JVL DMX protocol implementation

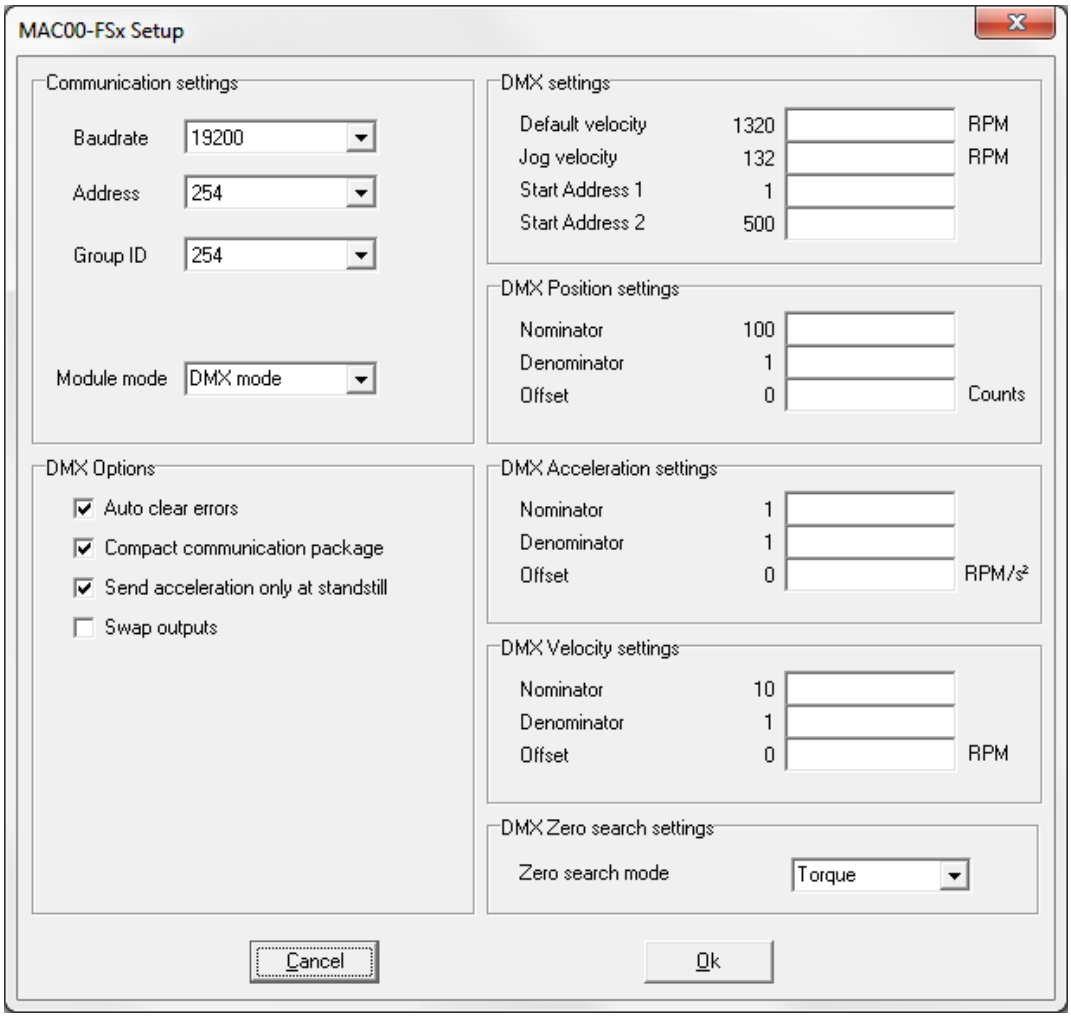
Introduction

This document describes how to use the DMX512 protocol, widely used for theatre equipment, with the MAC00-FSx module and MAC050, MAC095, MAC140 or MAC141 basic motor.
The required firmware versions are v2.02 for the MAC00-FSx module and v8_02 or later for the basic MAC50..141 motor (although v9.00 or later is highly recommended)
Some optional functionality is available only in FSx FW 2.03 or later, see descriptions below.
This document does not discuss the hardware, including cables and connectors.
While most of the information presented here is targeted for the end user, some information is included mainly for JVL supporters to understand the inner workings of the MAC00-FSx firmware.

General description

The DMX interface supports control of Position, Mode, Acceleration and Velocity of the smaller JVL drives.
It is intended to be used with a set of motors sharing the same Acceleration and Velocity, but with different positions and separate mode control.

DMX Configuration is done on the MAC00-FSx tab in MacTalk v1.50.8 or later:



Invalid values will generate an error that shows the allowed range like this:

The DMX functionality is enabled be selecting the DMX option for Module Mode, and saving the complete setup to flash memory.
The parameters specifically related to the DMX data, including start addresses and jogging velocity, are saved in flash memory in the FSx module itself, while the parameters related to the basic motor are saved in the motors own flash memory.
Note that the fields Baudrate, Address and Group ID are not used with DMX mode, but used only with Standard and I/O Control modes.

It is recommended to change the following basic motor parameters for DMX applications:
Start-up mode: Position.
Power Save: On
I/O Type: Pulse In
Resynchronize position after Passive mode: On
Zero search torque: Value to fit the mechanics, sign to match the sensor polarity.

To set up several motors to the same values, except the DMX start address, save the motor + FSx parameters to a .MAC file from MacTalk via the Save button, and then load that file into the next motor using the Open button. It is a new feature in MacTalk 1.49beta23 or later that the FSx parameters are stored in the .MAC file.

DMX Address names
The DMX can address four values: Position value, Control channel, Acceleration and maximum Velocity.
Using the MacTalk program, two separate DMX start addresses must be configured. Start Address 1 (called SA1 below) points to the three bytes holding Position (coarse + fine) and the Control Channel, which is used to select the motors operating mode to either Homing mode or Position mode. Start Address 2 (SA2) points to the two bytes holding Acceleration and Velocity. It is intended that each motor has separate values for SA1, but all motors share the value of SA2 and thus will use the same Acceleration and Velocity.

SA1 + 0 Position value (coarse)
SA1 + 1 Position value (fine)
SA1 + 2 Control channel
SA2 + 0 Acceleration
SA2 + 1 Maximum velocity

Scaling of parameters

The 16-bit position value and the 8-bit Acceleration and Velocity values must be scaled and possibly offset to fit their working range in motor counts. This is done by multiplying each value by a separate fraction and then adding an offset. All of these scaling parameters are configured in the MacTalk application.

The formulas used are:

P_SOLL = DMX Position (16-bit) * DmxPosNom / DmxPosDen + DmxPosOffset (32-bit)

A_SOLL = DMX Acceleration (8-bit) * DmxAccNom / DmxAccDen + DmxAccOffset (16-bit)

V_SOLL = DMX Velocity (8-bit) * DmxVelNom / DmxVelDen + DmxVelOffset (16-bit)

Note that all of the three Offsets and the Nominators for Position and Velocity are signed values, while all Denominators and the Acceleration offset are unsigned. MacTalk will limit the ranges to prevent invalid entries, such as division by zero.

Control channel

Setting the MODE_REG is done using the DMX Control Channel in a special way. The motor is kept in its configured start-up mode until 10 identical values in the range 180..189 have been received on the DMX Control Channel. Then the motor starts a sensor based homing operation, which is terminated when the sensor connected to the AIN signal is activated. The motor will use mode 14 for the homing (called Sensor Type 2 in the MAC manual). UPDATE: In later versions the type of homing can be selected from MacTalk.
Homing will not be aborted if the value of the Control Chanel is changed away from the 180..189 range after Homing was started.
Homing can be repeated at any time.
Note that the polarity of the sensor is determined by the sign of the Zero Search Torque in MacTalk.
After the Homing/Zero search has ended, the motor will switch to its configured start-up mode, which should be Position mode.
The motor will then stay in Position mode until the next Homing operation is requested (or until an error occurs).
When the value of the Control Channel is anywhere in the range 60..69, the scaled values for Position, Acceleration and Velocity are transferred from the DMX bus to the basic motor every time a new value is detected on the DMX bus. When the Control Channel values are neither in the range 60..69 or 1880..189, the motor is kept in Position mode, but no new values for Position/Acceleration/Velocity are transferred.
In FW v2.03 or later, values in the range 200..209 will send a command to the motor that will reset all errors. Note that if the source(s) of the error(s) are still present, the errors will be set again immediately.
The motors have a 24V PNP a digital error output built-in that will be activated if the motor experiences any error that caused a stop.

Jogging using digital inputs

When input 1 is switched from Off to On, it will set the motor into Jogging (Velocity) mode at an initial speed of zero RPM and ignore any data from the DMX bus. In FW v2.03 or later, it can be selected to also send a Reset Errors command at this time.

While in Jogging mode, setting input 2 On will make the motor run at the velocity configured in MacTalk as Velocity1. Setting input 2 Off in jogging mode will set the velocity to zero.

While in Jogging mode, setting input 3 On will make the motor run at the velocity configured in MacTalk as Velocity1, but in the opposite direction of input 2. Setting input 3 Off in jogging mode will set the velocity to zero.

In FW 2.03 or later, it can be configured to also send a Reset Errors command every time one of inputs 2 and 3 is switch On/Off state.

When input 1 is switched from On to Off, Jogging mode is ended, the maximum velocity is set to the value configured in MacTalk as Default Velocity. The motors target position is set [close] to the actual position resulting from the jogging.
The DMX must perform a Homing operation after jogging. This is done to prevent that the motor will start to move to its last received DMX target position as soon as the jogging enable, input 1, is set back to Off.

Other considerations

The DMX serial channel will accept either one or two stop bits per byte to be compatible also with DMX masters that send only one stop bit.

Only DMX packets with type zero will be used. Other packet types, like SIP (System Information Packets) will be ignored.

The firmware was tested during development using the freeware Windows application Q Light Controller Version 3.2.0-3 with a USB RS-485 adapter.

There might be a Communications bottleneck to be aware of if changing several values from one DMX frame to the next frame. This is because there is a relatively slow serial link from the FSx module to the basic motor, where it will take up to about 13-14 ms to write a new 32-bit position value. 16-bit values take 10-11 ms to write. Since a DMX frame takes at least about 23 ms, it will not be a problem to write a new position value in each frame, and there will also be time to change values for Control Channel, Acceleration and Max Velocity as long as they are not changed too often. The communications channel between the FSx module and the basic motor is buffered, so writing for instance three new values in one DMX frame and then changing only the Position for the next few DMX frames will not cause buffer overflow, but only a small initial delay until the internal communications line catches up.

To reduce communications on the internal communications line, the FSx module firmware will only write to the motor when a change in value has been detected in the DMX frames.

In FW v2.03 or later, it can be configured that the module will send new values for Velocity and Acceleration to the motor only when a new value for Position is received. In other words, a new Position value will cause the values for Position, Velocity and Acceleration in the same DMX telegram to be sent to the motor as a set. This is so a complete movement to one or more motors can be started and the motor will complete the movement using the same Velocity and Acceleration, even if other values are sent on the DMX bus to configure other motors to perform movements using other values for Velocity and/or Acceleration.

In FW v2.03 or later resetting of errors is done by writing the value zero to motor register 35. This will also clear some bits used to make relative movements and disable position limit inputs temporarily. Since the DMX operation does not use relative movements or position limit inputs, this should not give problems, but some special applications that use both the FSx module and Modbus communications, may need to be aware of this implementation. The reason for clearing errors this way is because the official FastMac command to clear errors will not clear all errors, but only the more common ones.

/Last updated on Mar 7, 2012 by NJG