Eddystone Broadcast

S7600 Series
S76005 – S7601 – S7602
500W – 1kW – 2kW
Low Power
FM Transmitters

Installation
and
Operation

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Eddystone Broadcast Ltd.
26, Arden Rd.
Arden Forest Industrial Estate
Alcester, Warwickshire
B49 6EP, England
Tel. 44 (0)1789 762278
Fax. 44 (0)1789 766033
www.eddystone-broadcast.com

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SECTION ONE: INTRODUCTION

! CAUTION !

These Transmitters operate at **high RF power levels, internal supply energy levels and mains supply current levels**. They also incorporate devices containing **toxic BeO**. Installation, operation and maintenance of this unit must therefore, only be carried out by suitably qualified personnel, familiar with and fully utilising the safety procedures such equipment demands.

NO attempt at installation should be made without full reference to and compliance with SECTION TWO: INSTALLATION.

NO attempt at internal maintenance should be made without full reference to and compliance with the appropriate sections (apart from fuse changing which is detailed in INSTALLATION).

1.1: GENERAL DESCRIPTION

The S7600 Series of Low Power FM Transmitters provide output powers of up to and including 2kW (used singly) or 4kW (using combined pairs) in the standard Band ll frequency range of 87.5-108MHz. They are normally supplied with either one or two Exciters, capable of generating a standard mono or stereo FM signal from a variety of analogue or digital audio or data sources (including left/right audio, MPX, RDS, SCA, DARC etc.). It is important to note that the Exciter(s) supplied will depend on the user's actual requirements in this regard which, therefore, must be clearly specified at time of ordering.

The Transmitters are totally self-contained (including forced air-cooling) and can be mounted as a complete unit (less Exciters) within a standard 19 inch rack with at least 600mm depth and 12U height (up to 1kW) or 14U (up to 2kW). Pairs (including drives) can be accommodated in racks of 42U height. All that is required is a connection to a mains supply, to an antenna and to the Exciter/Drive(s). When used in pairs, to generate up to 4kW, an additional two-way splitter, combiner and approximately 1kW balance load is also required. In this situation, additional manual 'patching' or manual/automatic switching can be provided, as an option, to direct all of one Transmitter's power to the antenna.

The key feature of The S7600 series is its ability to remain 'on-air'. The use of multiple Amplifier and Power Supplies Modules and dual power supply and control circuitry means that if failures do occur, it normally only results in a reduction of output power. Furthermore, the lightweight, hot-pluggable Amplifier and Power Supply Modules can be easily replaced, in seconds, without having to go 'off-air'. Provision for dual Exciter/Drive automatic changeover and for connection to a second active/passive reserve S76XX or S79XX (i.e. 500W to 10kW) Transmitter is also made, further enhancing the ability to remain 'on-air'.

Each Transmitter consists of a number of modules described as follows (1.1.1 – 5 inc.). Front and rear views, block and circuit diagrams, showing these modules are bound at the rear of this manual (S7600-01GA S7600-02GA, S7600-03GA, S7600-04GA, S7600-00BK and S7600-00CT).

Workshop editions of this manual contain extra information, also bound at the rear, which gives detailed test procedures, circuit diagrams, assembly diagrams, layouts and parts lists.

1.1.1 : E2021-07 350W Amplifier Module

Two (on S76005 500W) four (on S7601 1kW) or eight (on S7602 2kW) of these are provided, each with their own independent control and monitoring circuitry. This circuitry includes reverse power, supply current and temperature monitoring to shut down and protect individual modules. Failures in a single Amplifier Module only tend to give a reduction in power, with the Transmitter still operating with several modules having failed (in the S7601 and S7602).

Each Amplifier Module can be removed or replaced whilst the Transmitter is operating ('hot-pluggable'). This feature means that if failures do occur, modules can be replaced within seconds, without having to go 'off-air'. Red/green fault displays on the front of each module help indicate the faulty module to be replaced, this normally restoring the Transmitter's full output without any further immediate technical investigation being required. The relatively low weight and small size of each module assist their actual transport to site.

Each Amplifier also has its own front panel ‘mute’ switch, which is mechanically interlocked so that it has to be operated before the module can be removed. All other signal, 50V dc supply and control connectors are at the rear of the unit. The control connectors go to one of two independent internal Transmitter control buses.

Each control bus has its own RS485 data bus, which is used to carry the monitored serial information from the amplifier to the E2023 Controller. Each bus also has its own power level control line, derived from the E2025 Combiner Unit, to set the power level of each amplifier module and thus the final transmitter output power.

Various versions of the 350W Amplifier Module may be supplied. These versions have slightly different internal circuitry. They are however interchangeable, but to maximise output power, all modules should ideally be of the same version.

1.1.2 : E2088/E2322 1kW Power Supply Module

Any given Transmitter can only accept either E2088 or E2322 modules, not both

Two of these are provided on the S76005 and S7601, with four on the S7602 (two more on the /P options). The modules are equally grouped into two supplies ’A’ and ‘B’, with independent mains supply connectors to enable operation from dual mains supplies. The 500W S76005 may optionally be supplied with just one module/connector. The E2088/E2322 modules in each group are current OR’d together. Thus, on the /P option, where the extra module is fitted, the current lost when any single module in the group fails, can still be supplied by the remaining module(s) in the group.

The ‘A’ supply provides a supply bus to the one, two or four E2021 Amplifier Modules on the right hand ‘A’ side of the transmitter. The ‘B’ supply provides a separate bus to the one, two or four Amplifier Modules on the left hand ‘B’ side. Single units requiring power (E2023, E2024 and E2025) and both cooling fans are supplied from both supply buses.

All supplies are switched via a single front panel safety switch. The switch can be padlocked in the ‘off’ position to ensure that the transmitter remains off whilst work is being carried out at the antenna etc.

Each E2088/E2322 Power Supply Module has its own forced air cooling, output control and monitoring circuitry and generates a regulated 50V to 53V dc supply. Apart from on the single module 500W variant, failure of a single Power Supply Module leaves the Transmitter still operating but with a 6dB reduction in output power. As with the Amplifier Modules, each E2088/E2322 Power Supply module can be removed or replaced, within seconds, whilst the Transmitter is operating. Red/green fault displays, relatively low weight and small size again feature.

50-53Vdc outputs for each Amplifier, for all the low power single units and mains supplies for each Exciter are provided via separate fuses at the rear of the Transmitter. The Power Supply monitor connectors go to one of two independent internal Transmitter control buses and hence to the E2023 Controller.

1.1.3 : E2023 Transmitter Controller Unit

This single unit provides comprehensive monitoring of the forward power, current and temperature of each E2021 Amplifier Module and of the final output forward power, reverse power and temperature via the E2025 Combiner Unit. It also monitors the E2088/E2322 Power Supply Modules. In the situation where dual drive automatic changeover or automatic power level control is used, this unit provides the necessary control. Remote control and monitoring of the Transmitter can also be provided via this unit using parallel or serial data.

The Control Unit is microprocessor based with a back illuminated, high contrast 4 line by 20 character display and separate red/green ‘System Normal’ indicator. A robust, sealed membrane keypad is provided with a sounder to indicate correct key entry. The rear of the unit has separate connectors for the two independent internal Transmitter control buses, connectors to monitor and control one or two Exciters, a connector for power level control and a connector for parallel monitoring. An RS232 monitor/control port is provided on the front panel (E2023-01/02) with an additional TCP/IP monitor/control port on the rear (E2023-02 only). An RS232 monitor/control port is provided on the

rear panel (E2023-03/04) with an additional TCP/IP monitor/control port on the rear (E2023-04 only). When the RS232 port is provided on the rear panel, no parallel monitoring is available.

If a fault should occur within the E2023, manually operated switches on the E2024 Splitter/Drive Changeover Unit can be used for basic control of the Transmitter. This enables it to be kept 'on-air' whilst the E2023 is replaced.

1.1.4 : E2024 Splitter /Drive Changeover Unit

This single unit interfaces between the Exciter(s) and the multiple E2021 Amplifier Module inputs. The splitter section within the unit is either two way (S76005) four way (S7601) or eight way (S7602) and consists of the appropriate number of cascaded two way Wilkinson 3dB power splitters. These all use standard 75Ω coaxial cable, with 100Ω balance loads and are thus easily repaired if any become damaged. All outputs are brought to SMC connectors at the rear of the unit. Phase length matched, 50Ω coax leads then connect these outputs to the E2021 inputs.

A front panel lockable toggle switch is provided to manually mute or start (i.e. demute) the Transmitter or can be set to enable the E2023 Control Unit to select high/low power or to mute/demute the Transmitter as part of an automatic control sequence. An interlock switch connector is also provided on the rear to enable the open-circuiting of external switches placed at safety points (e.g. at Antenna access gates) to automatically mute the Transmitter. The state of this circuit is displayed on a front panel indicator.

As with the E2023, the rear of the E2024 has separate connectors for the two independent internal Transmitter control buses

The E2024 can also provide manual or automatic dual drive changeover in conjunction with the E2023 Control Unit. A second front panel lockable toggle switch is provided on the E2024 to manually select which Exciter (i.e. 'Drive') is to be used, or to enable the E2023 to automatically select the second Exciter should the first one fail. Switching is performed by two coaxial RF relays within the E2024. These direct one of two Exciter's outputs to the internal splitter and the other to a dumping load. This dumping load has to be provided (externally to the E2024) whenever two Exciters are supplied and the Exciter not in use is required to remain 'active' or be tested. Three TNC connectors are provided at the rear of the unit to connect to the Exciter(s) and the dumping load. Front panel indicators show which Drive is selected.

1.1.5 : E2025 Combiner Unit

This single unit interfaces between the multiple E2021 Amplifier Module outputs and the antenna. Phase length matched, 50Ω coax leads connect the E2021 outputs to the TNC connectors at the rear of this unit. The combiner section within the unit is either two way (S76005) four way (S7601) or eight way (S7602) and consists of the appropriate number of cascaded four or two way Wilkinson power combiners utilising standard handformable and flexible coaxial cable.

The combiner section is followed by an integral low pass filter, this removing harmonics of the wanted frequency. An output directional coupler is then provided with a 7-16 output socket for connection to the antenna. This coupler is used to monitor the output forward and reverse power. A sample of the forward power is also directed to a front panel BNC connector for easy connection to test equipment.

The E2025 also contains circuitry to measure the Transmitter's final output forward and reverse powers via the output coupler, the temperature of the Combiner's integral dumping load heatsink and the currents in the Transmitter's dual cooling fans. Front panel red/green displays indicate any fault condition. Two multi-turn preset potentiometers are accessible via the front panel to enable independent setting of two Transmitter output powers. They are selected using various forms of local, external or remote control or via a link on the Combiner/Fan connector Board (see section 3.4.2).

The single E2025 control connector goes to the two independent internal Transmitter control buses via the Combiner/Fan connector Board, where it monitors the dual fans' currents. As previously detailed, each control bus has its own RS485 data bus, one of which is used to carry the monitored serial information from the E2025 to the E2023 Control Unit. For these two buses, the E2025 also provides two equal but independent power level control voltages (derived from either the front panel High or

Low Power potentiometers) to set the power level of the E2021 Amplifier Modules and thus the final Transmitter output power. One control voltage is used for the Amplifier Modules on the right hand A side of the Transmitter and the other for the Amplifier Modules on the left hand B side.

Rear panel connectors give analogue dc output levels indicating the forward and reverse powers generated.

1.2 : VARIANTS AND OPTIONS

The main variants and their constituent modules and units are as follows :-

	Amplifier Modules	Power Supplies	Transmitter Auto. Cont.	Splitter and Drive C/O	Combiner Unit
S76005-01 500W Max.	2 off E2021-XX	1 off E2088-01 or E2322-01	Single E2023-XX	Single E2024-03	Single E2025-03
S76005-02 500W Max.	2 off E2021-XX	2 off E2088-01 or E2322-01	Single E2023-XX	Single E2024-03	Single E2025-03
S7601-01 1kW Max.	4 off E2021-XX	2 off E2088-01 or E2322-01	Single E2023-XX	Single E2024-01	Single E2025-01
S7602-01 2kW Max.	8 off E2021-XX	4 off E2088-01 or E2322-01	Single E2023-XX	Single E2024-02	Single E2025-02

The options (defined by a letter suffix) are as follows :-

/P	Fitted with two additional E2088/E2322 Power Supply Modules (or one only additional on S76005-01).
/T	Fitted with TCP/IP Remote Control (E2023-02 or E2023-04 Controller)

Examples are as follows :-

S76005-01	Standard 500W (with single E2088/E2322)
S76005-02/P	500W with two additional PSUs (four total)
S7601-01	Standard 1kW
S7602-01/P	2kW with two additional PSUs (six total)

1.3 TECHNICAL SPECIFICATIONS

The S7600 range of FM Transmitters is designed to meet or exceed ETSI Standards:-

EN 301 489-01 : ERM/EMC for Radio Equipment, Part 1, Common Technical Requirements.
EN 301 489-11 : ERM/EMC for Radio Equipment, Part 11, Specific Conditions for FM Transmitters.
EN 302 018-02 : ERM (Spectral Occupancy) for the FM Radio Broadcast Services.
EN 60215:1989 : Safety Requirements for Radio Transmitting Equipment

Note that the following figures do not include any which principally depend on the Exciter/Drive being used (e.g. frequency stability). The figures given below may also be affected by the Exciter/Drive's performance. In both cases the Exciter/Drive's own manual should be consulted.

RF Interface Ports	50Ω nominal
Input Drive Power	RF Input from Exciter/Drive supplied :- 8-10W for S76005 (13W absolute maximum) 17-20W for S7601 (25W absolute maximum) 35-40W for S7602 (50W absolute maximum)
Output Power Level	With any load with a return loss ≥ 14dB (1.5:1 VSWR) any angle. (though see note below in 'Output Power shutdown' section) Note two independent settings available for selection. Adjustable at least 200W to 500W for S76005 (Power Low setting) Adjustable at least 300W to 500W for S76005 (Power High setting) Adjustable at least 400W to 1kW for S7601 (Power Low setting) Adjustable at least 600W to 1kW for S7601 (Power High setting) Adjustable at least 800W to 2kW for S7602 (Power Low setting) Adjustable at least 1.2kW to 2kW for S7602 (Power High setting)
Output Power Variation	Not more than ± 1dB under all specified operating conditions.
Output Power Shutdown	Output power is automatically reduced or shutdown to ensure that any load with return loss <10dB including open and short circuits, does not cause any damage to the transmitter. The return loss level at which shutdown starts can be increased by an internal adjustment (see section 2.3.3). This level is normally set at the factory to be 16dB, the level at which excess reverse power first produces a warning indication.
Output Reverse Intermodulation	Reverse intermodulation products will be better than or equal to –10dB, relative to the interfering incident signal, this being offset over the range ±300kHz to ±20MHz (but remaining within 87.5MHz to 108MHz).
Frequency Range	87.5 -108MHz
Spurious Emissions	In the range 9kHz to 1000MHz : - Better than or equal to –75dBc (S76005) Better than or equal to –76dBc (S7601) Better than or equal to –79dBc (S7602)
Out of Band (Adjacent Channel) Emissions	Better than or equal to –110dBc/Hz, at ±200kHz offsets, and 145dBc/Hz at ±2MHz. When measured in a 1kHz bandwidth, the limit figures become –80dBc at ±200kHz offsets and –115dBc at ±2MHz.

Incidental Amplitude Modulation	Synchronous (AM due to FM) :- Not greater than 2% with a peak deviation of ±40kHz at a modulation frequency of 500Hz. Asynchronous (residual AM due to hum and noise with no FM modulation) :- Not greater than 1% when measured unweighted in a 20Hz to 20kHz bandwidth.
Status Indications	Output forward and reverse power and combiner temperature. Output forward power, temperature and current of any selected Amplifier module. Power Supplies, Cooling fans and (when connected) Drives' status. Red/green pass/fail led indicators on all modules.
Dimensions	Height :- 12U (S76005 and S7601) , 14U (S7602) Width :- to fit standard 19in rack. Depth :- to fit standard 600mm deep rack.
Environmental	Ambient Temperature (operating) : -5 to +50 deg.C Ambient Temperature (storage) : -20 to +70 deg.C Relative Humidity (operating) : Less than or equal to 90%, non condensing with the transmitter at a higher temperature than the ambient. Altitude (operating) : Up to 3000 metres a.s.l.
Power Supply	Two independent single phase inputs. 176 to 264V AC, 47- 63Hz. Apparent power factor 98%. Efficiency 88% (Power Supply units only) Supply current, at each input, at 230V AC typically :- 4A (S76005-01 with 500W RF output) 2A (S76005-02 with 500W RF output) 4A (S7601 with 1kW RF output) 8A (S7602 with 2kW RF output) Typical overall efficiency 55% at above power levels (AC in to RF out)

SECTION TWO : INSTALLATION

! CAUTION !

These Transmitters operate at **high RF power levels, internal supply energy levels and mains supply current levels**. They also incorporate devices containing **toxic BeO**. Before commencing installation, it is recommended that the complete INSTALLATION section is read and understood. **The instructions should then be strictly followed, by suitably qualified personnel, otherwise sub-standard or even dangerous operation may result.**

It is also **strongly recommended** that a **mechanical check** is made of the Transmitter, before it is installed and switched on. This is to ensure that no loosening of connectors or damage has occurred, during transit, which may lead to further damage being caused at switch-on. The principal items to check are : -

No obvious physical damage has occurred to the Transmitter frame, modules or internal wiring.
All removable, internal RF coaxial connectors (SMA/B/C, BNC, TNC, N etc) are in place and tight.
All internal multi-way connectors (Ribbon, D Type, Molex etc) are in place and secure.

Each E2021 Amplifier Module is pushed fully into the Transmitter with its lock switch fully pushed down – **do not try to force these modules home** – if they appear difficult to insert fully, check that the locating 'harpoons' at the rear of each module (either side of its D connector) are not bent.

Each E2088/E2322 Power Supply Module is pushed fully into the Transmitter with its locking lever engaged – **do not try to force these modules home** – if they appear difficult to insert fully, check the connectors at the rear of the module.

2.1 : PHYSICAL DIMENSIONS AND FITTING

2.1.1 Installation Items

Various installation items are required. A list of these (including spare fuses) is given below. Actual requirements depend on the configuration of the equipment supplied (e.g. with or without Exciter/Drive(s), separate to or already fitted into a 19 inch rack, whether or not leads are supplied ready made etc.). Note that extra, unlisted parts may be required for connections to any Exciter/Drive(s) that are supplied (see manuals supplied with them).

Typical Quantity	Description	Function
2	6 Way, 16A/440V, free sockets with top entry hoods (e.g. 'Contact Connectors' H-BE part numbers 10-1910 for insert and 10.0110+12.9543 for hood)	For connection to leads from mains supply distribution point. (Note only one required on S76005-01)
2 Length as req'd	3 core, 2.5mm^2 per core, type SY, flexible steel armoured cable.	Mains supply leads. (Note only one required on S76005-01)
2	16A 'C' rated 2 pole miniature circuit breakers (MCBs).	Fitted at mains supply distribution point to protect supply leads and mains input components in the Transmitter. (Note only one required on S76005-01)
1	7-16 RF coaxial free plug.	For connection to lead from Antenna or RF output load.
Length as req'd	Low loss 50Ω RF coaxial cable, rated in excess of Transmitter output power at maximum ambient temperature.	RF output lead.
1 - 3	TNC 50Ω RF coaxial free plug(s).	For connection to leads from Exciter/Drive(s) and their dummy load.

Typical Quantity	Description	Function
Length as req'd	Low loss 50Ω RF coaxial cable, rated in excess of Exciter/Drive output power at maximum ambient temperature.	RF input and dummy load leads.
1	Coaxial, 87.5 – 108MHz, 50Ω load with suitable free connector, rated in excess of Exciter/Drive output power at maximum ambient temperature.	Exciter/Drives' dummy load.
1	2 Way, 10A, 5.08mm pitch screw terminal block (c/w wire shorting link). (e.g. Weidmuller BL5.08/2)	External safety interlock connector (wire shorting link is removed when connector is wired to external safety circuits).
1 - 2	9 Way D plugs c/w covers.	For connection to leads from control/monitor inputs of Exciter/Drive(s).
1 - 2	9 Way D sockets c/w covers.	For connection to parallel and serial RS232 remote control/monitor links.
1	15 Way D plug c/w cover.	For connection to additional control/monitor input links.
Length as req'd	Multi-core screened cable (number of cores as required).	Control/monitor leads.
Length as req'd	Heavy gauge grounding wire/strap.	For safety earth lead.
1-2	IEC 6A free plug to free socket mains leads (1 metre, 3 core each 0.75mm^2, EPR insulated, HOFR sheathed for high temperatures).	For fused and switched mains supply connections to Exciter/Drive(s).
8	Screws c/w plastic cup washers and rack caged nuts.	For fixing S76005, S7601 or S7602 into 19 inch rack.
2	Side support 'L' brackets c/w fixing screws and washers.	For extra support to carry the Transmitter's weight in the rack.
3-9	500mA (F) Fuses (for smd holders, 'Littelfuse' R451.500)	For protection of control circuits within E2021 Amplifiers and E2025 Combiner Unit.
2-8	16A (T) HBC 5x32mm (¼ x1¼ in) Fuses	For protection of internal dc supply leads to and high current circuitry within E2021 Amplifiers.
4	6.3A (T) HBC 5x20mm Fuses	For protection of internal low current dc supply leads and of mains supply leads and circuitry intended for connection to Exciter/Drives(s).

2.1.2 Rack Mounting

If the Transmitter is not supplied ready mounted in a 19 inch rack, this will be required to be done at time of installation.

! CAUTION !

The S76005, S7601 and S7602 (i.e. the assembly carrying the Amplifiers, Power Supplies, Controller, Splitter/Drive Changeover and Combiner) are **heavy**. Before installation in a rack, the Amplifier Modules and Power Supplies should be removed to reduce the overall weight and ease the process. These units are removed from the front of the Transmitter, taking care to release the mechanical securing locks first. The Fan Assembly may also be opened, unplugged and then removed from the rear of the Transmitter.

The 19 inch rack should be of standard 600mm depth and at least 12U height (for the S76005 or S7601) or 14U (for the S7602). Additional height will be required if Exciter/Drive(s) are to be fitted into the same rack (recommended). These should be fitted below the actual Transmitter section for ease of inter-wiring. Additional bottom support 'L' brackets are also be required at each side, below the Transmitter, to help carry its weight. The Transmitter is then fixed to the front of the racking using eight screws, plastic cup washers and caged nuts. The Amplifier modules, Power Supplies and Fan Assembly can then be refitted and external connections made.

2.2 EXTERNAL CONECTIONS

2.2.1 Mains Supply Connectors

These are two independent 6 Way plugs at the rear of the Supply Disconnector section, CON02 and CON03. Having two enables use of independent 'A/B' power sources with the same or different phases. Each supply must be single phase, 176V to 264V AC, 47 - 63Hz.

The maximum current drawn from each supply (at 230V AC) is in the order of 2A (for the S76005-02), 4A (for the S76005-01 or S7601) or 8A (for the S7602).

! CAUTION !

The S76005, S7601 and S7602 MUST NOT be operated at voltages significantly below 176V, as the supply current may exceed the rating of the two 2x16A mains supply connectors and associated wiring and components. Fitting of the specified MCB (see next paragraph) will ensure this cannot occur

! CAUTION !

The mains supply leads (two total except for the 500W single input S76005-01, where only one is used) to the Transmitter must each consist of three core (P+N+protective earth) insulated cable. **Each core must be at least 2.5mm^2** and the overall cable armoured (type SY flexible steel armoured cable preferred) **and not mounted in a conduit with other supply cables**. **Two double pole, 16A (C rated) MCBs must be provided at the supply distribution board(s) to protect both leads and Transmitter supply input circuitry.** Also, since the supply input circuitry contains filters, which pass current to the Transmitter chassis, **the Transmitter chassis must be connected to a safety ground**.

Also ensure whilst making any connections to the mains supply, that the Transmitter's front panel Supply Disconnector is switched to 'off' (i.e. at O) and is preferably padlocked in that position to prevent inadvertent operation of the Transmitter.

Each lead terminates in a separate 6 Way 16A/440V free socket at the Transmitter end, which are wired as follows :-

Pin 1	Line
Pin 2	Neutral
Pin 3	Prot. Earth
Earthing Pin	Prot. Earth

The two leads must go via separate MCBs.

The armouring of the cable should also be taken to ground at the supply distribution board.

The free connectors should be fitted with top entry hoods.

An earthing bolt is provided adjacent to the mains supply input connector to allow the Transmitter chassis to be permanently bonded to nearby safety ground directly or via rack metalwork.

2.2.2 RF Output Antenna Connector

! CAUTION !

When operating, high RF Voltages are present on this connector. Always ensure when making connections here, or working on any load connected, that the Transmitter's front panel Supply Disconnector is switched to 'off' (i.e. at O) and is preferably padlocked in that position.

This is a 50Ω 7-16 coaxial socket on the E2025 Combiner Unit's output directional coupler (at the top rear of the Transmitter). Care must be taken to use adequately rated (at maximum ambient temperature) low loss cable for the lead to the antenna or load

2.2.3 RF Input Exciter/Drive(s) Connectors

! CAUTION !

When operating, high RF Voltages may be present on these connectors. Always ensure when making connections here, or working on any load connected, that the drive source(s) to the Transmitter are switched off or safely muted.

These are three 50Ω TNC coaxial sockets at the centre rear of the E2024 Splitter/Drive Changeover Unit. Socket SK08 (Drive A) is for connection a single Exciter/Drive's RF Output. When dual drive changeover is supplied, socket SK06 (Drive B) is used for connection to the second Exciter/Drive's RF Output. In this case, socket SK07 (Load) is used for connection a 50Ω Exciter/Drive dummy load, normally situated in the section of the rack where the Exciter/Drives are fitted.

2.2.4 Safety Interlock Connector

This is a removable, 2 Way, 5.08mm screw terminal block PL13 at the rear of the E2024 Splitter/Drive Changeover Unit. A shorting link has to be made between the terminals to de-mute the Transmitter (the front panel INTERLOCK EXT. MUTE display goes from red to green when the terminals are linked). If there are no external safety interlock switches, a short direct link is made, this being the state in which the connector is normally supplied. If connections need to be made to external safety switches, this link is removed and the switches are wired in a series loop to the connector so that if any switch opens, the link is broken.

! CAUTION !

For the safety interlocks to work correctly, the external switches and link wiring must 'float' (i.e. must not be grounded at any point). The total loop resistance should not exceed approximately 100Ω. The external wiring may also be ferrite loaded for emc requirements. **No external voltages should be applied to this connector.**

2.2.5 RF Output Monitor Connector

This is a 50Ω BNC coaxial socket SK01 on the left-hand side of the E2025 Combiner Unit front panel. This provides an harmonically filtered sample of the Transmitter's forward output power at a level, into 50Ω, approximately 64dB below the power being delivered into the load (e.g. approximately 0.4mW for 1kW being delivered). This connector is for test purpose only with the test equipment and lead being disconnected when not in use. **NOTE that the levels of any harmonics present are not necessarily equal to those at the antenna.**

2.2.6 Drive A/B Monitor and Control Connectors

These are two identical 9 Way D sockets SK03 and SK06 at the rear of the E2023 Controller unit. These are used to enable one or two Exciter/Drive(s) to be monitored and controlled by the E2023 (with two Exciter/Drives this enables automatic dual Exciter/Drive changeover). Multi-core screened cable, not exceeding 3 metres in length, should be used for the interconnecting leads.

Each lead terminates in a separate 9 Way free D plug at the E2023 end which is wired as follows :-

Pin 1	RS232 Data from Drive (not enabled)
Pin 2	Ground
Pin 3	Prefer Drive from Rem. Control Momentary low > approx. 1sec
Pin 4	Slow Status Monitor from Drive Continuous low >2secs registers 'good' Continuous high >10secs registers 'fail'
Pin 5	Fast Status Monitor from Drive Continuous low >2secs registers 'good' Continuous high >2secs registers 'fail'
Pin 6	RS232 Data to Drive (not enabled)
Pin 7	Ground
Pin 8	Ground
Pin 9	Mute/demute to Drive Continuous low to mute

Each input (pins 3, 4, 5) is internally 'pulled up' to +5V through 12kΩ and must be fed from a voltage free source of less than 1kΩ to ground for a low state (open-circuit for a high state). These inputs are protected against constant application of up to ±12V dc directly applied.

The mute/demute output (pin 9) is an 'open collector' NPN, silicon low saturation switching transistor suitable for driving loads from +5V to +24V dc with maximum currents of 10mA. The low state output impedance is approximately 10Ω.

These connections are wired in accordance with the monitor and control requirements of the type of Exciter/Drive(s) supplied and normally, not all the pins will need to be connected. Pin 3, if used, is for connection to a remote control and monitoring system. This enables selection of a particular drive to be preferred (forced) remotely by momentarily pulling this line to ground.

If automatic dual Exciter/Drive changeover only requires one of the two status monitor inputs for operation, the other must be connected to ground.

2.2.7 Parallel (standard) or RS232 Serial Remote Control DTE Connector

This is a 9 Way D plug PL04 at the rear of the E2023 Controller unit. It is used to enable various forms of remote control and monitoring, possibly requiring additional external units. Multi-core screened cable, not exceeding 3 metres in length, should be used for the interconnecting lead.

The lead terminates in a 9 Way free D socket at the E2023 end which is wired as follows :-

	Parallel (standard)	Serial RS232
Pin 1	Power Output Low (app.–2dB rel. set output)	Not connected
Pin 2	Power Output Fail (app. –12dB rel. max o/p)	Received Data (to E2023)
Pin 3	Reverse Power High (app. 13, 25 or 50W)	Transmit Data (from E2023)
Pin 4	Combiner Temp. High (app. +100deg.C)	Not Connected
Pin 5	Ground	Ground
Pin 6	Fan/Cooling System Fail	Not Connected
Pin 7	System Normal	Not Connected
Pin 8	Drive A/B Selected	Not Connected
Pin 9	Drive Changeover on Auto	Not Connected

The parallel outputs are 'open collector' NPN, silicon low saturation switching transistors suitable for driving loads from +5V to +24V dc with maximum currents of 10mA. The low state output impedance is approximately 100Ω. Each output is protected against constant application of up to ±5V dc directly applied. A normal (non-faulty) condition is indicated by the output pin being pulled to ground (i.e. low state) by the switching transistor. Drive A selected and Drive C/O on Auto are similarly indicated. Note that the serial option requires an additional internal link lead, which re-directs the serial remote control from the front panel COM port to the rear panel DTE connector (pins 2, 3, 5 only).

2.2.8 Second Transmitter Remote Control Connector

This is a 15 Way D socket SK05 at the rear of the E2023 Control Unit. It is used to enable externally derived automatic control of Transmitter muting and high/low power level setting. Multi-core screened cable, not exceeding 3 metres in length, should be used for the interconnecting lead.

The lead terminates in a 15 Way free D plug at the E2023 end which is wired as follows :-

Pin 1	Select Low Power Input (continuous low to select)
Pin 2	Mute Transmitter Input (continuous low to mute)
Pin 3	Output Status A (continuous low state – not used)
Pin 4	Output Status B (continuous low state – not used)
Pin 5	RS485 Data (+) In (not used)
Pin 6	RS485 Data (-) In (not used)
Pin 7	RS485 Data (+) Out (not used)
Pin 8	RS485 Data (-) Out (not used)
Pin 9	Not Connected
Pin 10	Ground
Pin 11	Ground
Pin 12	Ground
Pin 13	Ground
Pin 14	Not Connected
Pin 15	Not Connected

Each input (pins 1, 2) is internally 'pulled up' to +5V through 12kΩ and must be fed from a voltage free source of less than 1kΩ to ground for a low state (open-circuit for a high state). These inputs are protected against constant application of up to ±12V dc directly applied. Note that they are only active when the associated E2024 Auto-Mute-Start switch is in the Auto position and have delays in the order of 200mS. **Thus, they should not be used as part of a safety interlock system** (see 2.2.4).

Each output (pins 3, 4) is a relay contact to ground for a low state (open-circuit for a high state). The contacts are rated at 1mA (minimum at 5V dc) to 1A maximum switching current. The maximum voltage (including switching surges) must be limited to ±24V dc. These outputs (and pins 5-8 inc.) are not used and thus should not be externally connected.

2.2.9 Mains Supply Output Connectors

These are two standard IEC three pin (L+N+PE) sockets CON01 and CON04 either side of the mains supply input connectors. Each one is only connected, via the front panel SUPPLY DISCONNECTOR switch to the mains supply input which is adjacent to it Thus equipment connected to these supplies can be arranged in two independent groups, both groups being switched off when the Transmitter itself is switched off using the front panel switch.

The continuous total load on output each should not exceed approximately three amps. Each output is protected by a 6.3A (T) HBC fuse, FS11 and FS12, to allow for current surges at 'switch-on'

2.2.10 RS232 Serial Control and Monitor (COM) Connector

This is a 9 Way D plug PL01 on the right hand side of the E2023 Control Unit front panel. It is used to enable down loading of status and to enable simple control using a personal computer (PC) directly connected to this front panel COM port. Multi-core screened cable, not exceeding 30 metres in length, should be used for the interconnecting lead. The lead terminates in a 9 Way free D socket at the E2023 end which is wired as follows :-

Pin 1	Not connected
Pin 2	Received Data (to E2023)
Pin 3	Transmit Data (from E2023)
Pin 4	Not Connected
Pin 5	Ground
Pin 6	Not Connected
Pin 7	Not Connected
Pin 8	Not Connected
Pin 9	Not Connected

Note that the assigned pin numbers and their functions are for a standard 9 pin plug on 'Data Terminal Equipment' (DTE) such as computers. Standard crossover or 'null modem' leads may thus be used for connection to a personal computer or PC. The length of the interconnecting lead may be extended by use of compatible RS422/485 or fibre-optic line drivers.

Note that the internal connections to this connector may be re-directed to the rear panel DTE connector PL04 by the use of an optional internal link lead (see section 2.2.7).

Full details of serial remote control procedures via this connector are given in Section 2.4.

2.2.11 TCP/IP Control and Monitor Connector (/T option only)

This is a standard RJ45 connector SK08 mounted in an additional screened box fitted to the rear of the E2023-02 or E2023-04 Control Unit. This enables all the control and monitoring detailed in Section 2.4 to be performed using TCP/IP (Transmission Control/Internet Protocol)

This arrangement requires the unit to be assigned a unique Internet Protocol address. When first connected to the network via its RJ-45 connector, the E2023's TCP/IP adapter will attempt to acquire an IP address automatically (it's quite common to have networks configured to use 'DHCP', which provides these addresses on demand). The address to which a device has been assigned can then be determined and, if required, be overridden with a desired fixed value, using Eddystone supplied software.

Note that internal linking leads determine if control and monitoring is via this connector or the front panel RS232 COM port connector (both cannot be used together).

2.2.12 FWD/REV Output (Analogue Monitor) Connectors

These are two 50Ω SMC coaxial sockets PL13/14 at the left rear of the E2025 Combiner Unit. They provide DC analogue output voltages corresponding to the Transmitter output forward and reverse powers. Coaxial screened cable, not exceeding 3 metres in length, should be used for the interconnecting leads.

PL13 provides the forward power indication at a level of approximately 1.5V at 250W, 2V at 500W, 2.8V at 1kW and 4V at 2kW (limited by maximum transmitter output power).

PL14 provides the reverse power indication at a level of approximately 1.4V at maximum rated output power with a 15dB return loss load.

Both outputs are from impedances of approximately 5kΩ.

2.3 SETTING UP PROCEDURES

2.3.1 Fuses

If any problems occur after the Transmitter has been installed and switched on, fuses may need to be checked and possibly replaced. However, a blown or open-circuit resettable fuse would generally indicate the presence of a fault, which would need correcting.

The type, function and access to fuses is as follows :

Type	Function	Access
500mA (F) Fuses (for smd holders, 'Littelfuse' R451.500) One per E2021.	For protection of control circuits within E2021 Amplifier modules. If fuse blows, all front panel displays on just the affected E2021 go out and its power level falls.	Remove Amplifier module from front, taking care to release the mechanical securing locks first. Smd fuseholder is at rear of unit under the screen cover.
500mA (F) Fuse (for smd holders, 'Littelfuse' R451.500) One only.	For protection of control circuits within E2025 Combiner Unit If fuse blows, all front panel displays on just the E2025 go out and the overall output power level falls to zero. Note, if a spare fuse is not available, one may be transferred from one of the E2021 modules to enable operation at lower power.	Slide Combiner Unit forwards after removing front and single rear fixing screws, taking care not to strain any leads connected to its rear. Remove front screen cover section. Smd fuseholder is accessible underneath the screen cover on the front printed circuit board, right hand side. **! CAUTION ! Ensure that the front panel Supply Disconnector is switched to 'off' (i.e. at O) and is preferably padlocked in that position.**
16A (T) HBC 5x32mm (¼ x1¼ in) Fuses One per E2021.	For protection of internal dc supply leads to and high current circuitry within E2021 Amplifier modules. If fuse blows, all front panel displays on just the affected E2021 go out and its power level falls to zero.	At the bottom rear of the Transmitter, the larger fuse-holders grouped in ones, twos or fours on the left/right hand sides. Note FS number and position mirrors amplifier number and position. **! CAUTION ! these are high energy circuits and thus care must be taken if replacing the fuse with power on.**
6.3A (T) HBC 5x20mm Fuses Two only.	For protection of internal low current dc supply leads. Internal low current supplies are dual redundant, thus the loss of one fuse produces no failure (only E2023 display warning). If both blow, E2023, E2024 and E2025 front panel displays all go out and the overall output power level falls.	At the bottom rear of the Transmitter, the single smaller fuseholders on the left and right hand sides, FS9/10. **! CAUTION ! these are high energy circuits and thus care must be taken if replacing the fuse with power on.**
6.3A (T) HBC 5x20mm Fuses Two only	For protection of mains supply leads and circuitry intended for connection to Exciter/Drive(s).	At the bottom rear of the Transmitter, the single smaller fuseholders adjacent to the associated mains output sockets. FS11/12 **! CAUTION ! these are high energy circuits and thus care must be taken if replacing the fuse with power on.**

0.75A Hold RXE 60V Resettable Fuses Two	For protection of the dual fan cooling unit. If the fuse goes high impedance, the fan, which it supplies, will not operate and the FANS display on the front of the E2025 Combiner Unit will go from green to red.	On Fan Connector board inside top rear of Transmitter. Note this fuse will automatically reset if the front panel Disconnector switch is temporarily set to 'off' (i.e. to 'O') or if the Fan Unit is temporarily disconnected from the Fan Connector board.
3A Hold RUE 30V Resettable Fuse One only.	For internal protection of E2023 Controller unit. If the fuse goes high impedance, the E2023 front panel displays will all go out and any automatic control will cease.	Inside E2023, on rear Interface Board. Note this fuse will automatically reset if the front panel Disconnector switch is temporarily set to 'off' (i.e. to 'O') or if the E2023 is temporarily disconnected from the Control Bus Boards at <u>both</u> sides of the rear of the Transmitter.

<u>2.3.2 Output Power Level and Frequency Adjustment</u>

If the Transmitter is not supplied with preset output power levels and frequency, its front panel HIGH POWER and LOW POWER controls and the Exciter/Drive(s)' power output and frequency will need to be set. The manuals for the type of Exciter/Drive(s) supplied or in use must be consulted for information on how the settings required of them are actually made.

The procedure is as follows :

1) Ensure the Transmitter has been installed as detailed in sections 2.1 and 2.2. and that the E2024 Splitter/Drive Changeover front panel switches are set to MUTE and either SELECT A or SELECT B (i.e. not AUTO).

2) Disconnect all E2021 Amplifier modules by releasing their front mechanical locks and pulling them slightly forward.

3) Apply power to the Transmitter (i.e. ensure supply distribution 16A MCBs are on and the front panel Disconnector switch is at 'on' (i.e. at 'I').

4) Ensure all displays are on red, green or amber (except disconnected E2021s) else follow fuse checking procedure as detailed in section 2.3.1 (fault finding may be required if this occurs). Check Exciter/Drive(s) are operating.

5) Check the E2024 INTERLOCK/EXT MUTE display is green (if red ensure the safety interlock link at the rear of this unit is made).

6) Set the Exciter/Drive(s) power output to minimum, which must be less than 13W (S76005) 25W (S7601) or 50W (S7602) and frequency to that required.

7) Reconnect all E2021 Amplifier modules ensuring their mechanical locks are remade and ensuring all their displays come on at red, green or amber – if not, again check fuses.

8) Set the E2024 Splitter/Drive Changeover front panel switches to START and SELECT A or SELECT B to connect an Exciter/Drive to the Transmitter itself.

9) Set the E2025 Combiner Unit's front panel HIGH POWER and LOW POWER <u>twenty</u> turn controls to fully clockwise (i.e. <u>maximum</u> power setting). Ensure that the HIGH POWER control display is on. If the LOW POWER display is on, check that the link LK1 FORCE LOW POWER on the Fan Connector Board is removed (this board is inside the Transmitter at the top rear).

10) Slowly increase the selected Exciter/Drive(s) output power until 500W (on S76005) 1kW (on S7601) or 2kW (on S7602) is just obtained. To ensure complete accuracy, an external calibrated power meter should be used to measure this output power. Increase the input level by a further 1dB (approximately 20%). In no case however must the input power exceed 13W (on the S76005) 25W (on the S7601) or 50W (on the S7602). The output power should rise above 500W, 1kW or 2kW.

11) If a second Exciter/Drive is fitted, repeat step (10) with the E2024 front panel switch set at SELECT A or SELECT B to connect it to the Transmitter itself.

12) With the Exciter/Drive power set as described, turn the HIGH POWER control anti-clockwise until the measured output power falls back to 500W, 1kW or 2kW (or less if required). Check the same power is obtained by selecting the other Exciter/Drive if fitted (using the E2024 front panel switch).

13) Link LK1 FORCE LO POWER on the Combiner/Fan Connector Board The LOW POWER display on the E2025 should come on in place of the HIGH POWER display.

14) With the Exciter/Drive power still set as described, turn the LOW POWER control anti-clockwise until the output power falls back to the level required, typically down to approximately half of the Transmitter's maximum rated output. Check the same lower power is obtained by selecting the other Exciter/Drive if fitted (again using the E2024 front panel switch).

15) Unless required to stay in low power operation, remove enable LK1 FORCE LO POWER.

16) Check that the output power displayed on the E2023 Control Unit also reads the set output power. This reading will not be as accurate as the external calibrated power meter but should be within about ±0.25dB (approx. 25W at 500W, 50W at 1kW or 100W at 2kW).

17) If the reading is not within this range it may be adjusted by a preset control inside the E2025 Combiner Unit. To access this control, slide the E2025 forwards after removing its front fixing screws and single rear fixing screw, taking care not to strain any leads connected to its rear. Remove front screen cover section The preset control (marked 'CAL FWD') is at the rear left hand side of the printed circuit board. Care must be taken that none of the other four preset controls on the board are altered. Adjust the control clockwise to increase reading or anti-clockwise to decrease reading.

The Transmitter will now be ready for operation with audio and or data sources applied to the Exciter/Drive(s). The manuals for the type of Exciter/Drive(s) supplied or in use must be again consulted for information on how such sources are applied and controlled.

The RF Monitor connector at the left-hand front of the E2025 Combiner Unit may be used to check the close-in spectrum of the Transmitter output signal. Note that any harmonic levels shown will not necessarily indicate those present at the Transmitter output. Any test equipment should not however normally be left connected.

2.3.3 Reverse Power Trip Level Adjustment

If the REV led on the E2025 Combiner Unit is intermittently or permanently red, this indicates that the level of reverse power is greater than about 13W (on S76005), 25W (on S7601) or 50W (on S7602). This shows that the antenna system connected to the Transmitter is relatively poor. If the Transmitter's reverse power trip point is set too low, this may cause a reduction in the available output power. As long as the E2021 Amplifier's REV leds are not also red, the trip point setting can be increased to help maintain full output power (although the REV warning may still be displayed).

The reverse power trip point may be adjusted by a preset control inside the E2025 Combiner Unit. To access this control, slide the E2025 forwards after removing its front fixing screws and single rear fixing screw, taking care not to strain any leads connected to its rear. Remove front screen cover section.

The preset control (marked ‘REV TRIP’) is at the rear left hand side of the printed circuit board. Care must be taken that none of the other four preset controls on the board are altered. Adjust the control anti-clockwise until the output power reaches a maximum.

Note that if this preset control is ever advanced too far clockwise, this may cause a decrease in output power with less than 13, 25 or 50W reverse power, i.e. with a relatively good antenna system and with the E2025 REV led still green.

2.3.4 Serial Remote Control Baud Rate Setting

The operating Baud rate and be viewed and changed if required, by pressing [MODE] on the E2023 Transmitter Control Unit continuously for about 3 seconds. The screen will then change to show the present rate and the four 'soft' keys below can be used to select 2400, 4800, 9600 or 19200 Baud. The screen will time out in about 3 seconds after entry or after the last press of one of the four soft keys. Timeout is 'counted' down on the display. The Baud rate is held in non-volatile RAM and is error checked at power-on-reset, defaulting to 9600 if any Baud rate store error found.

2.4 SERIAL REMOTE CONTROL AND MONITORING

2.4.1 Introduction

Serial control via the front panel COM PORT connector (section 2.2.10) uses asynchronous data (1 start, 8 data, 1 stop bit, no parity) at 2400, 4800, 9600 or 19200 Baud. Control commands and status monitor requests are detailed in section 2.4.2. The content of status monitor information reverted from the E2023 is detailed in section 2.4.3. The /T option also enables the same functions using TCP/IP via a rear panel RJ45 connector (section 2.2.11). Selection of front panel COM port or rear panel RJ45 is made using internal link leads. The rear panel DTE port, PL04, may also be used as the COM port in place of that on the front panel (see section 2.2.7) again by using internal links.

The individual data bytes are defined in ASCII form, to enable basic control and monitoring using a PC running a terminal program. However, a PC program with a dedicated textual and/or graphical user interface is required for proper implementation of a remote control and monitoring system. Eddystone Broadcast should be contacted for further information regarding such programs and hardware implementations using the RS232 port directly or via USB or TCP/IP adaptors.

2.4.2 Control Commands and Status Monitor Requests

All command and status monitor requests are initiated by the remote control unit (PC) – the E2023 never outputs any serial data via the COM PORT connector unless requested to by that unit.

The remote control unit always sends a sequence of three bytes, waiting for each byte to be 'echoed' correctly before the next one is sent (which must be within 500mS of the previous one). A wait of 500mS is also recommended before the sequence is timed out and aborted. A new sequence of three bytes then can be attempted. Note that an echo will not be returned when an invalid sequence is detected by the E2023.

The three bytes are :-

First byte	'Handshake' (always ASCII #) – indicates start of sequence
Second byte	'Command' – indicates form of control or status monitoring
Third byte	'Status Requests' (after ASCII ? Command) - gives details of status monitoring required or 'Controls' (after ASCII % & , + Commands) - gives details of control required

Details of the Handshake, Command, Status Request and Control bytes are given in the following four tables. Typical examples of controller generated sequences are as follows :-

? 1 Request to revert the status of Amplifier #1
% A Sets auto drive to A
& P Sets drive mode to passive

Handshake (first byte sent from controller)			
Title	Function	Hex	ASCII
Async_Hshake	Remote input handshake	23	#

Remote Input Commands (second byte sent from controller)			
Title	Function	Hex	ASCII
Query_Status	Status query (request to revert)	3F	?
Drive_Prefer	Drive A or B	25	%
Drive_State	Drive state Active or Passive	26	&
Tx_Power	Tx power High or Low	2C	,
Tx_State	Tx state Mute or Start	2B	+

Remote Input Status Requests (third byte sent from controller after **?** command)			
Title	Function	Hex	ASCII
Op_Stat	Revert output status	30	0
Amp1_Stat	Revert amplifier 1 status	31	1
Amp2_Stat	Revert amplifier 2 status	32	2
Amp3_Stat	Revert amplifier 3 status	33	3
Amp4_Stat	Revert amplifier 4 status	34	4
Amp5_Stat	Revert amplifier 5 status	35	5
Amp6_Stat	Revert amplifier 6 status	36	6
Amp7_Stat	Revert amplifier 7 status	37	7
Amp8_Stat	Revert amplifier 8 status	38	8
Amp9_Stat	Revert amplifier 9 status	39	9
Amp10_Stat	Revert amplifier 10 status	3A	:
Amp11_Stat	Revert amplifier 11 status	3B	;
Amp12_Stat	Revert amplifier 12 status	3C	<
Amp13_Stat	Revert amplifier 13 status	3D	=
Amp14_Stat	Revert amplifier 14 status	3E	>
Amp15_Stat	Revert amplifier 15 status	3F	?
Amp16_Stat	Revert amplifier 16 status	40	@
Amp17_Stat	Revert amplifier 17 status	41	A
Amp18_Stat	Revert amplifier 18 status	42	C
Amp19_Stat	Revert amplifier 19 status	43	B
Amp20_Stat	Revert amplifier 20 status	44	D
Amp21_Stat	Revert amplifier 21 status	45	E
Amp22_Stat	Revert amplifier 22 status	46	F
Amp23_Stat	Revert amplifier 23 status	47	G
Amp24_Stat	Revert amplifier 24 status	48	H
Amp25_Stat	Revert amplifier 25 status	49	I
Amp26_Stat	Revert amplifier 26 status	4A	J
Amp27_Stat	Revert amplifier 27 status	4B	K
Amp28_Stat	Revert amplifier 28 status	4C	L
Amp29_Stat	Revert amplifier 29 status	4D	M
Amp30_Stat	Revert amplifier 30 status	4E	N
Amp31_Stat	Revert amplifier 31 status	4F	O
Amp32_Stat	Revert amplifier 32 status	50	P
Amp33_Stat	Revert amplifier 33 status	51	Q
Amp34_Stat	Revert amplifier 34 status	52	R
Amp35_Stat	Revert amplifier 35 status	53	S
Amp36_Stat	Revert amplifier 36 status	54	T
Amp37_Stat	Revert amplifier 37 status	55	U
Amp38_Stat	Revert amplifier 38 status	56	V
Amp39_Stat	Revert amplifier 39 status	57	W
Amp40_Stat	Revert amplifier 40 status	58	X
Sys_Stat	Revert system status	59	Y
Dri_Stat	Revert drive status	5A	Z

Remote Input Controls (third byte sent from controller after **% & , +** commands)			
Title	Function	Hex	ASCII
A_Drive	Set auto drive to A	41	A
B_Drive	Set auto drive to B	42	B
Passive	Set drive mode to passive	50	P
Active	Set drive mode to active/unmuted	55	U
Pwr_Hi	Set Tx power to high	48	H
Pwr_Lo	Set Tx power to low	4C	L
Mute	Set Tx to mute	4D	M
Unmute	Set Tx to start/unmute	53	S

2.4.3 Reverted Status Monitor Information

The status of the Transmitter is reverted in response to a ? command (see section 2.4.2). After the third byte is echoed back to the remote control unit, a further fifteen bytes are sent immediately from the E2023, with no delays between individual bytes (each 1 start, 8 data, 1stop, no parity). **NOTE that the E2023 must be left set on 'MAIN' mode for all the amplifier module status to be kept updated (section 3.3).**

The first fourteen of the fifteen bytes contains the specific status information requested. The last byte is an exclusive OR checksum of those fourteen bytes. This checksum can be used by the remote control unit to check that the information has not become corrupted.

The meanings of the various bytes in the information string are defined in the table below.

Reverted Status Information (meanings of bytes reverted in response to **?** command)			
Title	Meaning	Hex	ASCII
Norm	Status normal	4E	N
N_Norm	Status not normal	4F	O
Stat_Low	Status low	4C	L
Stat_High	Status high	48	H
Fail	Status fail	46	F
Fuse	Status fuse?	45	E
Auto	Tx/Drive on auto	54	T
Man	Tx/Drive on manual	59	Y
Drive_A	Drive preferred or on A	41	A
Drive_B	Drive preferred or on B	42	B
Drive_Pas	Drive passive	50	P
Drive_Act	Drive active/unmuted	55	U
Tx_Muted	Tx Muted	4D	M
Tx_Start	Tx Unmuted	53	S
N_Known	Not known	58	X
N_Applic	Not applicable	5A	Z
Direct Display	Numerical values	30-39	0-9
Direct Display	Sign	2B 2D	+ -
Direct Display	Decimal point	2E	.
Direct Display	Blank	00	NUL
Direct Display	Less than	3C	<

Most meanings are general. A string of fourteen information bytes would normally contain several 'N's, each one indicating that a particular status (forward power, reverse power etc.) is 'Normal'. Some are specific, 'A' and 'B' for example, only refer to Drives A and B.

Direct display bytes give an immediate numerical display of power, current and temperature etc., even when using a basic terminal program.

If the E2023 contains no known good information about a particular status, the 'X' byte is reverted. This occurs if the E2023 is unable to interrogate individual modules within the Transmitter and thus cannot determine their status. However, it should be noted that certain Transmitters do not have every amplifier or power supply module fitted - status of such modules is thus returned either as 'X's (amplifiers) or as 'F' (power supplies). The 'Revert Output Status Request' (ASCII 0) returns the Transmitter type and can be used by the Remote Control Unit to determine whether a particular module should, in fact, be missing and its status not known.

Note that the information returned may have a latentcy of one to two seconds, since the E2023 can take that amount of time to collect the status of all the individual amplifier modules.

The following four tables detail the contents of the various strings of reverted status information. The final column in each defines which ASCII values a particular byte can have. The table above defines the meanings of these values. The first byte in each table is the echo of the third byte sent from the remote control unit.

Reverted System Data Block (15 extra bytes reverted in response to **# ? Y** sequence)		
Title	Status	Possible Values (ASCII)
Tx_Data1	Tx data status request byte	third byte echo fixed at Y
Tx_Data2	Tx system normal status	N O
Tx_Data3	Tx forward power status	N L F X
Tx_Data4	Tx reverse power status	N H X
Tx_Data5	Tx combiner temp status	N H X
Tx_Data6	Tx fans/cooling status	N F X
Tx_Data7	Tx A 50V line status	N E F
Tx_Data8	Tx B 50V line status	N E F
Tx_Data9	Tx C 50V line status	N F
Tx_Data10	Tx D 50V line status	N F
Tx_Data11	Tx power auto/man status	T Y
Tx_Data12	Tx power (man) start/mute status	M S Z
Tx_Data13	Tx power (true) high/lo setting status	H L X
Tx_Data14	Tx power (auto) start/mute status	M S
Tx_Data15	Tx power (auto) high/lo setting status	H L
Tx_Data16	Tx status 8 bit EOR checksum (of 2-15 inc. only	

Reverted Drive Data Block (15 extra bytes reverted in response to **# ? Z** sequence)		
Title	Status	Possible Values (ASCII)
Dri_Data1	Drive data status request byte	third byte echo fixed at Z
Dri_Data2	Drive C/O auto/man status	T Y
Dri_Data3	Drive on A/B status	A B
Dri_Data4	Drive preferred A/B status	A B
Dri_Data5	Drive active/passive status	P U
Dri_Data6	Drive A slow status	N F
Dri_Data7	Drive A fast status	N F
Dri_Data8	Drive B slow status	N F
Dri_Data9	Drive B fast status	N F
Dri_Data10	Drive A pass/fail	N F
Dri_Data11	Drive B pass/fail	N F
Dri_Data12	Drive C/O count	0 1 2 3 4
Dri_Data13	Tx external mute status	M S
Dri_Data14	Tx external high/low status	H L
Dri_Data15	Tx external interlock status	M S
Dri_Data16	Drive status 8 bit EOR checksum (of 2-15 inc. only	

Reverted Output Data Block (15 extra bytes reverted in response to **# ? 0** sequence)		
Title	Status	Possible Values (ASCII)
Op_Data1	Output data status request byte	third byte echo fixed at ASCII 0
Op_Data2	Output Forward Power Level MSB (kW)	X or + (plus) - (minus) . (decimal point) Null (blank) 0 to 9 (inc)
Op_Data3	Output Forward Power Level MSB-1 (kW)	
Op_Data4	Output Forward Power Level LSB+1 (kW)	
Op_Data5	Output Forward Power Level LSB (kW)	
Op_Data6	Output Reverse Power Level MSB (W)	
Op_Data7	Output Reverse Power Level MSB-1 (W)	
Op_Data8	Output Reverse Power Level LSB (W)	
Op_Data9	Output Temperature Level MSB (deg.C)	
Op_Data10	Output Temperature Level MSB-1 (deg.C)	
Op_Data11	Output Temperature Level LSB (deg.C)	
Op_Data12	Output OS number MSB	
Op_Data13	Output OS number MSB-1	
Op_Data14	Output OS number LSB	
Op_Data15	Output Tx Type	0 (500W) 1-6 (1kW-6kW) 7 (5kW S7605C) 8-9 (8kW-9kW) : (10kW)
Op_Data16	Output data 8 bit EOR checksum (of 2-15 inc. only)	

Reverted Amplifier Data Block (15 extra bytes reverted in response to **# ? 1** to **# ? X** sequences)		
Title	Function	Possible Values (ASCII)
Amp_Data1	Amp number 1-40	third byte echo of ASCII 1-9 : ; < = >? @ A-X
Amp_Data2	Amp Forward Power Level MSB (W)	X or < (less than) + (plus) - (minus) . (decimal point) Null (blank), 0 t0 9 (inc.)
Amp_Data3	Amp Forward Power Level MSB-1 (W)	
Amp_Data4	Amp Forward Power Level LSB (W)	
Amp_Data5	Amp Current Level MSB (Amps)	
Amp_Data6	Amp Current Level MSB-1 (Amps)	
Amp_Data7	Amp Current Level LSB+1 (Amps)	
Amp_Data8	Amp Current Level LSB (Amps)	
Amp_Data9	Amp Temperature Level MSB (deg.C)	
Amp_Data10	Amp Temperature Level MSB-1 (deg.C)	
Amp_Data11	Amp Temperature Level LSB (deg.C)	
Amp_Data12	Amp Forward Power status	N F X
Amp_Data13	Amp Current status	N H X
Amp_Data14	Amp Temperature status	N H X
Amp_Data15	Amp Reverse Power status	N H X
Amp_Data16	Amp data 8 bit EOR checksum (of 2-15 inc. only)	

SECTION THREE : OPERATION

Once installed and set up as described in Section Two, manual operation is limited to the two switches on the E2024 Splitter/Drive Changeover Unit. Various forms of automatic control can be provided using the E2023 Controller Unit. This unit also provides comprehensive monitoring of power, current and temperature levels etc. as well as being the 'gateway' for various extended and remote control and monitoring options.

3.1 CONTROLS AND DISPLAYS

The controls and displays available for each module or unit and their functions are as follows :

3.1.1 E2021 Amplifier Module

Marked	Type	Function
LOCK	Opto Switch	To mute/demute and mechanically retain the module. Down position to demute and secure module. Up position to mute and enable module's removal.
FWD	LED Display	Red indicates forward power fail (module output power more than approximately 6dB below that required). Amber indicates forward power muted. Green indicates normal operation.
REV	LED Display	Red indicates reverse power to module in excess of approximately 30W (i.e. 10dB return loss relative to maximum module output). Green indicates normal operation.
TEMP	LED Display	Red indicates module heatsink temperature greater than approximately 85 deg.C. Green indicates normal operation
CURRENT	LED Display	Red indicates module current (to Amplifier Pallet) in excess of approximately 11A. Green indicates normal operation.
CPU	LED Display	Red indicates module CPU (microcontroller) failure, other LED displays will automatically be turned off. Green indicates normal CPU operation.

3.1.2 E2088 Power Supply Module

Marked	Type	Function
DC	LED Display	Green indicates that the supply output is above approximately 40V dc
DC	LED Display	Red indicates that the supply output is below approximately 40V dc
AC	LED Display	Green indicates that the input is above approximately 85V rms ac.

3.1.3 E2322 Power Supply Module

Marked	Type	Function
DC	LED Display	Green indicates dc output >75-85% of its rated value.
AC	LED Display	Green indicates ac input >78-86Vrms

3.1.4 E2023 Transmitter Controller Unit

Marked	Type	Function
SYSTEM NORMAL	LED Display	Red indicates one or more system conditions are abnormal (and should be cleared). Green indicates all significant system conditions are normal. Amber indicates 'Power-on-Reset' period
CONTRAST	Adjustable Pot. (1T)	To set the contrast of Controller's liquid crystal display (LCD) for best contrast in the prevailing viewing and ambient temperature conditions.
MAIN	Membrane Switch	To directly select the main LCD screen showing the Transmitter's output forward power, reverse power state and combiner heatsink temperature.
MODE	Membrane Switch	To select other Controller functions ('modes') such as Amplifier module monitoring.
∧	Membrane Switch	To step upwards through choices offered in the mode selected.
∨	Membrane Switch	To step downwards through choices offered in the mode selected.
Unmarked 'Soft' keys	Membrane Switches	To select various choices offered in the mode selected.
Unmarked Display	20 Character by 4 line LCD (back illum-inated by LEDs)	Indicates present mode (middle of top line) with status, input parameters etc. and next key operation choices below.

Note an internal sounder indicates correct membrane switch key operation by a single beep or an invalid key input by a short series of beeps.

3.1.5 E2024 Output Splitter/Drive Changeover Unit

Marked	Type	Function
DRIVE A B	LED Displays	Green LED indicates which Exciter/Drive is connected to the Transmitter input. The other LED remains off.
AUTO, SELECT A B	Lockable Toggle Switch (3 Way)	To manually select Exciter/Drive A or B or (in AUTO) to enable the selection to be made directly by the E2023 Controller (DRIVE A B LEDs confirm selection).
INTERLOCK, EXT MUTE	LED Display	Red indicates the safety interlock connector at the rear of the unit is open-circuit (i.e. link broken). Green indicates normal operation.
AUTO, MUTE and START	Lockable Toggle Switch (3 Way)	To manually mute or start (demute) the Transmitter or (in AUTO) to enable this to be done directly by the E2023 Controller

3.1.6 E2025 Combiner Unit

Marked	Type	Function
HIGH POWER	LED Display and Adjustable Pot. (20T)	Green LED indicates high power output setting selected and adjacent pot. can be used to directly set output power level. The LOW POWER LED will be off.
LOW POWER	LED Display and Adjustable Pot. (20T)	Green LED indicates low power output setting selected and adjacent pot. can be used to directly set output power level. The HIGH POWER LED will be off.
TEMP	LED Display	Red indicates unit heatsink temperature greater than approximately 100 deg.C. Green indicates normal operation.
REV	LED Display	Red indicates reverse power to Transmitter in excess of approximately 13W, 25W or 50W (i.e.16dB return loss relative to maximum Transmitter output of 500W, 1kW or 2kW). Green indicates normal operation.
FWD	LED Display	Red indicates forward power fail with output power more than approximately 6dB (500W Transmitters) to 12dB (2kW Transmitters) below that required. Green indicates normal operation.
FANS	LED Display	Red indicates one or both cooling fans are taking no current. Green indicates normal fan operation.
CPU	LED Display	Red indicates unit CPU (microcontroller) failure, other LED displays will automatically be turned off (except HIGH and LOW POWER). Green indicates normal CPU operation.

3.1.7 Supply Disconnector

Marked	Type	Function
‘O’ and ‘I’	Switch (4 pole)	To switch incoming mains supply on (‘I’) or off (‘O’). For extra safety whist working on the Transmitter or its’ antenna or load, this switch may be padlocked in the off position.

3.2 MANUAL CONTROL

Simple manual control of the Transmitter can be performed using the three way lockable toggle switches on the front of the E2024 Splitter/Drive Changeover/Output unit.

The AUTO – MUTE – START switch can be used to manually mute or start (demute) the Transmitter.

The AUTO – SELECT A – SELECT B switch can be used to manually select Exciter/Drive A or B.

As long as neither switch is in the AUTO position, the E2023 Controller can be removed without affecting Transmitter local operation (although no display of actual output power will be present). In this situation, individual modules and units will still display their own status on red/green LEDs.

Note that it is important that these switches are only left in their AUTO positions (as required in Section 3.4) if the automatic operations described in Section 3.4 are actually in use.

3.3 MANUAL MONITORING

The E2023 Controller Unit is primarily used to monitor the Transmitter's final output power etc. and to monitor the state of each individual E2021 Amplifier Module. Other functions are available which mainly relate to the automatic control optional features.

To display the Transmitter's final output forward and reflected powers, press [MAIN] on the E2023 Controller front panel. No matter what state the Controller is in, pressing this key will always display the final output power. A short beep from the internal sounder indicates a valid key press. In this state, the E2023 will monitor the output power (via the E2025 Combiner Unit) several times per second. It also polls through the E2021 Amplifier Modules to internally record their power, temperature and current status. A complete poll of all E2021s takes up to one second. **NOTE that when Amplifier Module status is being interrogated via remote monitoring, the E2023 mode must be left in 'MAIN' to ensure that the Modules continue to be polled and their latest status recorded (section 2.4.3).**

To display individual E2021 statuses, press [MODE] then the soft key on the horizontal row beneath 'Amps' on the LCD display. A short beep from the internal sounder indicates each time a valid key is pressed (if a non-valid key is pressed then several short beeps are sounded together). An individual E2021 status can be displayed by pressing the [∧] or [∨] keys on the left hand side of the LCD display to select that E2021's number. The E2021s are numbered left to right, bottom to top. Thus they start at number '1' on the left hand of the bottom row and end at number '4' (on S76005 and S7601) or '8' (on S7602) at the right of the first or second row. It is important to note that not all amplifiers are fitted on the 500W S76005. When an individual E2021 is being monitored in this way, the output power continues to be monitored but not displayed. To display the output power again, just press [MAIN] as previously described.

If the forward power status (via the E2025 Combiner Unit) or the status of an individual E2021 Amplifier cannot be read by the E2023 over the internal RS485 buses, the LCD display will show 'Status not present' in place of the expected readings. This will happen if a module is removed or if a fault exists in the monitoring circuitry (and in the case of unused amplifier 'slots' on the 500W S76005).

In all modes, if the Transmitter is muted by the front panel switch on the E2024 Splitter/Drive Changeover Unit, the amber 'FWD' led of the E2021 being monitored will flicker.

If any overall 'System Normal' status has failed, the front panel SYSTEM NORMAL led will change from green to red. To display individual overall 'System Normal' statuses, press [MODE] then the soft key on the horizontal row beneath 'System' on the LCD display. An individual status can then be monitored by pressing the [∧] or [∨] keys on the left hand side of the LCD display. To display the output power again, press [MAIN] as previously described.

3.4 AUTOMATIC CONTROL

The E2023 Controller Unit also enables various forms of automatic control such as dual Exciter/Drive changeover, muted/reduced power operation etc. or any normal combination of them.

For dual Exciter/Drive changeover, the E2024 AUTO – SELECT A – SELECT B switch must be set to AUTO. For muted/reduced power operation, the AUTO – MUTE – START switch must be set to AUTO.

3.4.1 Exciter/Drive Control and Monitoring

When dual Exciter/Drives are connected to the E2023, to enable monitoring and set-up, press [MODE] then the soft key on the horizontal row beneath 'Drives' on the LCD display. (note that a single Exciter/Drive can also be monitored or controlled in this way).

The LCD display will then indicate which Exciter/Drive is selected and will indicate whether it is 'normal' or 'fail'. If the other Exciter/Drive is passive (i.e. in a muted state) the display will show '????' By pressing the soft key beneath 'Act/Pas' the non-selected Exciter/Drive can be toggled between muted (passive) or demuted (active). This choice can also be made using remote control.

When the E2024 AUTO – SELECT A – SELECT B switch is set to SELECT A or SELECT B (i.e manual control), the top row of the display shows which Exciter/Drive A or B would be preferred or forced when AUTO control is later selected. A or B can be selected using the soft keys, the rear panel inputs or remote control.

When the E2024 AUTO – SELECT A – SELECT B switch is set to AUTO, the top row of the display shows the number of automatic changeovers (0 to 4) since it was last reset. Exciter/Drive A or B can again be preferred or forced by using the soft keys, the rear panel inputs or remote control.

Any such control action resets the automatic changeover counter to zero, the '0' flashing for approximately 30 seconds to indicate that no actual changeover can take place during this 'settling' period. An automatic changeover can then occur if the selected Exciter/Drive fails (by either a continuous 'fast' status failure for 2 seconds or a continuous 'slow' status failure for 10 seconds). If the non-selected Exciter/Drive is 'passive' the changeover will always take place. If the non-selected Exciter/drive is 'active' the changeover will only occur if it is registered as not failed. A changeover will increment the counter, the new displayed number again flashing for approximately 30 seconds to indicate that no further changeover can take place during this new 'settling' period. If the originally selected Exciter/Drive then becomes 'good' again (by both 'fast' status and 'slow' status being continuously 'good' for 2 seconds) it will not be automatically re-selected unless the newly selected drive itself fails.

Changeovers can occur up to 4 times, after which any further changes are prohibited until the counter is automatically reset to zero after a period of about one hour after the final changeover (or sooner by manual local or remote intervention).

To display the output power again, press [MAIN] as previously described.

3.4.2 Muting and Reduced Power Operation

When muting or reduced power control is required, to enable monitoring and set-up, press [MODE] then the soft key on the horizontal row beneath 'Power' on the LCD display.

The LCD display will then indicate the various muting and high/low power settings available (automatic local/ remote, manual and external). The four soft keys below the LCD display allow local selection of the MUTE/START and HIGH/LOW (power) settings used when AUTO control is selected. These settings can also be made using remote control. To allow the system to settle, any such control action also resets the automatic Exciter/Drive changeover counter to zero and prevents any changeover for a period of 30 seconds (see section 3.4.1).

When the E2024 AUTO – MUTE – START switch is set to MUTE or START (i.e. manual control), the display shows the actual switch setting and the manual setting of high/low power ('Manual='). The latter can only be done by an internal link (i.e. this setting of high/low power cannot be done from the front panel). In this mode, the switch mute/start selection can only be over-ridden by the safety interlock opening and muting the Transmitter directly (the first part of the display then showing 'Manual=I-Lock'). The automatic settings are displayed as 'Auto=' and can be set as described in the previous paragraph.

When the E2024 AUTO – MUTE – START switch is set to AUTO, the display shows the automatic settings in operation. As before, the mute/start selection can be over-ridden by the safety interlock opening and muting the Transmitter directly (the first part of the display then showing 'I-Lock'). However, auto operation also allows the internal auto mute/start setting to be over-ridden by the rear panel 'Mute Transmitter Input' (see section 2.2.8) the first part of the display then showing '(ext)Mute'.

The order of priority is thus 'I-Lock' then '(ext)Mute' then 'Start/Mute' as selected internally. When 'I-Lock' or '(ext)Mute' are operative, the START/MUTE soft-keys are disabled, being shown as '(x)', though this selection can still be made using remote control.

Similarly with the E2024 AUTO – MUTE – START switch set to AUTO, the internal high/low power setting can be over-ridden by the rear panel 'Select Low Power Input' (see section 2.2.8) the second part of the display showing 'Low(ext)'. The order of priority is thus 'Low(ext)' then 'High/Low' as selected internally. When 'Low(ext)' is operative, the HIGH/LOW soft-keys are disabled, being shown as '(x)', though this selection can again still be made using remote control.

It should be noted that auto mode has to be selected by the E2024 AUTO – MUTE – START switch to enable low power to be selected remotely or via the front panel. The only manual mode provision for selecting low power is via an internal link, which then over-rides all other auto settings that might be made.

To display the output power again, press [MAIN] as previously described.

--oOo—