FBs-CML User's Manual

1. Introduction

FBs-CML (CML for short) is wireless link between two or more PLC's FATEK. It is replacement for RS485 link between PLC's. You can create two point link or multipoint network. CML expects usage of function FUN151: CLINK in mode 0 on master PLC. The wireless network works in a similar way as RS485 and is transparent for PLC.

Main features

- ♦ Point to point wireless connection of PLC's
- ♦ Multipoint wireless network of PLC's (like RS485)
- ♦ More independent wireless network's in one place
- ♦ Can be used directly with FBs-xxMC (Port 3)
- ♦ No PLC program support is necessary – just use FUN151 (CLINK)
- ♦ LEDs for device status and data flow signalization
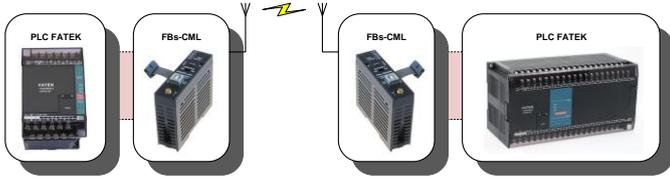- ♦ Works in free 2.4 GHz band

1. Indication LEDs
2. BTN button
3. Connection flat cable to PLC Fatek
4. Antenna connector RP SMA male
5. DIN rail holder

2. Content of the Delivery

- ♦ 1 pc of FBs-CML
- ♦ 1 pc of multidirectional antenna
- ♦ 1 pc printed documentation

3. Typical Application

In typical application CML connects two main PLC units. One of the PLC called MASTER uses function FUN151: CLINK in mode 0.

> **Warning**
>
> FATEK PLC is not part of the delivery of this product. It is needed to order independently. Any Fatek FBs-xxMC PLC can be used along with CML. **Turn off all power (including battery) during installation of CML to PLC or related equipments to prevent injury or damage to equipment!**

4. Possible Application
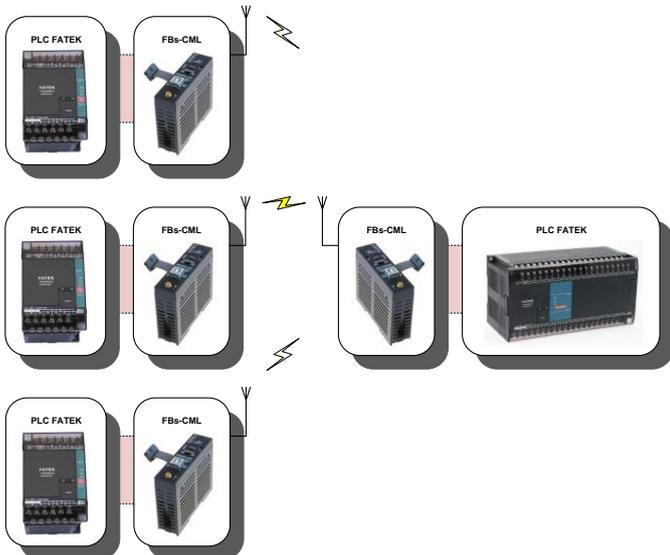
Multipoint wireless network of PLC's – similar to RS485

4.1 Front Panel

Name	Element	Description
POW	LED red	Lights when CML is powered
RUN	LED green Fast blink Blink-Pause Blink-Blink-Pause	CML operational mode: 1. PLC detection (after init) 2. Connection to SLAVE PLC 3. Connection to MASTER PLC (PLC with FUN151 CLINK)
ERR	LED red	Error indication
Tx	LED red	Serial Communication to PLC
Rx	LED green	Serial Communication from PLC
VF	LED yellow	RF activity (Blinks whenever any packet is sent)
BTN	Button	For future use
ANT	Antenna	Antenna connector

POW
RUN
ERR
Tx
Rx
BTN

FBs-CML
RADIO MODULE

VF
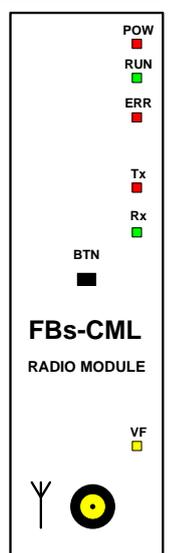
5. Connection to PLC

CML unit is connected to PLC FBs-… family using flat cable which is used for power supply and data communication with PLC via Port 3 (9600 Baud, 7 bits, Even parity, 1 Stop bit).

> **Warning**
>
> **Turn off all power (including battery) during installation of CML** to PLC or related equipments to prevent injury or damage to equipment!

For communication between PLC FUN151: CLINK in master PLC is used.
(See FATEK FBs-series User's Manual–II; Chapter 12,13:Communication of FBs-PLC)

6. Function of CML

CML acts as PLC unit with station number 254. CML uses two sets of registers:

State registers: **R2800 to R2809** – Registers are transmitted from CML to PLC
Command registers: **R2810 to R2019** – Registers are transmitted from PLC to CML

After power up CML starts to detect the connected PLC unit. It expects factory default setting of PLC serial Port3 (9600 baud, 7 bits, Even parity, 1 stop bit). CML tries all PLC station numbers from 1 to 253 one by one and waits for an answer from connected PLC unit. In case there comes no answer, CML lights the red LED ERR and then tests all station numbers again and again. In case an answer comes, it means for CML that the connected PLC is SLAVE type (without CLINK function). In case the connected PLC sends valid data to CML (station number 254) CML expects the PLC is MASTER (uses FUN151: CLINK). CML operational mode is indicated by the green LED RUN. See the next table for details:

| LED RUN	Description
Dark	CML is not supplied
Fast blink 1:1	Detection of connected PLC in progress
Fast blink 1:1 + LED ERR	No PLC detected E.g. Wrong setting of Port3 on PLC
Blink-Blink-Pause	CML is connected to MASTER PLC (with FUN151: CLINK)
Blink-Pause	CML is connected to SLAVE PLC (without FUN151: CLINK)
Permanently light	Reserved for future use

After the successful detection of connected PLC, CML starts to operate in one of the following modes:

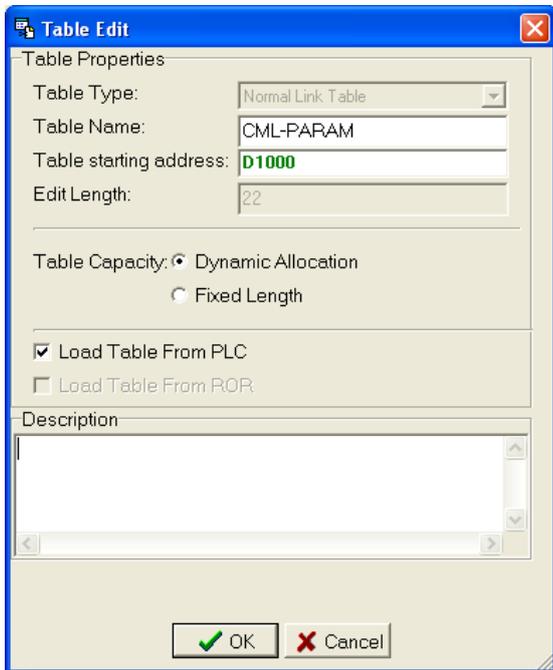**Connection to SLAVE PLC** (PLC is not using FUN151: CLINK)
CML periodically (1 per 15 sec) writes State registers (R2800 to R2809) to PLC and reads Command registers (R2810 to R2819) from PLC. CML listens on preset RF channel for any valid data packet and sends it to connected PLC (independently on the station number inside the data packet). In case the PLC recognizes the data packet has the same station number as PLC, it sends an answer data packet to CML which sends it via RF back to MASTER PLC without any change.

Connection to MASTER PLC (PLC is using FUN151: CLINK in mode 0)
State and Command registers (R2800 to R2819) for CML are sent by MASTER PLC as a part of FUN151: CLINK, (Port3, station number 254). The wireless RF data communication is practically the same as in RS485 protocol. CML analyses the data packet from PLC and in case the packet has another station number than CML (other then 254) CML sends this data packet to RF on a preset RF channel and then start to listen on preset RF channel for and answer. CML sends all data packets from RF to connected PLC. All RF communication is done on preset RF channel (see "Appendix – RF Channels" for list of available channels).
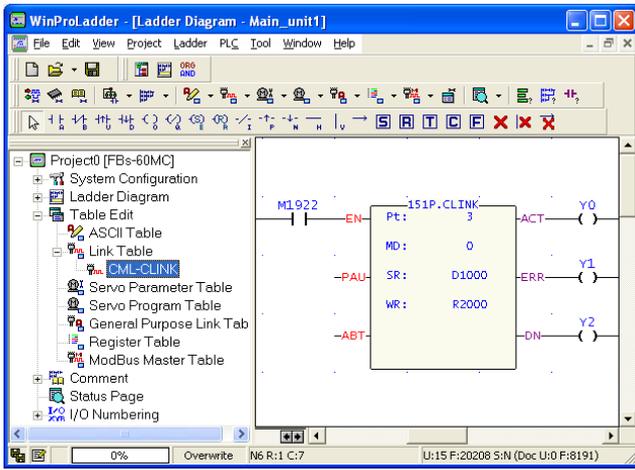
Example of usage function FUN151: CLINK
Pt: 3; PLC port 3 is used for communication with CML
Md: 0; FUN151: CLINK uses "mode 0"
SR: D1000; Link table for FUN151: CLINK
WR: R2000; Working registers for FUN151: CLINK

CML State Registers Description (output registers from CML):

Register	Name	Description
R2800	DI_STAMP 'CL'	0x434C ('CL') Sign of CML
R2801	DI_CHANNEL	Actual RF Channel number See Appendix of this document
R2802	DI_ALIVE	CML writes value 0x0001 whenever diagnostic record is refreshed (cca 6 seconds). This is intended for PLC program to check if CML is alive. In this case PLC program will write a 0x0000 into this register and wait for 0x0001 here.
R2803	DI_VERSION	Firmware version of CML: In high byte is high version number Inn low byte is low byte is low version number
R2804	DI_RSSI	RSSI value of the last received data packet recalculated into dBm
R2805		Reserved
R2806		Reserved
R2807	DI_STATUS	x0H=Detection of PLC in progress x1H=Connection to SLAVE PLC detected x2H=Connection to MASTER PLC detected 1xH=Communication with PLC OK
R2808(Lo) R2809(Hi)	DI_TIME_UP	32 bit counter which is incremented every second. The counter is cleared after restart of CML. The counter value indicates in a certain way how long the CML is running without restart (so called Uptime).

CML Command Registers Description (input registers for CML):

Register	Name	Description
R2810	CF_STAMP 'CL'	0x434C ('CL') CML Sign. Must be set to 'CL'. Otherwise CML does not accept any command (RF Channel set, Bandwidth set, Reset) from PLC!
R2811	CF_CHANNEL	RF Channel No. setting See Appendix – RF Channels
R2812	CF_BANDWIDTH	RF Band Width setting (Reserved for future usage)
R2813		Reserved
R2814		Reserved
R2815	CF_RESET	If PLC writes value 0xF3A5 to this register the CML will make reset of itself.
R2816		Reserved
R2817		Reserved
R2818		Reserved
R2819		Reserved

Link table setup for FUN151: CLINK
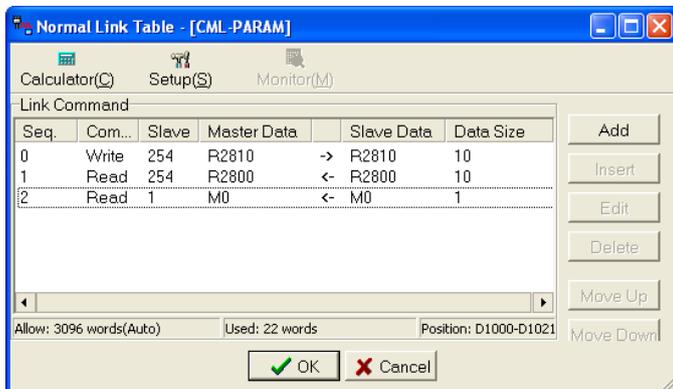
Link table setup for FUN151: CLINK
Seq. 0: Command registers R2800 to R2809 for CML (station number 254)
Seq. 1: Status registers R2810 to R2819 from CML (station number 254)
Seq. 2: Reading of M0 state from remote PLC (station number 1) to MASTER PLC

7. Technical specification

7.1 General

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Dimensions	Width	w			25		mm
	Height	h			95		mm
	Depth (without antenna)	d			80		mm
Fixing		DIN rail or flat panel screw fixing					
Power		5V / 40mA from power supply of PLC main unit					
Backup power		no					
Temperature	Operating	t_A		-20		+60	°C
	Storage			-25		+70	°C
Humidity	Operational	h_A				90	%
RF power						20	dBm
RF sensitivity		-100 dBm at 9.6 kbps and 1% packet error rate					dBm
Automatic Frequency Compensation (AFC)		up to +/- 400					kHz
RF frequency		Free 2.4GHz band *) 2400 to 2483 MHz Factory setting: RF Channel 24, Band Width 81 kHz					
RF freq. drift		+/- 50kHz in the range of operating temperatures					kHz
Range	Inside building	Up to 20 m					m
Range	Outdoor	Up to 200 m					m
Antenna Connector		RP SMA male (Device) RP SMA female (Antenna)					
Communication interface		Flat cable connected directly into Fatek PLC					

Warning

*) SRD Regulations (Short Range Device): International regulations and national laws regulate the use of radio receivers and transmitters. The most important regulations for the 2.4 GHz band are EN 300 440 and EN 300 328 (Europe), FCC CFR47 part 15.247 and 15.249 (USA), and ARIB STD-T66 (Japan). Please note that compliance with regulations is dependent on complete system performance. It is the customer's responsibility to ensure that the system complies with regulations.

8. FAQ

- **CML does not communicate with connected PLC.** A) Please, check setup of serial Port 3 in PLC (9600 Baud, 7 bits, even parity, 1 Stop bit). If the problem persists try to initialize the PLC into factory default. (In program WinProladder[Menu] -> PLC -> Clear PLC). B) Please, check SLAVE PLC address setting (WinProladder[Menu] -> PLC -> Setting -> Station Number). C) Check CML LED diodes (especially Rx and Tx).

- **How to reach the highest reliability of CML wireless communication when transmitting data packets?** CML uses **free** 2.4 GHz band. It means that not every data packet can be successfully transmitted to remote CML due to jamming. Each packet is secured by several levels of check sums. It's recommended to send max. 50 bytes of user data in each data packet. (50 bytes can transmitted by CML trough RF in one data packet without necessity to divide them it into sub packets. 50 bytes means transmission of eight 16bites registers e.g. R1000 to R1007. For larger data packets the probability of successful data transmission is lower.

- **Is it possible to connect two PLCs on longer distances outside building**? Use YAGI antenna or sector antenna.

- **After change of station number of SLAVE PLC, CML ceased to communicate with PLC.** After change of station number of PLC it's necessary to switch off and on the power supply of PLC.

- **Note:** CML does not recognize serial parity on Port3 of PLC

- **Manufacturer**: SEA, www.seapraha.cz

- **FATEK Manufacturer:** FATEK Corporation, www.fatek.com

9. Warranty

General warranty period is 12 months after purchase, when eventual malfunction device will be repaired free of charge in SEA company while shipping to SEA is paid by customer and SEA pays for shipping back to customer. For SW there is 24 months warranty under following conditions:

Both CPU and PC software is sold "as is". The software was created by the best software engineers in SEA and was carefully tested both in SEA and also by SEA customers using GSM applications products made in SEA. In spite of making all possible to get error free software it can happen, that the software in CPU or PC programming SW or their mutual interaction has some error under some specific conditions. If such error is found and the description of the problem including configuration file is sent by E-mail to SEA ltd., the error is removed free of charge and SEA will send new SW by E-mail to customer.

SEA ltd. has NO RESPONSIBILITY for any damage, lost, costs and any other problems direct or inducted, caused by such SW error, by eventual device malfunction from any reason or by undelivered SMS from the device.

10. Appendix – RF Channels

Channel No.	Frequency [MHz]	Channel No.	Frequency [MHz]	Channel No.	Frequency [MHz]
0	2400,5	30	2430,5	60	2460,5
1	2401,5	31	2431,5	61	2461,5
2	2402,5	32	2432,5	62	2462,5
3	2403,5	33	2433,5	63	2463,5
4	2404,5	34	2434,5	64	2464,5
5	2405,5	35	2435,5	65	2465,5
6	2406,5	36	2436,5	66	2466,5
7	2407,5	37	2437,5	67	2467,5
8	2408,5	38	2438,5	68	2468,5
9	2409,5	39	2439,5	69	2469,5
10	2410,5	40	2440,5	70	2470,5
11	2411,5	41	2441,5	71	2471,5
12	2412,5	42	2442,5	72	2472,5
13	2413,5	43	2443,5	73	2473,5
14	2414,5	44	2444,5	74	2474,5
15	2415,5	45	2445,5	75	2475,5
16	2416,5	46	2446,5	76	2476,5
17	2417,5	47	2447,5	77	2477,5
18	2418,5	48	2448,5	78	2478,5
19	2419,5	49	2449,5	79	2479,5
20	2420,5	50	2450,5	80	2480,5
21	2421,5	51	2451,5	81	2481,5
22	2422,5	52	2452,5	82	2482,5
23	2423,5	53	2453,5	83	2483,5
24	2424,5	54	2454,5		
25	2425,5	55	2455,5		
26	2426,5	56	2456,5		
27	2427,5	57	2457,5		
28	2428,5	58	2458,5		
29	2429,5	59	2459,5		

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