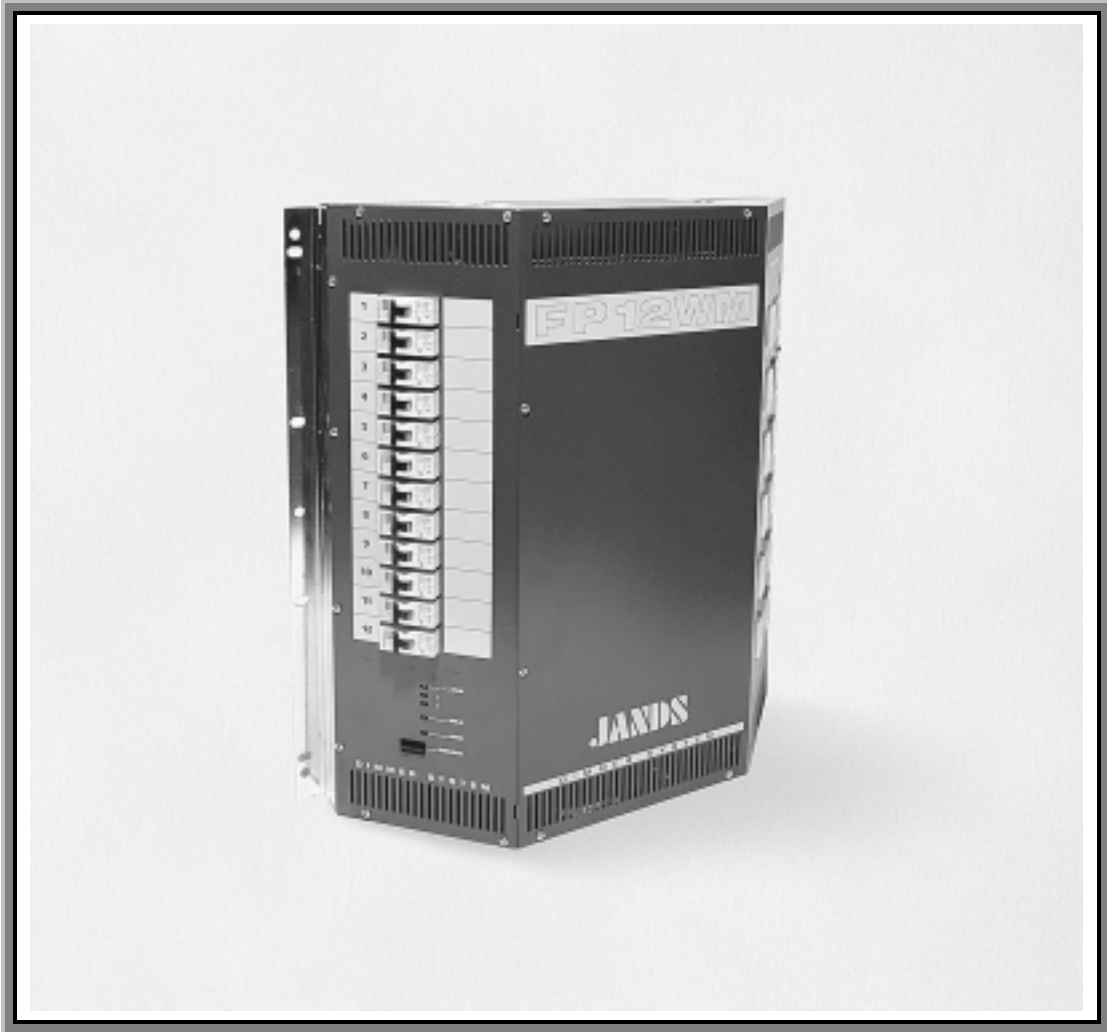


FP12WM

Digitally Controlled Dimmer



OPERATING MANUAL

JANDS

EMC COMPLIANCE



This product is approved for use in Europe and Australia/New Zealand and conforms to the following standards

European Norms	Australian / New Zealand Standards
EN 55014	AS/NZS 1044
EN 50082-1	AS/NZS 4251.1
EN 60350	AS/NZS 3350.1

To ensure continued compliance with EMC Directive 89/336 and the Australian Radiocommunications Act 1992, use only high quality data cables with continuous shield, and connectors with conductive backshells. Examples of such cables are:

DMX: Belden 8102 100% Aluminium foil screen, 65% Copper braid.

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It is recommended that all service and repairs on this product be carried out by JANDS ELECTRONICS PTY LTD or its authorised service agents.

JANDS GP Series dimmers must only be used for the purpose they were intended by the manufacturer and in conjunction with this operating manual.

JANDS ELECTRONICS PTY LTD cannot accept any liability whatsoever for any loss or damage caused by service, maintenance or repair by unauthorised personnel, or by use other than that intended by the manufacturer.

Disconnect mains power when not in use.

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1.0 Introduction

The JANDS FP12WM is a high quality, rugged, 12 channel, 2.4kVA per channel (10A/240V) dimmer rack specifically designed for contracting / theatre applications.

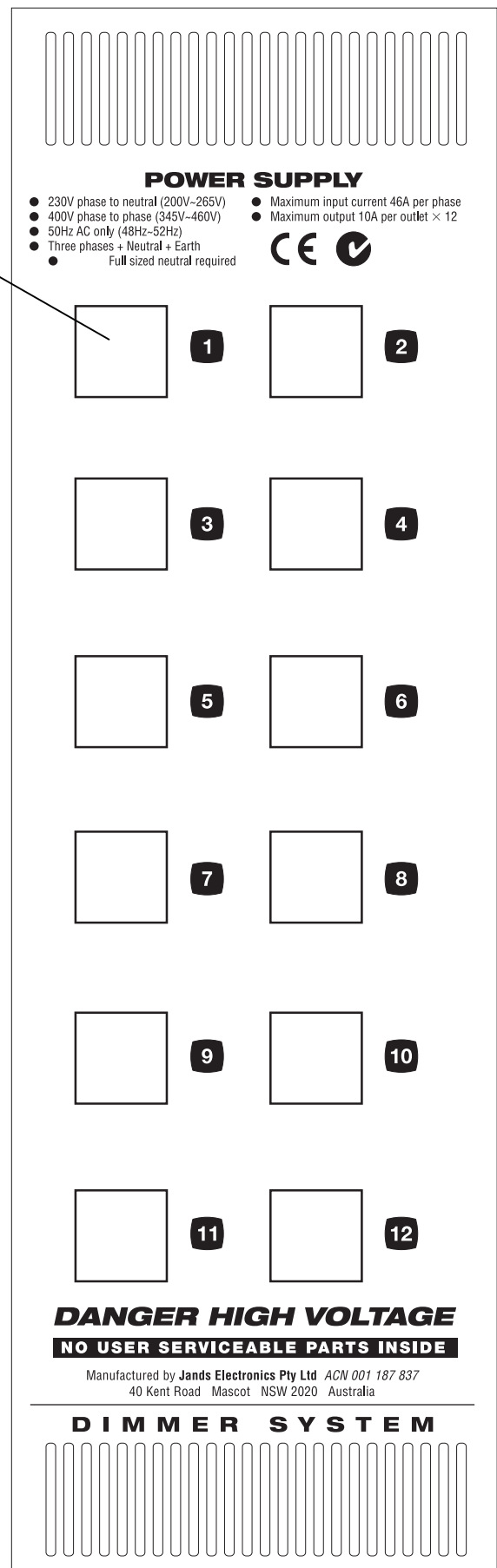
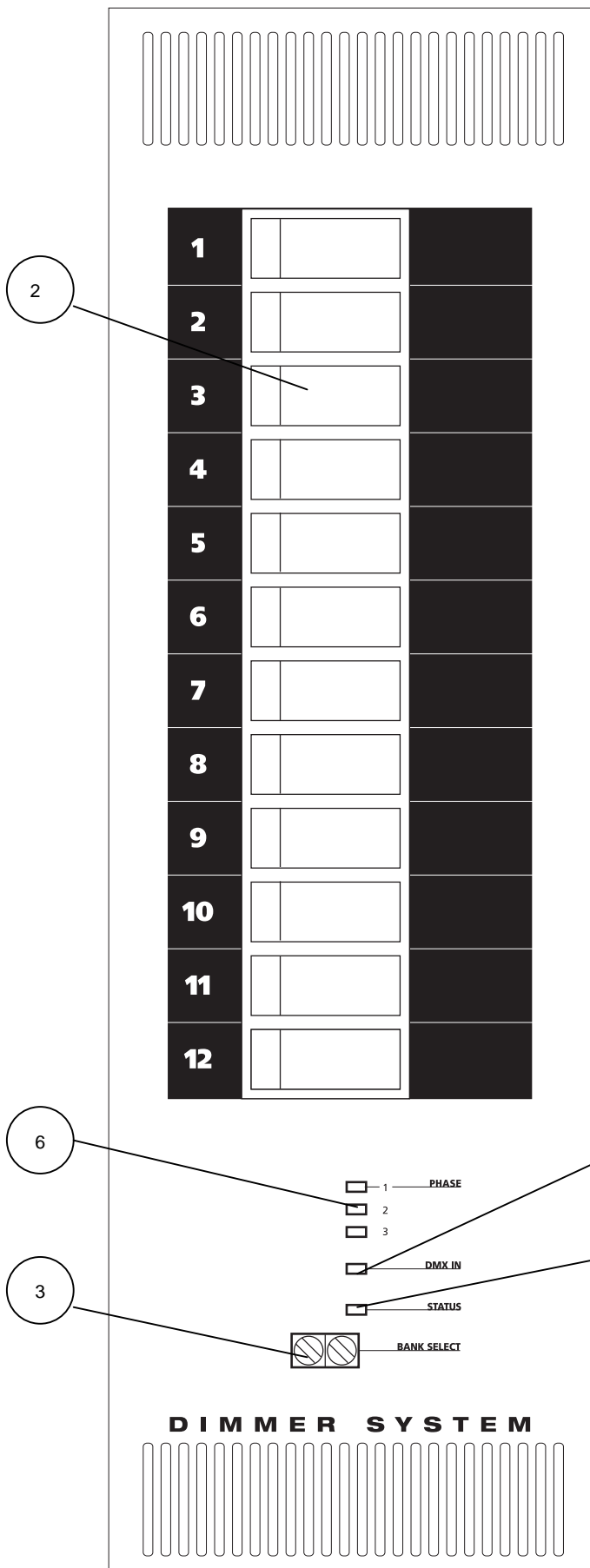
A separate wall bracket simplifies the installation process. It allows cabling to be routed to the dimmer location prior to the installation of the actual dimmer units, providing the contractor with the ability to fit off the dimmers when the site is secure.

As an option, a 24 way patch panel kit is available which, when combined with the extended wall mounting bracket, provides the end user with an economical and compact dimmer rack/patch

Features

- 12 x 2.4KW dimming channels
- DMX-512 digital control protocol
- DMX terminating switch
- Suitable for permanent installations
- Soft turn on characteristic
- Low acoustic/electrical noise
- Jands FerroDip™ chokes
- Three mains phase indicator LEDs
- Built in test facilities
- Dimmer curve set for linear relationship between the control input and output power
- Compensation for fluctuations in the mains supply voltage and minimises the effect of superimposed control tones, ensuring a constant light output and increased lamp life
- May be rack mounted, attached to a wall by means of supplied mounting brackets, or rigged using hook clamps
- Microprocessor control
- Single, three phase star, or three phase delta operation
- Over-temperature cutout
- Pre-heat facility
- Dimmer will hold last DMX value should control data be interrupted
- 50/60Hz operation
- CE and CTick approved

2.0 Equipment Description



2.1 Front panel layout

Refer to Fig 2.1 (opposite) for a description of the front panel controls.

1. **Channel output sockets:** The twelve output sockets are each rated at 10 amps.
2. **Channel output circuit breaker:** If a circuit breaker trips during use ensure the fault has been cleared before resetting.
3. **Bank select switches:** These switches select the DMX start bank and the Test functions.
4. **DMX SIGNAL LED:** A green LED indicates the presence of DMX signals. If there is no DMX signal, the LED will flash at a rate of approximately 2 seconds on/ 2 seconds off.
5. **STATUS LED:** A red LED flashes in the presence of a fault. In normal operation this LED should be off.
6. **PHASE LEDs:** Three green LEDs (one for each phase) indicate that the three phase mains supply is available.

3.0 Getting Started

The FP12WM would normally be wall mounted before any wiring is terminated. Refer to section 6.0 Installation for details.

3.1 Connecting power

The FP12WM dimmer is supplied with a 6 way terminal block for the connection of incoming mains power. The FP12WM can be powered from either:

- Three Phase star (four wire plus earth)
- Three phase delta (three wire plus earth)
- Single phase (three wire pairs plus earth)

In each case the supply must be protected by a suitable circuit breaker. Refer to the specification table for the upstream circuit breaker rating.

3.1.1 Three phase star wiring

This is the normal three phase power connection. The incoming power cable is terminated within the dimmer at a six-way terminal block and an earthing stud. The six-way terminal block has three poles for the three live mains phases (labelled A1, A2, A3), and three poles for the mains neutral (N1, N2, N3). The three neutral poles are bridged with a copper link, with the mains neutral connected to terminal N2.

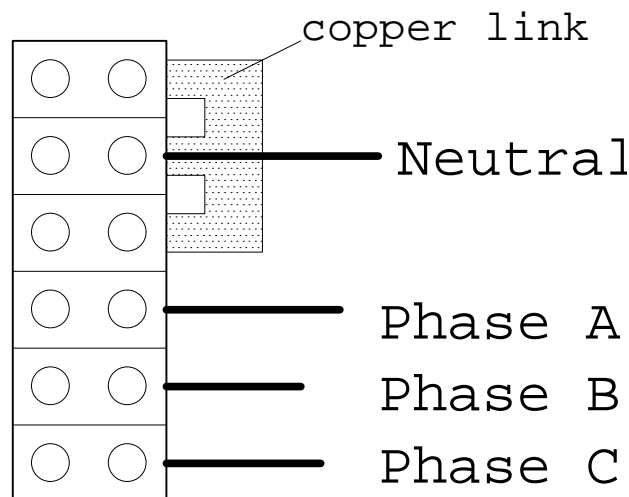


Figure 3.1: Three phase star wiring

3.1.2 Three phase delta wiring

WARNING

This connection is ILLEGAL in Australia, Europe and the U.K.

This connection renders the output sockets' neutral pins LIVE.

Note that the maximum phase to phase voltage with a delta power source is less than for a normal Star connection – refer to the specifications for details.

The available venue mains supply in some countries may be in the form of three phases with no neutral connection. In this case the bridge between the three neutral terminal poles (N1, N2, N3) must be removed and the incoming mains wiring connected as follows:

- The first incoming active is connected to terminals A1 and N3.
- The second incoming active is connected to terminals A2 and N1.
- The third incoming active is connected to terminals A3 and N2.

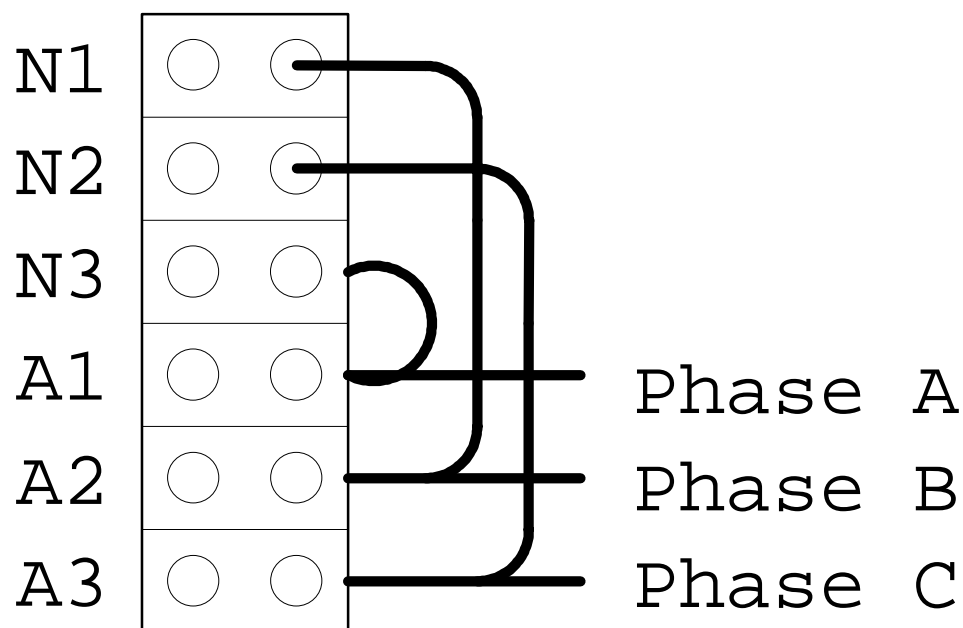


Figure 3.2: Three phase delta wiring

3.1.3 Single phase wiring

The dimmers may be configured for single phase operation where three phase mains supply is unavailable.

The dimmer must be supplied with three same-phase actives and three neutrals. The three active lines must each be individually circuit breaker protected. The three neutral conductors must each be rated at the same current as the actives. The earth conductor should be similarly rated.

The bridge between the three neutral terminal poles (N1, N2, N3) must be removed before the three incoming neutral lines are connected.

Although it is possible to supply the dimmer with one large single phase feed, the dimmer's breakers are not rated to clear faults if the supply is protected at currents of over 50 amps.

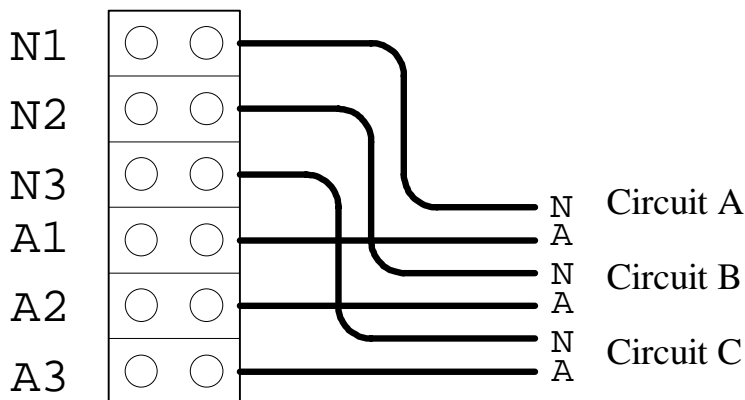


Figure 3.3: Single phase wiring

3.2 Setting the mains frequency

The FP12WM can be configured to run from either 50Hz or 60Hz mains power - as supplied from the factory it is configured for 50Hz. To change the dimmer to 60Hz, change the three jumpers to “60Hz” as per Figure 3.4.

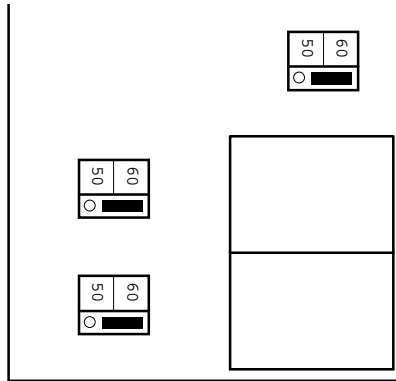


Figure 3.4: 60Hz jumper locations

3.3 Powering up

Turn on the power and check that the three PHASE indicator LEDs are on before connecting any loads. If the PHASE LEDs indicate a fault condition (see section 5.4), power down and remedy the fault before trying again.

If all is well, power down and connect loads.

3.4 Connecting loads

The standard output connectors are either twelve Clipsal 415P 10 amp sockets, twenty-four Weiland GST18 sockets, or terminal strip (export models may differ from these configurations). Ensure any plugs are pushed firmly into their sockets and/or all screw terminals are tight.

The FP12WM will drive most incandescent loads as well as hotspots, fans, and dimmable fluorescent tubes. The load should be greater than the specified minimum.

3.5 Connecting DMX-512 input

The dimmer input signal should conform to the USITT DMX-512 1990 specification. The DMX input connects to the terminal strip on the main circuit board labelled “DMX IN”. The DMX signal may be daisy-chained to the next dimmer via the terminal strip labelled “LOOP”.

The green DMX IN LED indicates the presence of DMX signals.

Refer to Section 8.2 for DMX connections.

3.6 DMX Termination

In any DMX-512 system the signal should be terminated at the last dimmer receiver in the chain, and the FP12WM can provide this function. To terminate the DMX signal, remove the front panel and locate the jumpers labelled “Link Setting” at the top of the main circuit board. As supplied from the factory the jumpers will be set to “Thru”, where

no DMX termination is applied. Shift the two jumpers to the “Term” position to terminate the DMX control signal. Note that in this position no signal is present at the “DMX Thru” terminals.

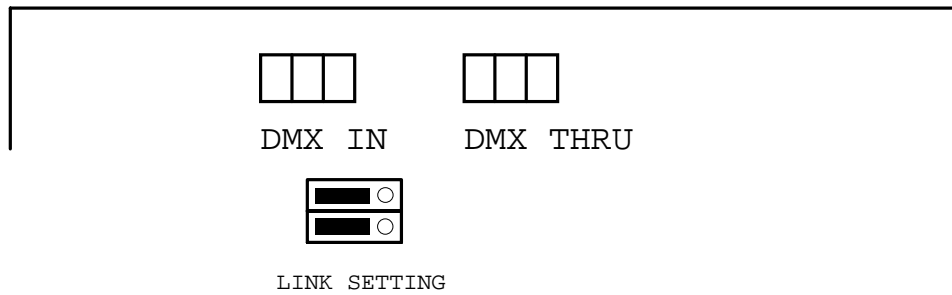


Figure 3.5: DMX termination jumper position

3.7 Adjusting the Preheat

The FP12WM incorporates a global preheat facility that allows all channels to be driven at a low level when the control input is off. This feature can extend the life of the lamps and minimise nuisance tripping of circuit breakers. In practice the preheat trimpot on the main circuit board is adjusted until the connected loads show a barely perceptible dull glow.

3.8 Power-up sequence

When powering up lighting systems, the following sequence should be used:

1. First the control desk;
2. Then any softpatches and/or DMX receivers;
3. Finally the dimmers, preferably one at a time starting from the first dimmer rack in the DMX loop.

This procedure minimises the risk of producing the lighting equivalent of an audio “thump” and prevents damage to lamps, dimmers, and other controlled devices.

Use the reverse procedure when powering down.

4.0 Dimmer Operation

This section assumes the dimmer has been correctly connected to three phase power and a source of DMX-512 control signal.

4.1 Operating modes

The FP12WM has two operating modes:

1. **DMX mode:** the dimmer is controlled from an external DMX-512 control console,
2. **Test mode:** the dimmer is controlled by the internal microprocessor.

4.1.1 DMX mode

In this mode, the DMX Bank Select switches are used to select which bank of 12 channels from the 43 possible DMX-512 banks will control the FP12WM.

See Table 4.1 (below) for a list of banks and their corresponding Channels.

Decide which bank of channels is required, and rotate the selector switches to the desired setting. For example, if DMX Channels 25 to 36 are desired (ie. bank 3), set selectors to “03”. FP12WM Channel #1 is now DMX Channel #25. A FP12WM with this setting ignores DMX Channels 1 to 24 and 37 to 512, and only decodes Channels 25 to 36 as it’s dimmer information.

Setting the Selectors to “00” puts the dimmer in a standby state, with all Channels driven to the preheat setting.

Bank	Channels	Band	Channels	Band	Channels	Band	Channels
00	Outputs at minimum	11	121 - 132	22	253 - 264	33	385 – 396
01	1 - 12	12	133 - 144	23	265 - 276	34	397 – 408
02	13 - 24	13	145 - 156	24	277 - 288	35	409 – 420
03	25 - 36	14	157 - 168	25	289 - 300	36	421 – 432
04	37 - 48	15	169 - 180	26	301 - 312	37	433 – 444
05	49 - 60	16	181 - 192	27	313 - 324	38	445 – 456
06	61 - 72	17	193 - 204	28	325 - 336	39	457 – 468
07	73 - 84	18	205 - 216	29	337 - 348	40	469 – 480
08	85 - 96	19	217 - 228	30	349 - 360	41	481 – 492
09	97 - 108	20	229 - 240	31	361 - 372	42	493 – 504
10	109 – 120	21	241 - 252	32	373 - 384	43	505 – 512

Table 4.1 DMX bank / Channel allocation

4.1.2 Test mode

In this mode, the FP12WM’s internal controller is used to drive the dimmer channels. It is accessed by setting the Selector switches to banks between “44” and “99”. No DMX control is necessary, but a control signal may be left connected if desired.

This mode is split into two sections with individual Channel testing from banks “44” to “59” and group channel testing from banks “60” to “99”. The first section is not level controllable and each channel is driven to full.

Refer to Table 4.2.

Selector Switches	Channel Under Test	Output Level
44	Channel 1	Full
45	Channel 2	Full
46	Channel 3	Full
47	Channel 4	Full
48	Channel 5	Full
49	Channel 6	Full
50	Channel 7	Full
51	Channel 8	Full
52	Channel 9	Full
53	Channel 10	Full
54	Channel 11	Full
55	Channel 12	Full
56 - 59	12 Step Chase	Full

Table 4.2 TEST MODE – Individual Channel Selection

The second section is level controllable, the level being set by the right hand Selector switch. The left-hand Selector switch changes the grouping. Refer to Table 4.3.

Selector Switches Right		Channel Grouping	Channel Left Level
6	0-9	Channels 1-4 ON (Phase A)	0-9
7	0-9	Channels 5-8 ON (Phase B)	0-9
8	0-9	Channels 9-12 ON (Phase C)	0-9
9	0-9	Channels 1-12 ON	0-9

Table 4.3 TEST MODE – Group Selection

4.2 Status LED

The Status LED is used to indicate fault conditions. In normal operation this LED should not illuminate. When active this LED will either be flashing or on continuously.

1. When the LED is flashing an over-temperature or over-voltage condition is present, and the dimmer outputs will be driven to the preheat level until the over-voltage or over-temperature condition is removed.
2. The status LED being on continuously indicates one or more of the following error conditions have occurred:
 - Over-voltage

- Over-temperature
- Serial data errors
- Software failure

The dimmer outputs are active while the Status LED is on continuously.

If the Status LED is on it may be cleared by changing the setting of the bank select switches or by switching the dimmer off momentarily.

5.0 Fault Diagnosis

NOTE

Contact your authorised JANDS Distributor for repairs or servicing.

In Australia refer all repairs to an authorised JANDS service agent or return the faulty unit in suitable packaging to:

JANDS ELECTRONICS Service Dept,

40 Kent Rd

Mascot NSW 2020

Sydney Australia

5.1 Output protection

Output protection consists of a circuit breaker on each channel. These are designed to pass the rated current, but will disconnect the output circuit for any overload condition; the larger the overload, the quicker the disconnection.

The purpose of the circuit breaker is to protect the dimmer's output devices from short-circuit loads and faulty wiring looms, and save on expensive repairs. At the same time, the tripped circuit breaker indicates to the operator a load fault that requires immediate attention.

5.2 Output faults

If a short-circuit lamp or output cable is plugged into the dimmer, the circuit breaker will trip to disconnect the fault from the dimmer. In nearly all circumstances, this is quick enough to prevent damage to the output devices.

In some circumstances however, a triac failure may be experienced, although these devices are usually quite reliable and robust. If a triac does fail, it will either turn a channel on to full (triac short-circuit), or turn it off (triac open-circuit). If a triac fault should occur, that channel may be isolated by manually switching the circuit breaker off.

5.3 DMX faults

The FP12WM dimmer features an "Output Hold" facility that "remembers" the last received DMX message. In the event of a cable being unplugged or severed, the FP12WM dimmer rack will continue to output the "Held" DMX levels until a new DMX message is provided.

The **DMX IN** LED will "flash" slowly if the DMX signal is removed.

5.4 Phase fault indication

The three green **PHASE** LEDs will show when all three power input phases are present.

WARNING

IF ONE OR MORE PHASE LEDS IS OFF, IMMEDIATELY DISCONNECT POWER TO THE DIMMER AND CHECK THE MAINS SUPPLIES AND WIRING BEFORE RE-CONNECTING POWER TO THE DIMMER.

5.5 Overheating

As the FP12WM is a convection-cooled dimmer, it is very important that adequate ventilation is provided when in use, particularly around the top and bottom vent slots. If the vent slots are blocked and/or the ambient air temperature is too high, the dimmer will shut down and the status LED will flash until the temperature is reduced. A FP12WM running normally at full power will get quite warm to the touch.

In addition a mechanical cutout isolates the dimmer electronics if the internal temperature rises above the specified maximum.

Refer to section 6.1 regarding FP12WM ventilation requirements.

5.6 Over-voltage

The FP12WM incorporates an over voltage cutout that constantly monitors the incoming mains voltage. If the mains voltage rises above the specified maximum the dimmer will shut down and the status LED will flash until the over voltage condition is removed.

5.7 Fault finding guide

FAULT SYMPTOM	POSSIBLE CAUSE	REMEDY
Circuit breaker trips when desk channel flashed to full or near full	Large incandescent load Excessive load	Use dimmer Preheat facility Reduce Channel loading
Circuit Breaker trips after prolonged operation	Excessive load Lamp or wiring fault	Reduce Channel loading Check lamps and wiring
Circuit breaker trips immediately when channel is driven	Output short Triac short	Check lamps and wiring Factory service
One channel flickers when dimmed Same load flickers on another Channel	DMX source problem Faulty dimmer channel Insufficient or very inductive load	Softpatch another desk fader Service desk Factory service Connect 100W lamp in parallel
Radio interference	Faulty EMC filtering	Factory service
All Channels flicker when dimmed	Incorrect DMX protocol / wiring Mains control tones exceed limits	Replace DMX source / wiring Contact factory
Signal LED flickers	Faulty DMX wiring/connections Faulty console Faulty dimmer rack	Repair Repair Factory service
Status LED flashing	Over-voltage Over-temperature	Check mains connection/supply Improve dimmer cooling
Status LED on continuously	Recent over-voltage Recent over-temperature DMX control errors Software failure	Check mains connection/supply Improve dimmer cooling Check DMX wiring, console Factory service

6.0 Installation

The FP12WM dimmers are designed for use in fixed installations - the dimmer is supplied with a wall-mounting bracket. This bracket enables the FP12WM to be mounted in one of the following arrangements:

- The dimmer may be mounted in a 19 inch equipment rack, using 11RU
- The dimmer may be mounted flush to a wall with the cabling coming through the wall
- The dimmer may be flown from a bar using a pair of standard hook clamps (not supplied)

An optional extended mounting bracket allows the following mounting options:

- The dimmer may be mounted proud of a wall for use with surface cable conduit. The conduit may run either horizontally or vertically
- The dimmer may be mounted so to straddle a vertical cable tray up to 420mm wide and 75mm deep

An optional patch kit allows an extended mounting bracket to be used as an output patch panel.

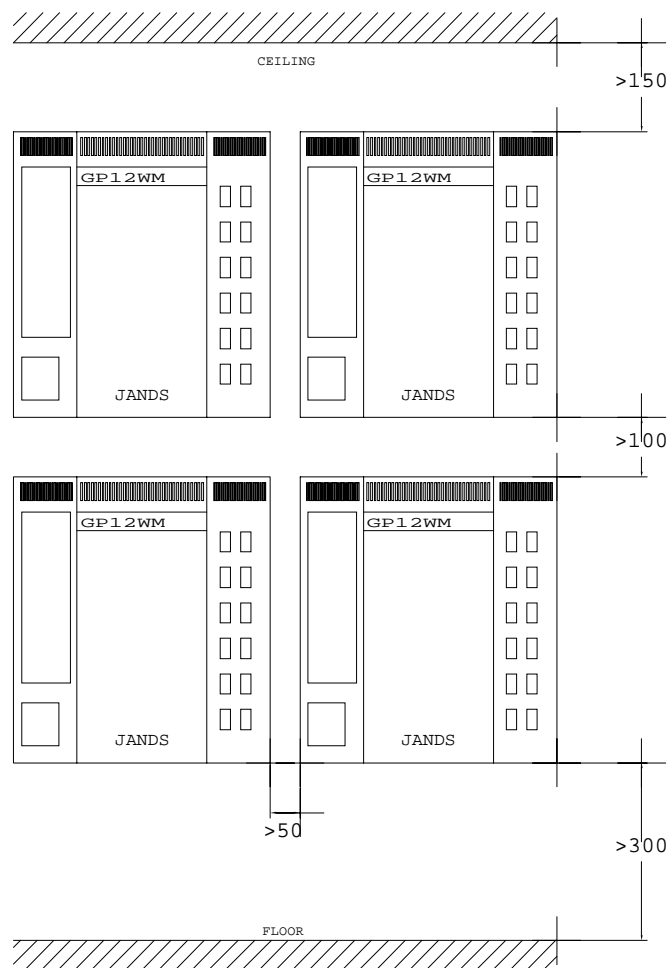
6.1 Dimmer Ventilation

The FP12WM dimmers are cooled by natural convection. The air intake is by slots at the bottom front, and exhausts through slots at the top and top-front.

The FP12WM dimmers are intended for wall mounting in unenclosed spaces. Multiple dimmer arrays should be spaced **at least** 100mm apart vertically, and no more than three dimmers high, to avoid excessive heating of the top dimmer. Dimmers should be spaced **at least** 50mm horizontally.

Dimmers should be mounted **at least** 300mm from the floor to avoid excessive ingress of dust and fluff, or as dictated by local building statutes. Dimmers must be mounted **at least** 150mm below ceilings or shelves for adequate ventilation.

Mounting within unventilated cupboards is not recommended. If the dimmers are mounted within cupboards, allow **at least** 150mm above and below the dimmer, and at least 100mm at each side and the front of the dimmer. In addition, the cupboard must be vented with **at least** 400 cm² (eg 40cm x 10cm) per dimmer at the top and bottom of the cupboard. Additional venting area will serve to further reduce internal dimmer temperatures and will enhance the dimmer's reliability.

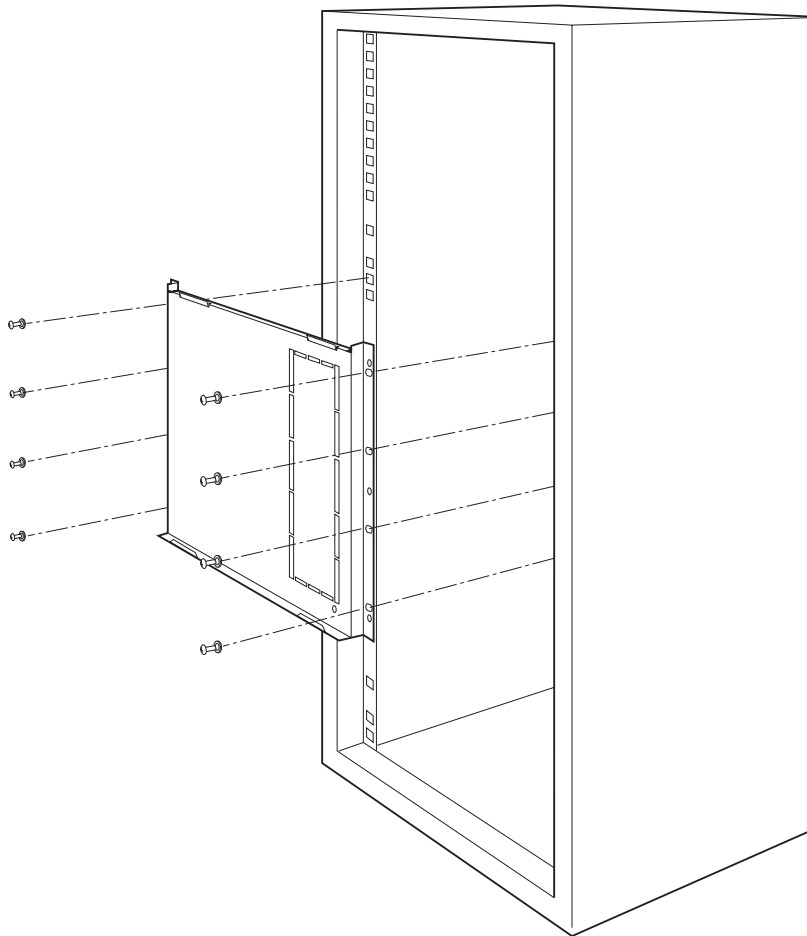


6.2 Wall Mounting Dimmers - In Racks

Both the wall and the extended mounting bracket may be attached to standard 19" rack strips. The bracket is screwed to the rack strip using standard cage nuts and screws (not supplied).

A rear blanking plate (supplied) is fastened inside the dimmer with five screws. Supply cable entry may be via a 32mm gland hole at the bottom right of the main chassis, or via one of two 32mm holes in the rear blanking plate. Unused 32mm holes should be covered with the blanking plugs provided.

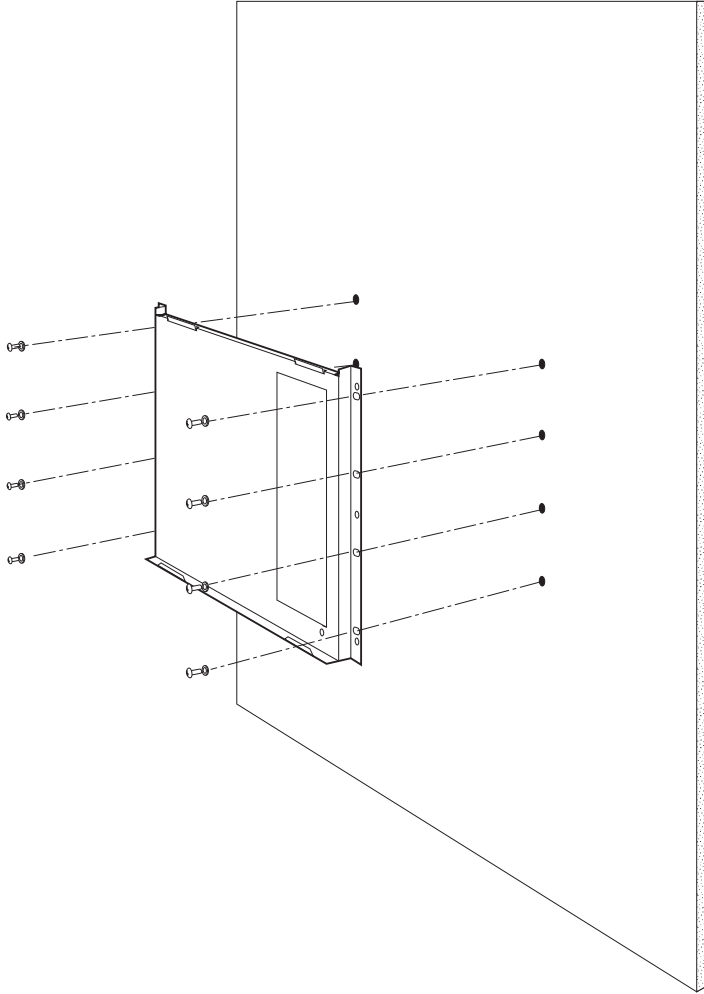
Attach the dimmer to the bracket as described in Section 6.8.



6.3 Wall Mounting Dimmers - Flush to Wall

Remove the cable access blanking piece of the wall mounting bracket by cutting the holding webs with shears. De-burr the metal. Feed any cables (supply, output, and control) through this cable access cutout, and place the bracket against the wall, orienting the bracket as indicated on the bracket. Mark and drill at least 4 fixing points, and attach the bracket to the wall.

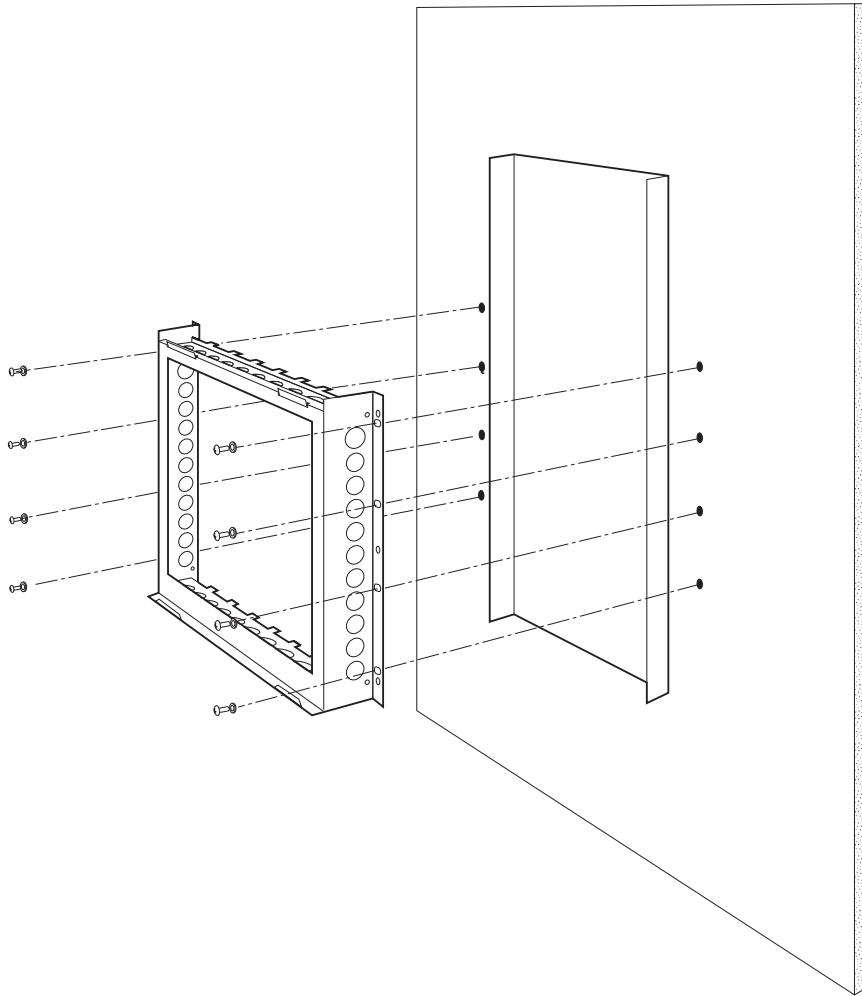
Attach the dimmer to the bracket as described in Section 6.8.



6.4 Wall Mounting Dimmers - Straddling Cable Trays

The optional extended mounting bracket will straddle cable trays up to 420mm wide and 75mm deep. Remove the top blanking piece by cutting the holding webs with shears, and remove the eight screws securing the bottom blanking piece. De-burr the metal. Position the bracket over the cable tray against the wall, orienting the bracket as indicated on the bracket. Mark and drill at least 4 fixing points, and attach the bracket to the wall. Feed any cables (supply, output, and control) through the cable access cutout.

Attach the dimmer to the bracket as described in Section 6.8.

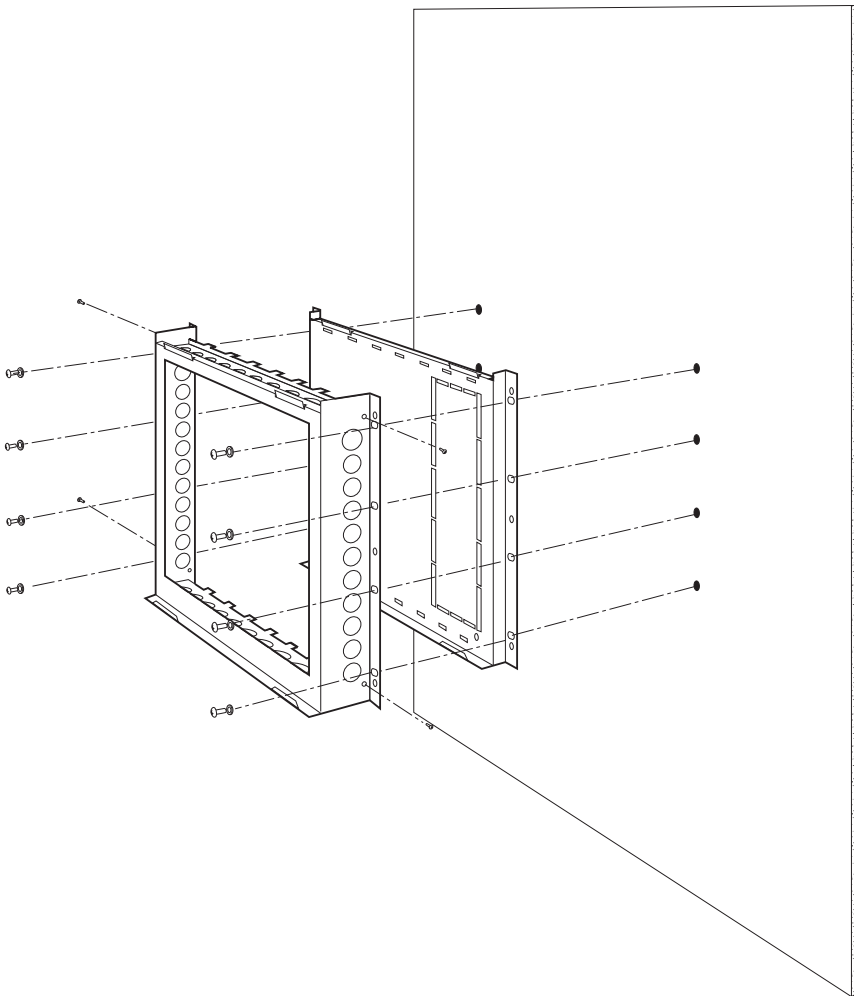


6.5 Wall Mounting Dimmers - Conduit Cable Entry

Use both the wall and optional extended mounting brackets to form an enclosure. Place the deep bracket over the shallow bracket, so that the tags in the back of the deep plate fit into the mating slots in the shallow bracket, noting the orientation marks on both pieces. Use four thread-cutting screws (supplied) at each side to screw the two pieces together, forming an 80mm deep enclosure. The enclosure formed has an assortment of holes to suit 25mm and 32mm (1" and 1-1/4") conduit end nuts on all four sides.

Place the assembly against the wall at the desired location, and mark and drill holes for at least 4 fixing points. Mount the enclosure on the wall.

Attach the dimmer to the bracket as described in Section 6.8.

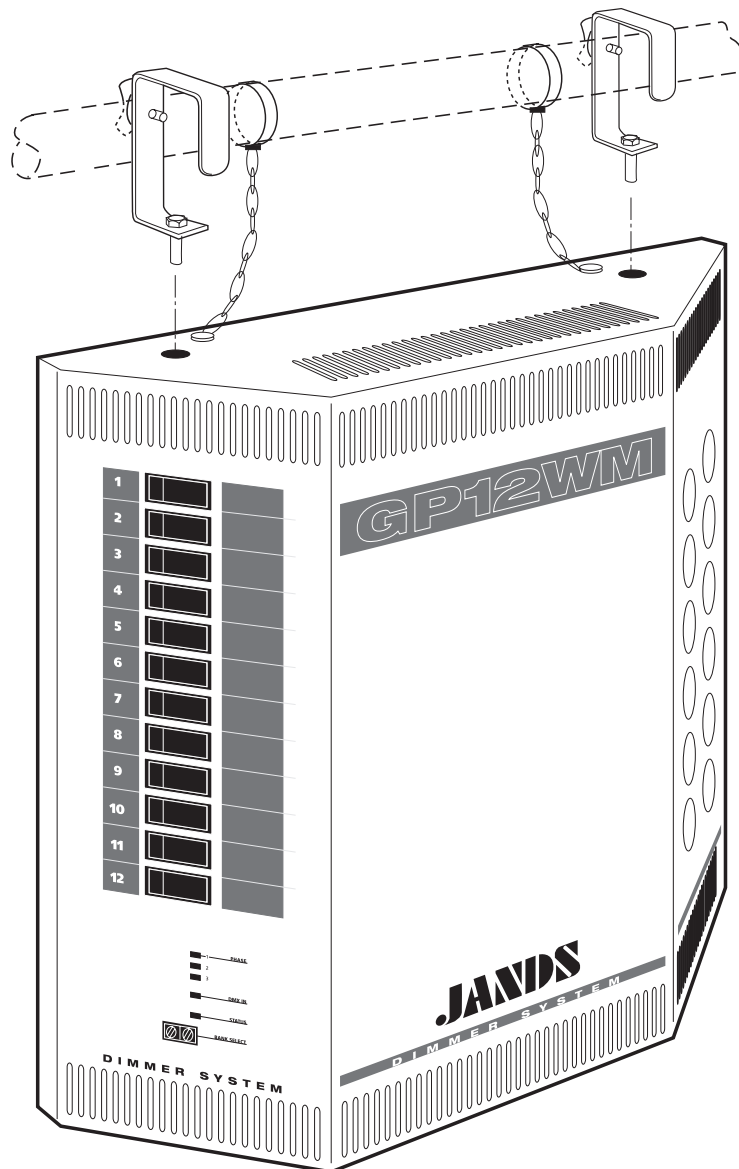


6.6 Wall Mounting Dimmers - Hung from Bar Hooks

The FP12WM dimmers have two M10 captive nuts on the top face. These may be used to secure the dimmer using standard bar hooks (not supplied), allowing the dimmers to be flown from lighting trusses or catwalk rails. The bolts should not penetrate the top surface of the dimmer by more than 25mm.

Additional holes at the top rear edge of the dimmers allow the dimmer chassis to be secured with safety cables.

The dimmers are flown without using the wall or extended mounting brackets. A rear blanking plate (supplied) is fastened inside the dimmer with five screws. Supply cable entry may be via a 32mm gland hole at the bottom right of the main chassis, or via one of two 32mm holes in the rear blanking plate. Unused 32mm holes should be covered with the blanking plugs provided.



6.7 Wall Mounting Dimmers - Patch Lead Option

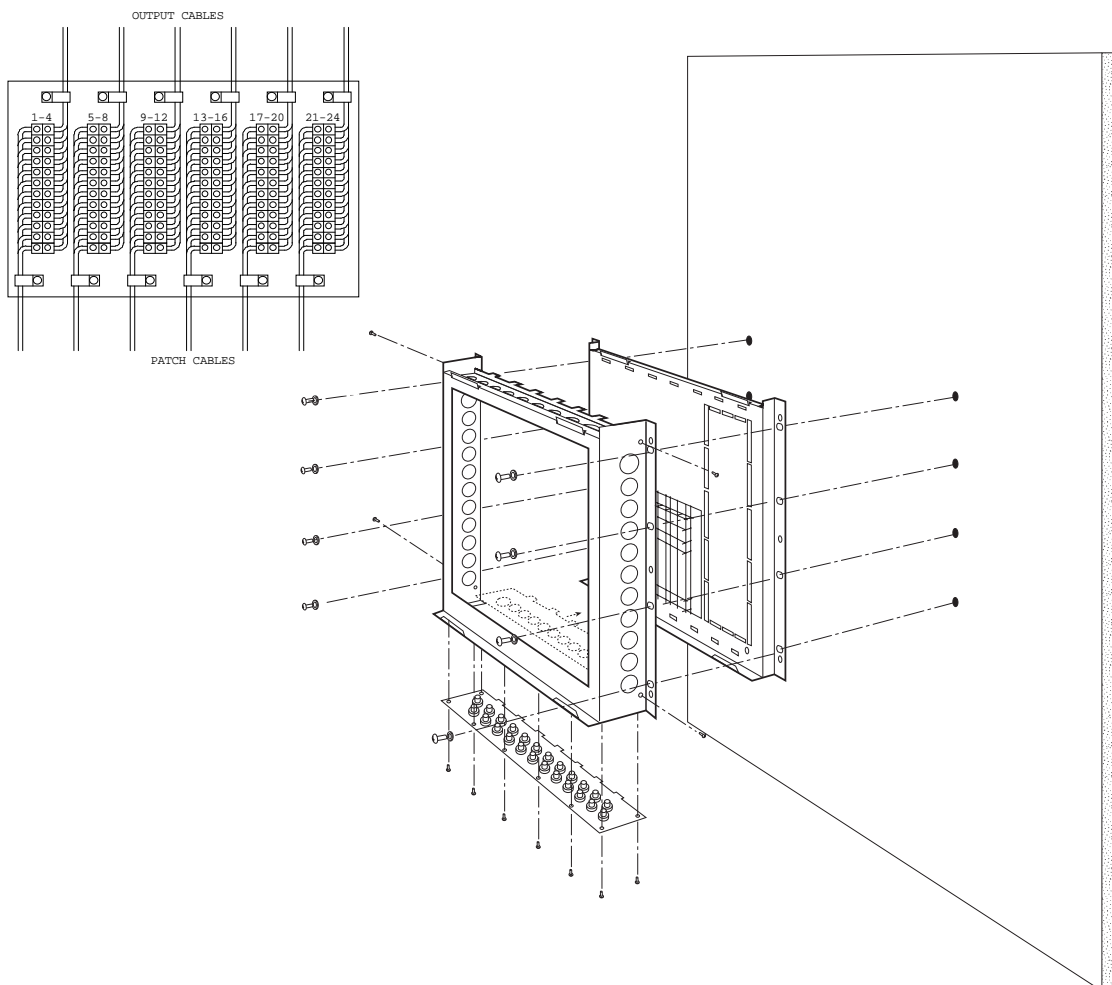
The wall-mount bracket system may include flying lead output patching. Two types of flying lead patch options are available:

- Twenty-four 3-pin Australian Clipsal 463 plugs
- Twenty-four 3-pin Wieland ST18 plugs

Output cables up to 4mm² capacity are terminated at screw terminal blocks. These terminal blocks are supplied pre-wired to plugs on flying patch leads, which may then be patched to any desired dimmer outlet socket.

To install:

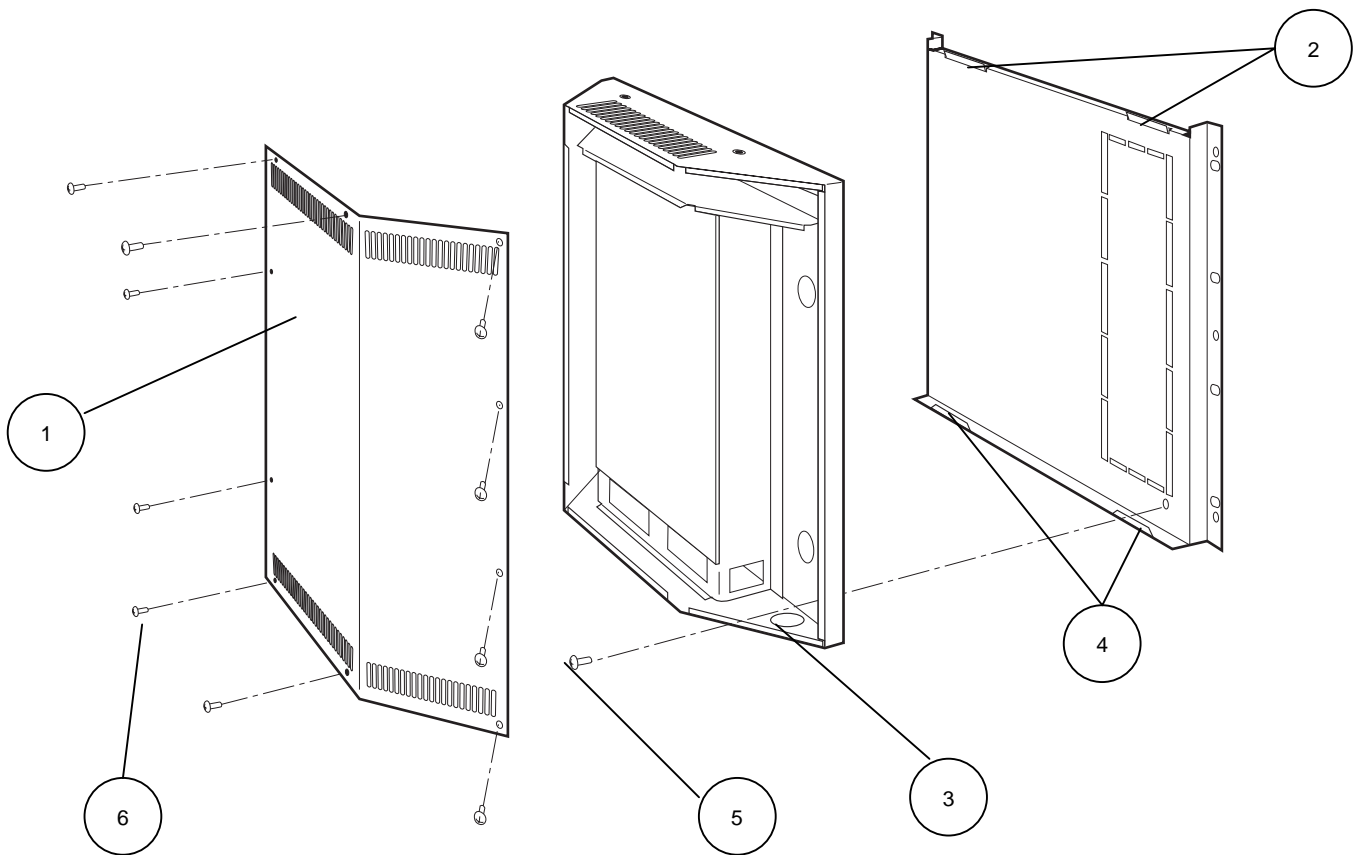
1. Remove the bottom blanking plate from the optional extended bracket (eight screws).
2. Replace the bottom blanking plate with the pre-wired patch gland plate using the screws removed in step 1.
3. Fasten the deep bracket to the shallow bracket (see section 6.2.4).
4. Screw the terminal block plate to the shallow bracket (six screws).
5. Secure the assembly to the wall as described in section 6.5.
6. Connect the load wires to the terminal blocks.
7. Mount the dimmer as described in Section 6.8 and connect the supply and DMX-512 cables.



6.8 Mounting the dimmer to the bracket

Dimmers are attached to the pre-mounted brackets as follows:

1. Remove the dimmer's right-hand front panel (eight screws).
2. Hang the top edge of the dimmer on the two bracket tabs. These support the weight of the dimmer while allowing the bottom of the dimmer to pivot away from the bracket.
3. Feed any cables (mains supply, output or control) into the rear of the dimmer and terminate them as necessary. This may only be performed by a licensed electrician.
4. Latch the dimmer onto the bracket by lifting the dimmer a few millimetres and allowing the bottom two bracket tabs to engage.
5. Lock the dimmer in place with one M4 screw at the bottom right inside corner.
6. Re-attach the front panel.



7.0 Maintenance

With care, the FP12WM dimmer will require little or no maintenance.

WARNING

DO NOT ALLOW THE ENTRY OF LIQUIDS OF ANY SORT INTO THE DIMMER CHASSIS.

If the front panel requires cleaning, wipe with a mild detergent on a damp soft cloth.

DO NOT spray liquids onto the front panel.

DO NOT use solvents for cleaning the front panel.

8.0 Technical Data and Specifications

PARAMETER	FP12WM
No. of Channels:	12
Input Power Requirements 3 phase Star:	415 VAC Phase-Phase @ 40A/phase protected at 50A/phase
Input Power Requirements 3 phase Delta:	240 VAC Phase-Phase @ 40A/phase protected at 50A/phase
Input Power Requirements Single Phase	Three 240VAC @ 40A protected at 50A each
Maximum Power / Channel	2.4 kW
Minimum Power/Channel	25W
Maximum Dissipation	<24 W/channel (<300 W total)
Maximum Ambient Temp	40°C
Control Signal	DMX-512 (1990) Protocol
DMX Input	Circuit board terminal strip
Test Function Level	Individual Channels @ 100% Group Channels @ 10% steps
LED Indicators	DMX IN, STATUS, Phases A, B, and C
Output Protection	12 x 10 Amp circuit breaker
Over temperature cutout	Electronic: 83°C rising, 78°C falling Mechanical: 90°C
Over voltage cutout	Average 290VAC
Preheat adjustment	0-10%
Size (mm)	482 (w) x 485 (h) x 130 (d)
Weight	16 kg net

8.1 DMX connector pin-outs

PIN No	CONNECTION (DMX IN)	CONNECTION (LOOP)
1	SHIELD	SHIELD
2	IN-	OUT-
3	IN+	OUT+

8.2 DMX bank allocations

BANK	CHANNELS	BANK	CHANNELS
00	Preheat Only	22	253 – 264
01	1 – 12	23	265 – 276
02	13 – 24	24	277 – 288
03	25 – 36	25	289 – 300
04	37 – 48	26	301 – 312
05	49 – 60	27	313 – 324
06	61 – 72	28	325 – 336
07	73 – 84	29	337 – 348
08	85 – 96	30	349 – 360
09	97 – 108	31	361 – 372
10	109 – 120	32	373 – 384
11	121 – 132	33	385 – 396
12	133 – 144	34	397 – 408
13	145 – 156	35	409 – 420
14	157 – 168	36	421 – 432
15	169 – 180	37	433 – 444
16	181 – 192	38	445 – 456
17	193 – 204	39	457 – 468
18	205 – 216	40	469 – 480
19	217 – 228	41	481 – 492
20	229 – 240	42	493 – 504
21	241 – 252	43	505 – 512

8.3 Mains wiring colour codes

Phase A	Red
Phase B	White
Phase C	Blue
Neutral	Black
Earth	Green/Yellow