the masking, priority assignments, and vector addressing. These functions are all software programmable.

The following peripherals are connected to the interrupt controller:

- 3 timer outputs
- real time clock
- line time clock
- console or keyboard

To start the interrupt controller after a "power up" or "bus INIT" when it is reset by the hardware, its mode of operation must be initialized in its various registers (refer to section 7).

4.2.3 RTC real time clock

The RTC has the following functions:

- Real time clock with seconds, minutes, hours, days of the week, date, month and year (leap years are programmed).
This clock has a battery back-up so that it continues to run when the unit is off.
- Alarm interrupt once a day, with preset alarm time in seconds, minutes, and hours.
- Periodic interrupts with programmable time intervals
- Square wave output with programmable division factor
- 18 byte user CMOS RAM with battery back-up

The data for the clock time are stored internally in an 8 – 6 CMOS RAM and updated every second.

When enabled, the interrupts affect the processor via the interrupt controller.

The square wave output generates a divided clock signal originating from the basic frequency of the clock oscillator. This is available to the timer.

4.2.4 LTC Line time clock

The MM 420 controls the line time clock signal. It is adapted to the Q-bus specification and transmitted to the BEVNT line.

By jumper k three modes may be selected:

- no LTC
- LTC from power supply
- LTC from timer

4.2.5 RUN indicator

The RUN LED on the back panel shows the operational status of the processor. It lights when the processor is working on a program sequence, and it is dark when it is in a halt mode such.

Comment: The RUN display does not function with every type of processor (such as Falcon). In addition, the jumper for the SRUN line must be placed according to the slot for the processor board in the SC 420.

4.2.6 HALT jumper (back panel)

When in place, HALT jumper J3 (short circuit jumper) causes the CPU to interrupt the program run and for example, change to ODT (for testing purposes).

4.2.7 Battery back-up

The battery back-up is turned on when the BATT switch on the back panel is at ON. The back-up time can be calculated from the following formula:

$$t_{\text{back-up}} = \frac{275 \text{ mAh}}{I_{\text{B MM420}} + I_{+5 \text{ VB}}}$$

$I_{\text{B MM420}}$: Consumption by MM 420 (refer to section 3)

$I_{+5 \text{ VB}}$: Load on bus line "+5 VB"

Note:

For breaks longer than the back-up capacity, the BATT switch must be set to OFF to protect the storage battery from total discharge. This also applies for storage and shipping.

(The first series of MM 420's has a BATT jumper instead of a switch. To disable the battery back-up this jumper must be removed and placed in the HALT position).

4.2.8 Watchdog

The watchdog is a hardware function unit for monitoring the software run.

After the supply voltage has been turned on, the watchdog is set on standby. It remains on standby until the first time it is triggered by the software. Once triggered, the software must refresh at regular intervals. It can only be stopped with "bus INIT". If the watchdog is not refreshed due to a computer error, it generates a system reset after a selected period of time. In a system reset a BUS INIT command is given which initializes all the analog and digital outputs. The computer is also reset, and a new power up sequence is subsequently carried out.

A response of the watchdog is indicated on the pc board by a lighted LED until the watchdog is restarted.

The time interval of the watchdog can be selected with a jumper, which can also be placed on disable (refer to section 6.2.4).

5. CONFIGURATION

5.1 Factory configuration (also refer to Appendix A)

	Factory Configuration		User Configuration	
	Status	Jumpers/Switch	Status	Jumpers/Switch
a) Memory:	Enabled	OUT: A17		
– Startaddress	160'000	IN: A12		
		OUT: A13, A14		
		A15, A16		
– Capacity	2k-word chips	IN: B/1 – 2		
		IN: B/3 – 4		
		IN: C/2 – 3		
		IN: D/2 – 3		
b) I/O-Devices:				
– Baseaddress	175'000	IN: E8, E10		
		OUT: E9, E11,		
		E12		
Display	175'000			
Keyboard	175'040			
Timer	175'100			
INT-Contr.	175'140			
RTC	175'200			
LTC	175'300			
Watchdog	175'340			
– Timer: CLK 0	32.768 kHz	IN: F/1 – 4		
CLK 1	32.768 kHz	IN: F/3 – 1		
CLK 2	32.768 kHz	IN: F/5 – 3		
OUT 0	TINT 0	IN: G/1 – 2		
OUT 1	TINT 1	IN: G/3 – 4		
OUT 2	TINT 2	IN: G/5 – 6		
c) LTC	TIMER 0	IN: G/1 – K/2		
		OUT: K1		
d) Watchdog	4 seconds	IN: H3		
		OUT: H1, H2,		
		H4, H5		
e) Backplane "HALT"	Run	OUT: HALT		
f) Backplane "BATT"	OFF	BATT OFF		

5.2 Address selection

5.2.1 Memory

5.2.1.1 Configuration for the different sized memories

The RAM memory, located at N4 and N14, must be selected as required. The following is possible:

- 2k words: 2 CMOS RAM's 2k x 8 bit (such as TC 5517 APL)
- 8k words: 2 CMOS RAM's 8k x 8 bit (such as TC 5564 PL)

Jumper configuration:

2k words	8k words
B/1 - 2	B1 open
B/3 - 4	B3 open
C/2 - 3	C/1 - 2
D/2 - 3	D/1 - 2

Note the dashed line in the layout plan when you insert 2k chips. Contacts 1, 2, 27, 28, of the socket remain free.

5.2.1.2 Addressing

The memory is enabled and the start address is set with jumpers A 12 ... A 17. It is dependent on the memory capacity.

a) 2k word memory

Start address	Jumpers					
	A17	A16	A15	A14	A13	A12
Memory Disable	∅	X	X	X	X	X
∅∅∅ ∅∅∅	1	∅	∅	∅	∅	∅
∅1∅ ∅∅∅ (2k)	1	∅	∅	∅	∅	1
∅2∅ ∅∅∅ (4k)	1	∅	∅	∅	1	∅
(2k address steps)	⋮	⋮	⋮	⋮	⋮	⋮
15∅ ∅∅∅ (26k)	1	∅	1	1	∅	1
I/O-Page						
16∅ ∅∅∅ (28k)	1	1	1	1	1	∅
17∅ ∅∅∅* (30k)	1	1	1	1	1	1

- ∅ ≙ jumper set
- 1 ≙ jumper removed
- X ≙ jumper irrelevant

*CAUTION: no address windows for I/O devices

b) 8k word memory

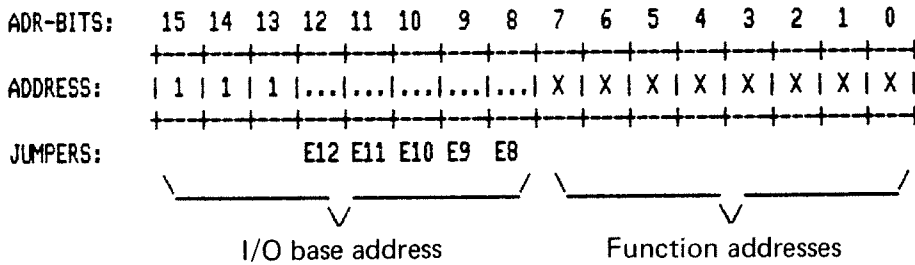
	Start address	Jumpers					
		A17	A16	A15	A14	A13	A12
Memory Page	Memory Disable	∅	X	X	X	X	X
	∅∅∅ ∅∅∅	1	∅	∅	∅	1	1
	∅4∅ ∅∅∅ (8k)	1	∅	∅	1	1	1
	1∅∅ ∅∅∅ (16k)	1	∅	1	∅	1	1
	14∅ ∅∅∅ (24k)	1	∅	1	1	1	1
I/O-Page	16∅ ∅∅∅* (28k)	1	1	1	1	1	1

∅ ≙ jumper set
 1 ≙ jumper removed
 X ≙ jumper irrelevant

*CAUTION: no address windows for I/O devices

5.2.2 I/O devices

Setting for the base address:



Address bit = 0 : jumper set
 Address bit = 1 : jumper not set

5.3 Further settings

5.3.1 TIMER selection

a) The clock signal for each counter in the Timer IC can be jumpered in field F1 ... F5:

- F1: clock signal input Counter 1
- F3: clock signal input Counter 2
- F5: clock signal input Counter 3

The following selection of clock signals is available:

- F2: SQW: Clock signal supplied by real time clock with programmable frequency from 2 Hz to 8.192 kHz.
- F4: 32.768 kHz fixed frequency

b) The counter outputs must be wired with jumperfield G1 ... G6 according to the application:

- G1: Output counter 0
- G3: Output counter 1
- G5: Output counter 2
- G2: Interrupt connection 0 (TINT 0)
- G4: Interrupt connection 1 (TINT 1)
- G6: Interrupt connection 2 (TINT 2)

5.3.2 Watchdog

Jumpers settings for watchdog expiration period:

Period	Jumper setting
0,5 s	H1
1,0 s	H2
4,0 s	H3
8,0 s	H4
Disable	H5

5.3.3 Line Time Clock

Signal source	Jumper setting
Power supply	K1 – K2
Timer 0	G1 – K2
Timer 1	G3 – K2
Timer 2	G5 – K2
SQW	F2 – K2
none	K1, K2 open

6. INSTALLATION

6.1 Important information

Read the section "Installation of modules" in the operating instructions for the SC 420.

- Before any manipulation is undertaken on the module or its connections, the unit and any external voltage supplies must be turned off.
- The back-up battery must be disconnected (switch or jumper). Otherwise the battery could be short circuited and destroyed if the module were laid on conducting material or placed in antistatic packaging.
- Do not use connection cables from other modules.

6.2 Installation in the SC 420

The MM 420 must be installed in slot J5 to allow it to work with the power supply (LTC and PF)

6.3 Connections

Console connector J2 is specially equipped for the connection of the CS 420. Refer to diagram BG 541 184 -S for the pin assignment.

7. PROGRAMMING

Detailed information for the programmer can be found in the Engineering Handbook.

8. MAINTENANCE

8.1 Periodic maintenance

The MM 420 contains gas tight nickel cadmium storage batteries which must be checked, particularly after longer breaks in operation. If the ambient temperature in the rack is constantly over 45°C, we recommend replacing the batteries annually.

To prevent the battery from total discharge we recommend disconnecting it if the unit won't be operated for longer periods of time (refer to section 4.2.7).

8.2 Troubleshooting

Symptom	Possible causes	Location	Repair
The unit has been powered on, but the keyboard and the display do not function	<ul style="list-style-type: none"> – Power status signals BDCOK H and BPOK H are not present 	Check BDCOK H and BPOK H. If both are low, the cause must be found: <ul style="list-style-type: none"> – The PF power fail LED on the board lights – +5V def → SPOK = HIGH? – Voltage sensor SPOK = HIGH? – Voltage sensor SPOK = LOW? 	<ul style="list-style-type: none"> – Check PS 420 – Check PS 420 – Voltage sensor defective – Check the power up/down sequencer
The battery voltage monitor flag is set in the real time clock	<ul style="list-style-type: none"> – Insufficient voltage from the battery 	<ul style="list-style-type: none"> – Check the battery voltage on the pc board U_{BATT} min. = 3.0 V 	<ul style="list-style-type: none"> – Stby current may be too large because of a defective load → locate – Replace battery

Symptom	Possible causes	Location	Repair
The BEVENT signal (line time clock) does not appear on the bus	<ul style="list-style-type: none"> – no signal at K2 – LTC command flag is not set – No LTC from the power supply 	<ul style="list-style-type: none"> – Check with scope – Set with ODT – Check with an scope 	<ul style="list-style-type: none"> – Check configuration, start timer – Check MM or software – Check the PS 420 – Check the MM 420
RUN LED does not light	<ul style="list-style-type: none"> – FALCON generates no SRUN signal – Faulty configuration – Faulty program run – Missing jumper on the Processor space on the BS 420 – RUN indicator on the MM 420 is defective 	<ul style="list-style-type: none"> – Check processor – Check with configuration table of instrument – Check program nr. with configuration table of instrument – Check BS 420 – Check SRUN signal with oscilloscope 	<p>None</p> <ul style="list-style-type: none"> – Improve configuration – Use suitable program <p>Insert jumper</p> <p>Check RUN INDICATOR</p>
If other symptoms occur consult the Balzers Service Dept.			

9. DETAILED DESCRIPTION

Detailed information for the trained service engineer can be found in the engineering handbook.

10. SPARE PARTS

Defective units are completely replaced or sent to Balzers for repair

Note: If the MM 420 to be replaced contains 8k RAMs, these must be ordered additionally, standard is 2k RAMs.

	Description Teil	Item Pos.	Order No. Bestell-Nr.	S	Reference Bemerkungen
1	MM 420 (2k words / Worte)		BG 512 780 -T		
1	Akku / Batterie, XKCF 250 ST		B 5151 102 -1		3 pieces required
1	Heat shrink tubing / Schrumpfschlauch, RNF 100, Sw, 3/4"		B 4616 734 AA		100 mm long / lang
1	CMOS RAM e.g. / z.B. TC5564PL (8k x 8)		B 5088 516 QT		2 pieces required
1	CMOS RAM e.g. / z.B. TC5517APL (2k x 8)		B 5088 462 QT		2 pieces required
Spare Parts for / Ersatzteile zu				BALZERS	
	MM 420		BG 512 780 -T		BG 800 190 E

