Communication Protocol

This protocol, which enables RS-232 communication between the **FC-4040** and the PC, complements Kramer's "Protocol 2000" (Kramer's switcher protocol). Both protocols can co-exist without disturbing one another. (According to Protocol 2000's definition, the **FC-4040** would be machine number 18 (for A0=0) or 19 (for A0=1), so care should be taken not to set a switcher with this machine number). The protocol uses four bytes of information, and data is at 9600 baud, no parity, 8 data bits and 1 stop bit. Connect the controller and the machine via a null -modem connection, if using a DB-9 port, as follows:

- Connect pin 5 of the PC to pin 5 of the machine
- Cross pins 2 and 3, i.e., connect pin 2 of the PC to pin 3 of the machine, and connect pin 3 of the PC to pin 2 of the machine
- On the PC side, short pins 4 and 6
- On the PC side, short pins 1, 7 and 8

Table 5: Structure of the Protocol

MSB							**LSB**
		INSTRUCTION					
0	TO PC[1]	I5	I4	I3	I2	I1	I0
7	6	5	4	3	2	1	0
1st byte							
	DATA						
1	D6	D5	D4	D3	D2	D1	D0
7	6	5	4	3	2	1	0
2nd byte							
	EXTENDED DATA						
1	E6	E5	E4	E3	E2	E1	E0

1 The DESTINATION BIT

7	6	5	4	3	2	1	0
3rd byte							
	MSB's						**ADDR**
1	E7	D7	1	0	1	0	A0[1]
7	6	5	4	3	2	1	0

4th byte[2]

I4..I0 is the "INSTRUCTION", D7..D0 is the "DATA"and E7..E0 is the "EXTENDED DATA". The destination bit, TO PC, is 0 when sending from the PC to the machine, or 1 when sending from the machine to the PC. The address bit, A0, is determined by the setting of DIP-switch 8 on the SG-4040. If the switch is in the ON position, ADDR should be set as 1; if it is in the OFF position, ADDR should be set as 0.

Table 6: Instruction Set for the FC-4040

#	INSTRUCTION	I5	I4	I3	I2	I1	I0
0	Reset	0	0	0	0	0	0
1	Read front-panel switch status	0	0	0	0	0	1
2	Write front-panel switch status	0	0	0	0	1	0
3	Press front-panel switch	0	0	0	0	1	1
4	Read front-panel switch data	0	0	0	1	0	0
6	Write front-panel switch data	0	0	0	1	1	0
8	Write encoder data	0	0	1	0	0	0
9	Write decoder data	0	0	1	0	0	1
10	Write EEPROM data – low address	0	0	1	0	1	0
11	Read EEPROM data – low address	0	0	1	0	1	1
13	Reserved – read I²C	0	0	1	1	0	1
14	Read Input Standard	0	0	1	1	1	0
16	Error	0	1	0	0	0	0
20	Write EEPROM data – high address	0	1	0	1	0	0
21	Read EEPROM data – high address	0	1	0	1	0	1
57	Enable "Power-down save"	1	1	1	0	0	1
61	Identify machine	1	1	1	1	0	1

DESCRIPTION OF INSTRUCTIONS

INSTRUCTION 0 – RESET

DATA=0: initialize the machine.
When the machine is initialized, it will send the RESET code (DATA = 0). If the machine receives this code, it will reset to its "power-up" state.
DATA=1: configure the machine to its factory default state.
When the machine receives this code, all programmable parameters are reset to their factory -default values.
EXTENDED DATA - set as 0.

INSTRUCTION 1 – READ FRONT-PANEL SWITCH STATUS

DATA = set as front-panel switch number (see switch number definitions below).
When sending, set EXTENDED DATA as 0.
When receiving, LSB of EXTENDED DATA = status of front-panel switch.
The PC sends this instruction to the machine. The machine replies by setting the EXTENDED DATA according to the current status of the addressed front-panel switch - that is, E0=1 if the switch is on, or E0=0 if it is off.

INSTRUCTION 2 – WRITE FRONT-PANEL SWITCH STATUS

DATA = front-panel switch number; LSB of EXTENDED DATA = status of the front-panel switch.
When a front panel switch is pressed, its status is sent to the PC if the status of this switch is changed.
When the PC sends the status of the switch directly to the machine, the machine implements this instruction, and replies by sending the same data back to the PC (if valid).

INSTRUCTION 3 – PRESS FRONT-PANEL SWITCH

DATA = front-panel switch number (see below).
EXTENDED DATA - set as 0.

1 The LSB of the MACHINE ADDRESS

2 Note that the MSB's of the DATA (D7) and the EXTENDED DATA (E7) are in the fourth byte

When the machine receives this instruction, it implements the function that would be performed if the designated front -panel switch was pressed. If this results in a change in the switch status or a switch value, then this change is sent to the PC. This instruction is never sent by the machine. (If a button is pressed resulting in a change in the switch status or a switch value, it will send the change to the PC).

INSTRUCTION 4 – READ FRONT-PANEL SWITCH DATA

When sending to machine: DATA = front-panel switch number; EXTENDED DATA - set as 0.
When replying: DATA = front-panel switch number; EXTENDED DATA = front-panel switch value + 128.
The PC sends this instruction to the machine. The machine replies by sending back a value that relates to that switch.

INSTRUCTION 6 – WRITE FRONT-PANEL SWITCH DATA

DATA = front-panel switch number; EXTENDED DATA = front-panel switch value.
The PC sends a value directly to the machine. If valid, the machine implements this new value, and replies by sending the same data back to the PC. Note that the addressed front-panel switch does not need to be pressed in order to change its value via RS-232.
If the "+" or "-" button is pressed on the machine, resulting in a change in a switch value, then this switch number and value is sent to the PC.

INSTRUCTION 8 – WRITE ENCODER DATA

DATA = encoder sub-address; EXTENDED DATA = data to be written to this sub-address.
The PC sends data directly to the encoder. The machine implements this new value, and replies by sending the same data back to the PC. CAUTION – this function was designated for development and testing purposes. Improper use of this function may cause erratic behavior of the machine.

INSTRUCTION 9 – WRITE DECODER DATA

DATA = decoder sub-address; EXTENDED DATA = data to be written to this sub-address.
The PC sends data directly to the decoder. The machine implements this new value, and replies by sending the same data back to the PC. CAUTION – this function was designated for development and testing purposes. Improper use of this function may cause erratic behavior of the machine.

INSTRUCTION 10 & 20 – WRITE EEPROM DATA

DATA = EEPROM sub-address; EXTENDED DATA = data to be written to this sub-address.
The PC sends data directly to the EEPROM. The EEPROM stores this new value, and replies by sending the same data back to the PC. CAUTION – this function was designated for development and testing purposes. Improper use of this function may cause erratic behavior of the machine.

INSTRUCTION 11 & 21 – READ EEPROM DATA

For sending to machine, DATA = EEPROM sub-address.
When replying: DATA = EEPROM sub-address; EXTENDED DATA = requested data.
The PC sends this instruction to the machine. The machine replies by sending back the data of this sub-address.

INSTRUCTION 14 – READ INPUT STANDARD

For sending to machine, set DATA = EXTENDED DATA = 0.
When replying: DATA = 0; EXTENDED DATA = INPUT STANDARD.
The PC sends this instruction to the machine. The machine replies by sending back the INPUT STANDARD, defined as follows: 0 = Unknown input standard; 1 = PAL; 2 = NTSC3.58; 3 = NTSC4.43; 4 = SECAM.

INSTRUCTION 16 – ERROR

If the machine receives an invalid instruction, it replies by sending this error code.

INSTRUCTION 57 – ENABLE "POWER-DOWN SAVE"

DATA = 0 disables power-down saving; DATA = 1 enables saving. EXTENDED DATA - set to 0.
The PC sends this instruction to the machine. The power-down option is enabled or disabled according to the value of DATA. If the power-down option is enabled, then the machine will "remember" its state before being turned off, and revert to this state when turned on again. Note that whenever the machine is turned on, the power-down save option is enabled.

INSTRUCTION 61 – IDENTIFY MACHINE

For sending, DATA = 1 to request machine name; DATA = 3 to request software version number. EXTENDED DATA - set to 0.
The PC sends this instruction to the machine. The machine relies as follows:
If the machine name is requested, the machine replies with DATA = 40 (hex), and EXTENDED DATA = 40 (hex).
If the software version is requested, the machine replies with DATA as the version number before the decimal point, and EXTENDED DATA is the value following the decimal point. For example, for version 3.4, the machine replies with DATA = 03 (hex), and EXTENDED DATA = 04 (hex).

FRONT-PANEL SWITCH DATA

INPUT SWITCH

The value of the switch data for the INPUT switch is defined as:
0 = CV
1 = YC

2 = YUV
3 = RGB
4 = RGBS

GENLOCK SWITCH

The value of the switch data for the GENLOCK switch is defined as:
129 (decimal) = Machine is Genlocked to input.
1 = Machine is in Genlock mode, but has not genlocked to input (searching).
0 or other = Machine is not in Genlock mode.

OUTPUT SWITCH

The value of the switch data for the OUTPUT switch is defined as:
0 = PAL
1 = NTSC3.58
2 = NTSC4.43
3 = SECAM

COMPONENT OUTPUT SWITCH

The value of the switch data for the COMPONENT OUTPUT switch is defined as:
0 = YUV
1 = RGB
2 = RGBS

BRIGHTNESS, CONTRAST, SATURATION, HUE and Y, U, V SWITCHES

The value of the switch data for these switches is defined as:
EXTENDED DATA: value of the number displayed + 128. For example:
For CONTRAST = 12, the value of EXTENDED DATA = 140;
For CONTRAST = -17, the value of EXTENDED DATA = 111

FRONT-PANEL SWITCH NUMBERS

The table below shows the front-panel switch numbers, as defined for this protocol, and indicates the information which may be read (status, data) on each switch:

Table 7: Front Panel Switch Numbers for the FC-4040

SWITCH	D3	D2	D1	D0	STATUS	DATA
Select Input Format	0	0	0	1	NO	YES
Genlock	0	0	1	0	YES	NO
Select Output Standard	0	0	1	1	NO	YES
Select Component Output	0	1	0	0	NO	YES
Brightness	0	1	0	1	YES	YES
Contrast	0	1	1	0	YES	YES
Saturation	0	1	1	1	YES	YES
Hue (NTSC only)	1	0	0	0	YES	YES
UP	1	0	0	1	NO	NO
DOWN	1	0	1	0	NO	NO
Panel lock	1	0	1	1	YES	NO