

# Strand Lighting

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TWO-WIRE ANALOGUE

DIMMER MULTIPLEXING

STANDARD D54

ISSUE - 2

3X31110





## TWO WIRE ANALOGUE DIMMER MULTIPLEXING STANDARD

### 1 SCOPE

This standard describes the electrical and mechanical criteria to ensure signal compatibility between control system multiplex outputs and dimmer inputs to ensure reliable interworking. A second signal is similarly described to allow the multiplexing of manual faders into the control system.

### 2 DESCRIPTION

#### 2.1 Outline

The multiplex dimmer levels are transmitted down a screened cable using time-division multiplexing with timing information derived from superimposed sync and end-of-frame pulses for a normal capacity of up to 384 dimmers per cable. An expansion capacity of up to 768 dimmers per cable is described. For larger installations, two or more multiplex cables shall be used. A typical system block diagram is shown in Fig. 1.

In all cases the control system is the master and the dimmer and/or fader interfaces act as slaves. Each interface may just drive dimmers, multiplex faders or both as required. Each interface shall be coded to respond only to the dimmers of interest and means shall be provided to assure predictable response in the case of incomplete or absent multiplex drive.

One signal (and conductor) is used to multiplex the dimmer levels (DMX) and an optional second to multiplex faders (FMX).



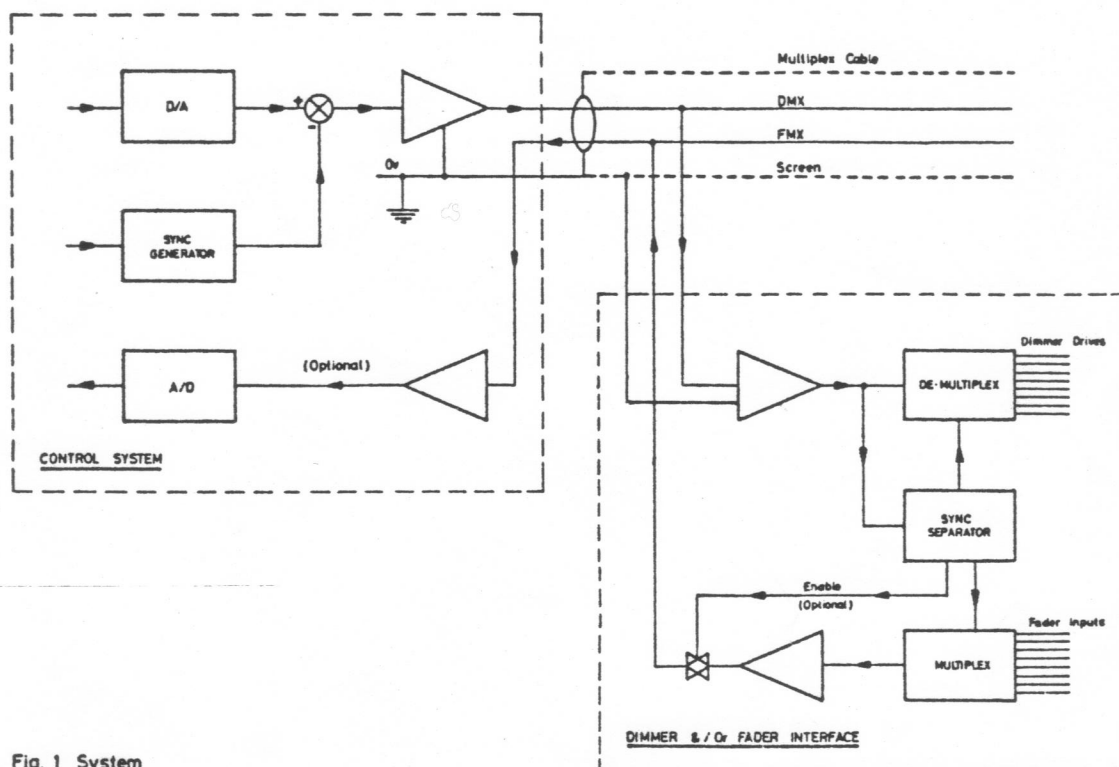


Fig. 1 System

## 2.2 Signal Specifications

The transmitter and receiver are specified separately at their output and input terminals respectively to allow for tolerances and signal distortion in typical cables.

The DMX signal is terminated by a distributed a.c. termination configured to provide a noise immunity appropriate to the size of the system.

The FMX signal is fully terminated at its receiver and has a current sink to ensure that when not driven it settles to zero. Each driver for the FMX signal shall be gated onto the cable only for the duration of the fader numbers being multiplexed. Inadvertent connection of two fader multiplexers to the cable, both coded for the same faders, may give indeterminate results but shall not cause damage. A front porch is set to 0V to minimise bus conflict between fader multiplexers at change-over from one interface to the other.

## 2.2.1 Impedances and Levels

Fig. 2 Impedances

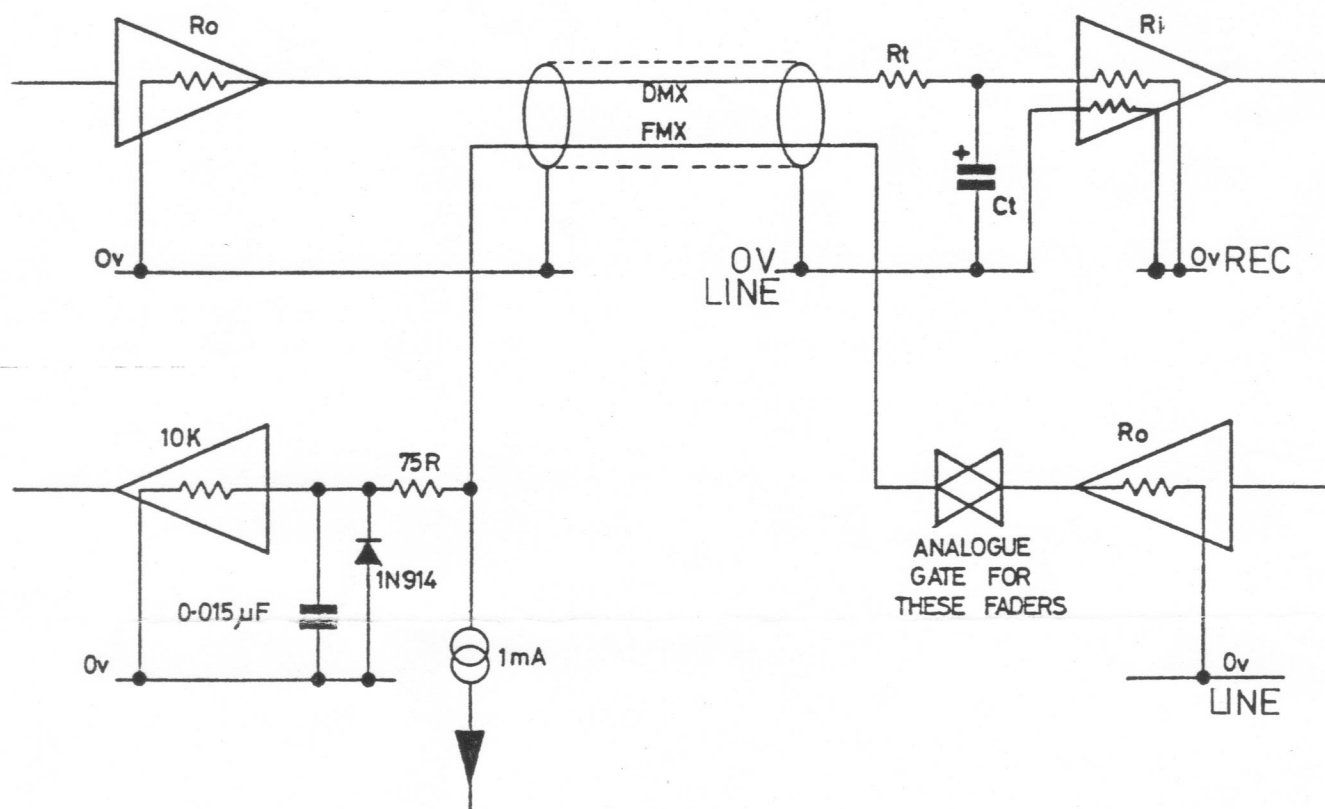
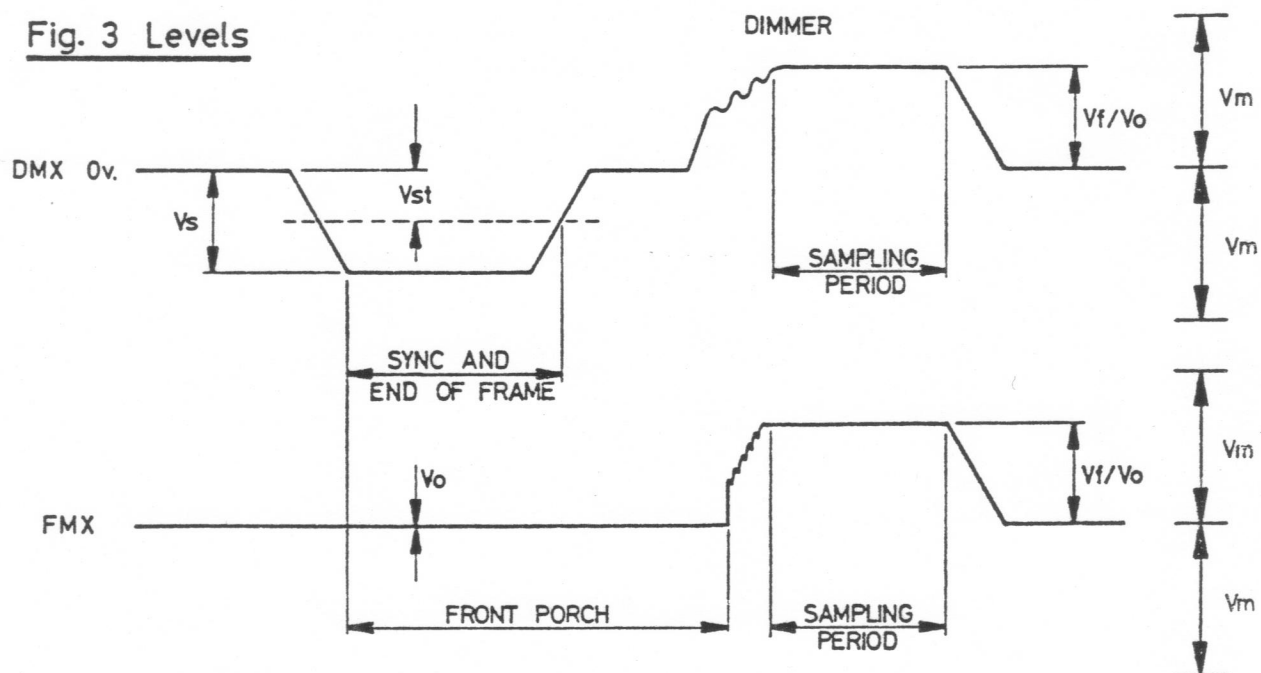


Fig. 3 Levels



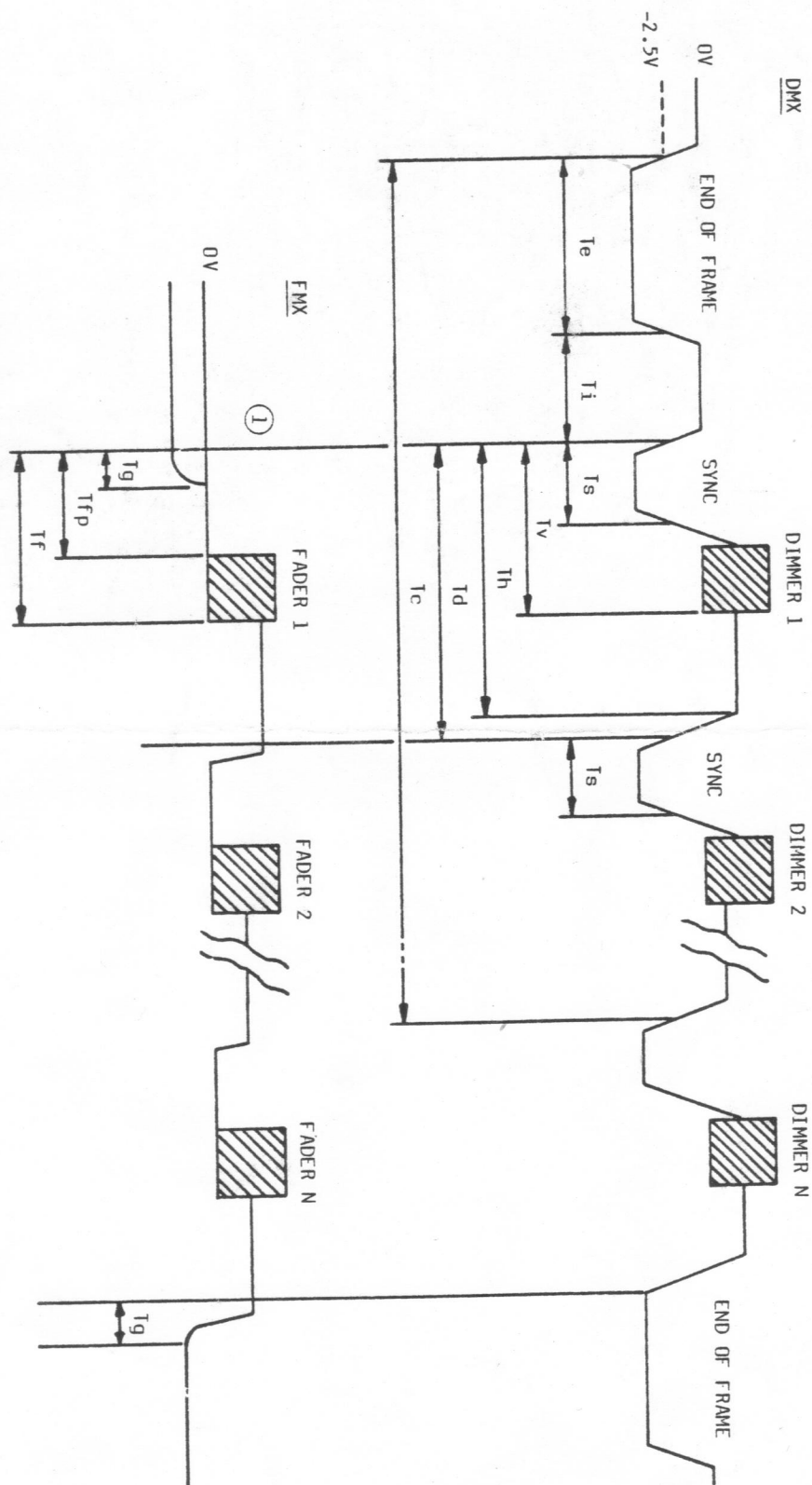
Note			TRANSMIT			RECEIVE		
			Max	Min	Norm	Max	Min	Norm
(1)	Transmitting Impedance	Ro	10R	-	4R7	-	-	-
	Receiving Impedance	Ri	-	-	-	-	70k	80k
(2)	Termination per dimmer	Rt	-	-	-	30k	20k	24k
(3)	Termination Capacitor	Ct	-	-	-	+25%	-25%	$\frac{10^{-6}}{R_t}$
	Sync Level	Vs	-6.0V	-4.0V	-5.0V			4.6pF
	Sync Detector Threshold	Vst	-	-	-	-3.0V	-2.0V	-2.5V
(4)	Full Level	Vf	5.1V	4.9V	5.0V	5.1V	4.9V	5.0V
	Off Level	Vo	0.1V	-0.1V	0.0V	0.1V	0.1V	0.0V
	Safe Input Levels	Vm	-	-	-	-	+/-10V	-

#### Notes

- 1) Outputs to be short-circuit proof to 0V to unlimited periods.
- 2) The termination resistor is paralleled for multiple dimmers received, e.g. 24 dimmers use 1k.
- 3) The termination capacitor is set to give a 1us time-constant, e.g. for  $R_t = 1k$ ,  $C_t = 1,000pF$ .
- 4) Full Level may be adjusted at the control system.

## 2.2.2 Timing

Fig. 4 Timing



Note			TRANSMIT			RECEIVE		
			Max	Min	Norm	Max	Min	Norm
	End of Frame Pulse	Te	0.5s	35us	-	0.5s	30us	-
	Inter-Frame Period	Ti	0.5s	15us	-	-	10us	-
	Sync Pulse	Ts	10us	6us	8us	15us	3us	-
	Analogue Valid Delay	Tv	15us	-	-	20us	-	-
	Analogue Hold Period	Th	Td	Td -5us	-	Td	45us	-
(2)	Total Dimmer Period	Td	0.5s	55us	-	0.5s	55us	-
	Total Cycle Period	Tc	0.5s	-	40ms	0.5s	-	40ms
	Analogue Gate Delay	Tg	20us	0	-	-	-	-
(1)	FMX Front Porch	Tfp	Tf	20us	-	-	-	-
(1)	FMX Valid Delay	Tf	35us	-	-	70us	-	-
(2)	Number of Dimmers	N	384	1	-	768	1	-
	Slew Rate	-	-	2V/us	2.5V/us	-	0	-

#### Notes

- 1) FMX delays start at leading edge of Sync local to the receiver.
- 2) Provision should be made at the receiver to accept an expanded capacity of 768 dimmers. This will not support FMX signals and Td (min) = 50us.
- 3) Th must not be assumed to extend to the commencement of Sync.

### 2.3 Cable and Connections

The cable used shall be a single (for DMX only) or twin screened cable generally of good microphone quality. Whilst cables may be chosen for the most economic performance in each particular installation, for optimum performance to achieve a maximum transmission distance of 1km a cable should be used as below:

Each Conductor:  $0.5\text{mm}^2$  minimum  
 Screen: Full copper braided  
 Capacitance:  $300\text{pF/m}$  maximum  
 Nominal Impedance: 75R

Where input/output connectors are used, the following type and connections are to be preferred:

XLR 3 PIN (e.g. CANNON AXR-3-xx)

<u>Pin</u>	<u>Signal</u>	<u>Preferred Wire Colour</u>
1	0V	Screen
2	FMX	Red
3	DMX	Blue

### 3 EARTHING CONSIDERATIONS

Precautions shall be taken to ensure that no earth loop, leakage or external fault current flows down the cable screen. Particular attention should be taken to avoid multiple earth connections in situations where multiple Neutral-Earth connections are made (e.g. PME mains distribution systems), since these can cause neutral current to flow through the screen.

Connection, if required, between 0V and mains earth shall only be made at the main control system.

To reduce the risk of current flowing along the signal screen as a result of multiple earth connections, issue 2 of this standard requires DMX receiver circuits to be differential and the signal screen to be isolated from the receiver 0v circuit.



#### 4 Differences of D54 Specification Issue 2 from Issue 1

##### 4.1 DMX receiver circuits are specified to be differential.

The FMX line signal is driven with respect to the line screen, not the FMX driver 0V.

The 0V power system of the dimmer and/or fader interface units is not connected to the multiplex cable screen.

Receiver impedance  $R_i$  was 90k min / 100k typ., now 70k min / 80k typ.

##### 4.2 To ensure that circuits designed to this standard can readily be adapted to work with USITT AMX 192 protocol the permitted range of certain timings has been tightened:-

Transmitter Analogue Hold period  $T_h$  (min) was 50uS, now  $T_d$ -5uS  
Trans & rec Total Dimmer Period  $T_d$  (min) was 70uS, now 55uS

##### 4.3 Transmit Interframe Period $T_i$ was Max 15uS Min 0.5S Should have been Max 0.5S Min 15uS (Typographical error)