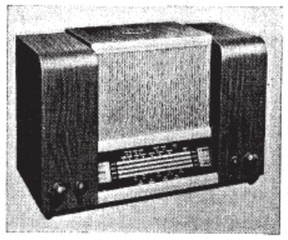
"TRADER" SERVICE SHEET

783

INVICTA 30

4-BAND A.C. SUPERHET



The Invicta model 30 A.C. superhet. If the wooden beading beneath the scale is removed, the glass scale can be withdrawn.

FOUR wavebands are covered in the Invicta model 30, comprising a S.W. band of 13-50 m, which is referred to throughout this *Service Sheet* as S.W.1, a "Trawler" band of 50-200 m, referred to as S.W.2, and the usual M.W. and L.W. bands.

The receiver is a 3-valve (plus rectifier) superhet designed to operate from A.C. mains of 200-250 V, 40-100 c/s. There is provision for the connection of a gramophone pick-up and an external speaker.

For gramophone operation, the triode section of the frequency changer is used as a pre-amplifier, and a screw-type switch is fitted to mute the internal speaker. A plug on a flexible lead acts as a mains aerial connector. The scale lamps are energized from a tapping on the L.T. transformer winding. A 3-position tone control is associated with a negative feed-back circuit.

Release date and original price: January, 1946; £17 0s, *plus purchase tax*, £3 13s 2d.

CIRCUIT DESCRIPTION

Aerial input is via coupling coils **L1** (S.W.1), **L2** (S.W.2) and **L3** (M.W. and L.W.) to single-tuned circuits **L4, C29** (S.W.1), **L5, C29** (S.W.2), **L6, C29** (M.W.) and **L7, C29** (L.W.) which precede triode hexode valve **(V1, Mullard metallised ECH35)** operating as frequency changer with internal coupling.

Triode oscillator anode coils **L12** (S.W.1), **L13** (S.W.2), **L14** (M.W.) and **L15** (L.W.) are tuned by **C33.** Parallel trimming by **C30** (S.W.1), **C10, C31** (M.W.) and **C11, C32** (L.W.); series tracking by **C8** (S.W.1), **C9** (S.W.2) and **C12** (M.W. and L.W.). Reaction coupling by grid coils **L8** (S.W.1), **L9** (S.W.2), **L10** (M.W.) and **L11** (L.W.).

Second valve **(V2, Mullard metallised EF39)** is a variable-mu R.F. pentode operating as intermediate frequency amplifier with tuned-primary, tuned-secondary transformer couplings **C5, L16, L17, C6** and **C14, L18, L19, C15.** All the tuning capacitors are fixed, and trimming is effected by adjusting the iron-dust cores.

Intermediate frequency 465 kc/s.

Diode second detector is part of double diode-pentode output valve **(V3, Mullard metallised EBL31).** Audio frequency component in rectified output is developed across load resistor **R9,** and passed via A.F. coupling capacitor **C20,** manual volume control **R10** and grid stopper **R11** to C.G. of pentode section. I.F. filtering by **C17, R7** and **C18** in diode circuit, and **R11** in pentode C.G. circuit. Provision is made for the connection of a low impedance external speaker, and a screw type switch **S27** permits the internal speaker to be muted.

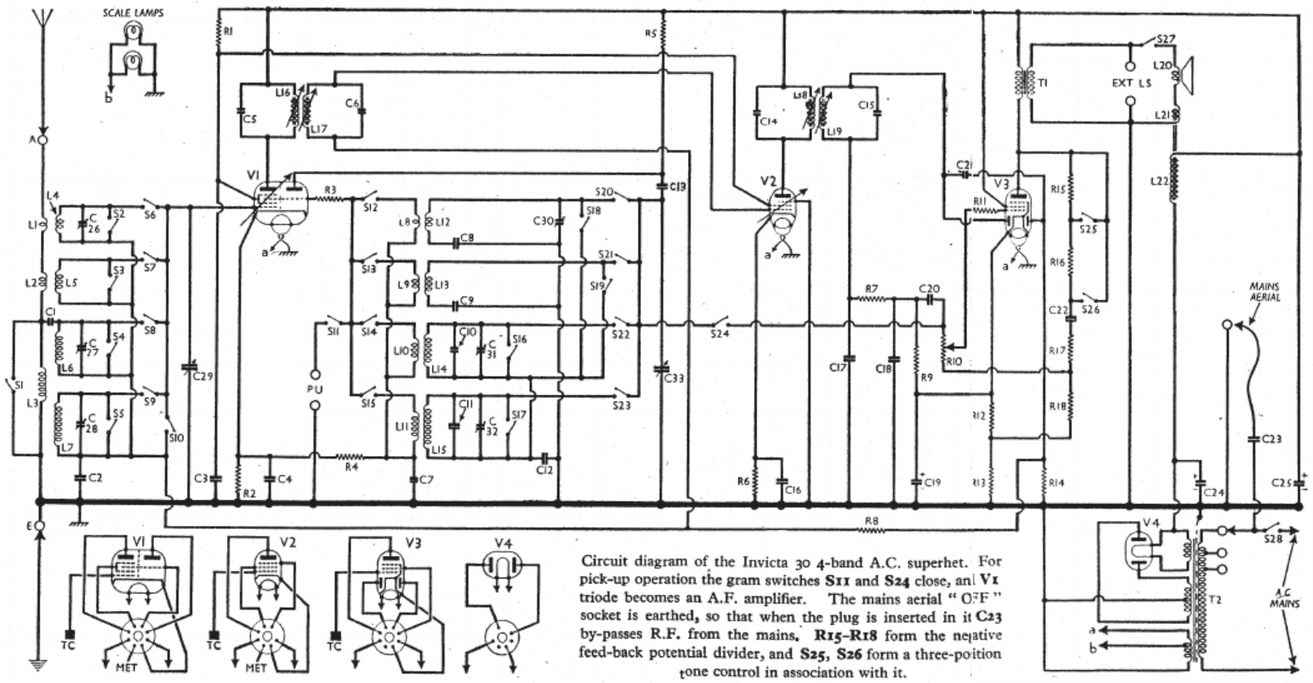
For pick-up operation, the triode section of the frequency changer **V1** is used as an A.F. amplifier. The pick-up output is fed in via **S11** to the control grid circuit, and the output from the anode is developed across **R5** and passed via **C13** and **S24** to the manual volume control **R10,** and so on to the control grid of **V3** pentode. **S11** and **S24** close when the waveband control is turned to the gram position together with a muting switch **S10,** and two incidental switches **S2, S18.**

Second diode of **V3,** fed from **L19** via **C21,** provides D.C. potential which is developed across load resistor **R14** and fed back through decoupling circuit as G.B. to F.C. and I.F. valves, giving automatic volume control. Delay voltage, together with G.B. for pentode section, is obtained from the drop along resistors **R12, R13** in **V3** cathode lead to chassis.

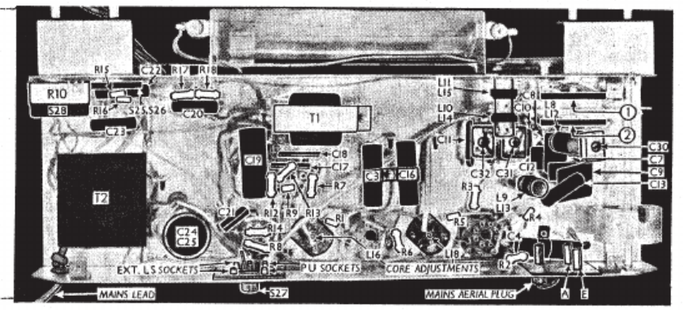
The output from **V3** pentode anode is developed across a potential divider comprising **R15, R16, C22, R17, R18** and switches **S25, S26,** and the fraction of the output appearing across **R18** is fed back via **R10** to the control grid circuit of the pentode section. Bias for the control grid is obtained by returning **R18** to the junction of **R12, R13.**

For tone control purposes the frequency characteristic of the feed-back circuit is modified, from the "Brilliance" condition (both switches open) to "Normal" (**S25** closed) and "Mellow" (**S26** closed).

H.T. current is supplid by a full-wave rectifying valve **(V4, Mullard AZ31).** Smoothing by speaker field **L22** and electrolytic capacitors **C24, C25.** Mains aerial connection is provided by a plug and flexible lead, via coupling capacitor **C23.** When not required, the plug is inserted in a specially provided earthed socket and **C23** then functions as a mains R.F. by-pass capacitor.



Circuit diagram of the Invicta 30 4-band A.C. superhet. For pick-up operation the gram switches **S11** and **S24** close, and **V1** triode becomes an A.F. amplifier. The mains aerial "E" socket is earthed, so that when the plug is inserted in it **C23** by-passes R.F. from the mains. **R15–R18** form the negative feed-back potential divider, and **S25, S26** form a three-poition tone control in association with it.



Under-chassis view. The waveband switch units (marked 1 and 2 in circles) are indicated here and shown in detail in the diagrams in col. 4 overleaf. The tone control switch unit **S25, S26** indicated on the left, is shown in detail in a diagram in col. 2 overleaf.

COMPONENTS AND VALUES

	CAPACITORS	Values (μF)
C1	Aerial "top" coupling ...	0·00006
C2	A.V.C. line decoupling ...	0·1
C3	V1, V2 S.G.'s decoupling	0·1
C4	V1 cathode by-pass ...	0·1
C5	1st I.F. transformer tuning capacitors	0·00007
C6		0·00007
C7	V1 osc. C.G. capacitor ...	0·000047
C8	Osc. circuit S.W.1 tracker	0·005
C9	Osc. circuit S.W.2 tracker	0·0013
C10	Osc. M.W fixed trimmer	0·000022
C11	Osc. L.W. fixed trimmer...	0·00034
C12	Osc. M.W. and L.W. tracker	0·00065
C13	V1 osc. anode coupling ...	0·001
C14	2nd I.F. transformer tuning capacitors ...	0·00014
C15		0·00014
C16	V2 cathode by-pass ...	0·1
C17	I.F. by-pass capacitors ...	0·00015
C18		0·00015
C19*	V3 cathode by-pass ...	25·0
C20	A.F. coupling to V3 pent.	0·005
C21	V3 A.V.C. diode coupling	0·000022
C22	Neg. feedback coupling...	0·01
C23	Mains aerial coupling ...	0·001
C24*	H.T. smoothing capacitors	8·0
C25*		16·0
C26†	Aerial circ. S.W.1 trimmer	0·00003
C27†	Aerial circ. M.W. trimmer	0·00003
C28†	Aerial circ. L.W. trimmer	0·00003
C29†	Aerial circuit tuning ...	0·000532
C30‡	Osc. circ. S.W.1 trimmer...	0·00003
C31‡	Osc. circ. M.W. trimmer...	0·00003
C32‡	Osc. circ. L.W. trimmer...	0·00003
C33†	Oscillator circuit tuning...	0·000532

* Electrolytic. † Variable. ‡ Pre-set.

	RESISTORS	Values (ohms)
R1	V1, V2 S.G.'s H.T. feed...	47,000
R2	V1 fixed G.B. resistor ...	150
R3	V1 osc. grid stopper ...	47
R4	V1 osc. C.G. resistor ...	47,000
R5	V1 osc. anode H.T. feed...	47,000
R6	V2 fixed G.B. resistor ...	220
R7	I.F. stopper	47,000
R8	A.V.C. line decoupling ...	1,000,000
R9	V3 signal diode load ...	470,000
R10	Manual volume control ...	1,000,000
R11	V3 pent. grid stopper ...	100,000
R12	V3 pent. G.B. and A.V.C. delay resistors	150
R13		330
R14	A.V.C. diode load	1,000,000
R15	Tone control resistors ...	100,000
R16		47,000
R17	Feed-back potential divider	15,000
R18		4,700

OTHER COMPONENTS			Approx. Values (ohms)
L1	Aerial S.W.1 coupling ...		0·45
L2	Aerial S.W.2 coupling ...		0·6
L3	Aerial M.W. and L.W. coupling		65·0
L4	Aerial S.W.1 tuning ...		0·1
L5	Aerial S.W.2 tuning ...		0·5
L6	Aerial M.W. tuning ...		3·7
L7	Aerial L.W. tuning ...		12·8
L8	Osc. S.W.1 reaction coil		55·0
L9	Osc. S.W.2 reaction coil		0·65
L10	Osc. M.W. reaction coil...		1·2
L11	Osc. L.W. reaction coil...		1·6
L12	Osc. circ. S.W.1 tuning...		Very low
L13	Osc. circ. S.W.2 tuning...		1·0
L14	Osc. circ. M.W. tuning ...		1·7
L15	Osc. circ. L.W. tuning ...		2·3
L16	1st I.F. trans.	Pri. ...	8·5
L17		Sec. ...	8·5
L18	2nd I.F. trans.	Pri. ...	6·0
L19		Sec. ...	6·0
L20	Speaker speech coil ...		2·0
L21	Hum neutralising coil ...		Very low
L22	Speaker field coil ...		1,000·0
T1	Output trans.	Pri. ...	255·0
		Sec. ...	Very low
T2	Mains trans.	Pri., total ...	17·5
		Heater sec.	Very low
		Rect. heat. sec.,	Very low
		H.T. sec., total	350·0
S1-S24	Waveband switches ...		—
S25,S26	Tone control switches ...		—
S27	Int. speaker switch		—
S28	Mains switch, ganged R10		—

VALVE ANALYSIS

Valve voltages and currents given in the table below are those measured in our receiver when it was operating on mains of 230 V, using the 220-230 V tapping on the mains transformer.

The receiver was tuned to the lowest wavelength on the M.W. band, the volume control was at maximum and the tone control was at the "Brilliance" setting, but there was no signal input. Voltages were measured on the 400 V scale of a model 7 Universal Avometer, chassis being the negative connection.

Valve	Anode Voltage (V)	Anode Current (mA)	Screen Voltage (V)	Screen Current (mA)
V1 ECH35	290	2·7	82	2·9
	Oscillator 92	3·0		
V2 EF39	290	6·3	82	1·75
V3 EBL31	275	37·5	290	4·2
V4 AZ31	333†	—	—	—

† Each anode, A.C.

DISMANTLING THE SET

The cabinet is fitted with a detachable bottom cover, upon removal of which (four round-head wood screws) access may be gained to the oscillator and I.F. trimmer adjustments and most of the under-chassis components.

Removing Chassis.—Remove the four control knobs (pull off) from the front of the cabinet;

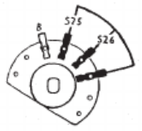


Diagram of the tone control switch unit, drawn as seen when viewed from the rear of an inverted chassis.

remove the four bolts (with steel washers, rubber grommets, and brass sleeves) holding the chassis to the base of the cabinet, when the chassis may be withdrawn to the extent of the speaker leads.

To free the chassis entirely, unsolder from the connecting panel on the speaker the four leads connecting it to the chassis.

When replacing, connect the speaker leads as follows, numbering the tags on the connecting panel from top to bottom: 1, red; 2, yellow; 3, green; 4, no external connection; 5, black.

Two of the specially shaped rubber washers should be fitted to each chassis bolt, one going each side of the base of the cabinet, with a brass distance piece between them; a flat steel washer fits beneath the head of each bolt. This operation is simplified if the two front rubber washers are placed in position inside the cabinet before inserting the chassis.

Removing Speaker.—Remove the nuts from the four bolts holding the speaker to the sub-baffle.

When replacing, the connecting panel should be on the right, and if the leads have been unsoldered they should be reconnected as previously described.

GENERAL NOTES

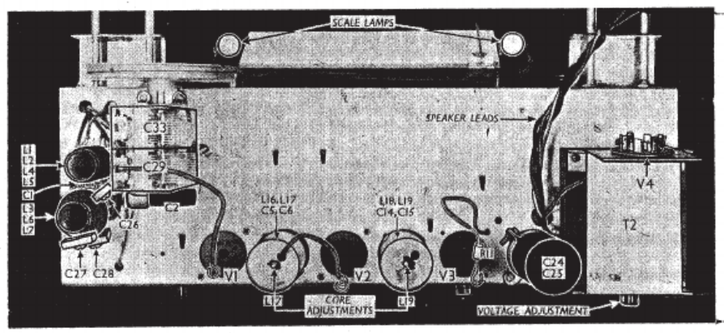
Switches.—S1-S24 are the waveband, pick-up and muting switches, ganged in two rotary units beneath the chassis. These are shown in our under-chassis view, where they are indicated by numbers (**1** and **2**) in circles, and arrows. The arrows show the direction in which they are viewed in the diagrams in col. 4, where the units are shown in detail.

The table below gives the switch positions for the five control settings, starting from the fully anti-clockwise position of the control. A dash indicates open, and **C**, closed.

Waveband Switch Table

Switch	Gram.	S.W.1	S.W.2	M.W.	L.W.
S1	—	C	C	—	—
S2	C	C	—	—	—
S3	—	C	—	—	—
S4	—	—	C	—	—
S5	—	—	C	—	—
S6	—	C	C	—	—
S7	—	—	C	—	—
S8	—	—	—	—	—
S9	—	—	—	—	—
S10	C	—	—	—	—
S11	C	—	—	—	—
S12	—	C	—	—	—
S13	—	—	C	—	—
S14	—	—	—	—	—
S15	—	—	C	—	C
S16	—	—	—	—	—
S17	—	—	—	C	C
S18	—	—	—	—	—
S19	C	—	—	—	—
S20	—	C	C	—	—
S21	—	—	C	—	—
S22	—	—	—	—	—
S23	—	—	—	C	C
S24	C	—	—	—	C

Switches.—Those recommended by the makers are rated at 6.2 V, 0.3 A, with 15 mm clear spherical bulbs and M.E.S. bases. As the valve heater

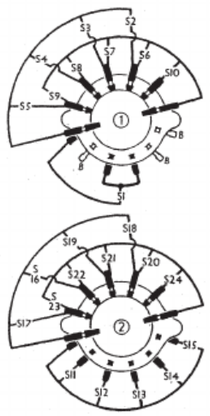


Plan view of the chassis. The small capacitor **Cx** is seen on the side of the **L3, L6, L7** coil unit beside the gang. The I.F. transformer secondary adjustments are indicated here; the primary adjustments are shown in our under-chassis view overleaf.

by a thumb-screw which connects together a threaded tag and a contact plate, which are interleaved in the panel, when screwed fully home.

S28 is the Q.M.B. mains switch, ganged with the manual volume control **R10.**

Waveband Switch Diagrams



Diagrams of the waveband switch units, drawn as seen when viewed from the rear of the underside of the chassis. "*B*" indicates a blank tag.

Coils.—The S.W.1 and S.W.2 aerial circuit coils **L1, L2, L4, L5** are in a tubular unit on the chassis deck, with the S.W.1 trimmer **C26** mounted on the side of it, facing the rear of the chassis. **L4** is the thick wire winding, and **L1** is interwound with it.

The M.W. and L.W. aerial coils **L3, L6, L7** are in a second tubular unit on the chassis deck, beside the first unit, with their pre-set trimmers **C27** (top) and **C28** (bottom) mounted on its side, facing rearwards. The small "top" coupling capacitor **C1** is also mounted on the side of the unit.

The oscillator circuit coils **L8, L12; L9, L13;** and **L10, L11, L14, L15** are in three unscreened tubular units beneath the chassis deck. The S.W.1 unit is mounted on the rear unit of the waveband switch unit, the S.W.2 unit is mounted on the underside of the chassis deck, and the M.W. and L.W. unit is mounted on the front chassis member.

The I.F. transformers **L16, L17** and **L18, L19** are in two screened units on the chassis deck, their core adjustments projecting from the tops and bottoms of the units.

Scale Lamps.—Those recommended by the makers are rated at 6.2 V, 0.3 A, with 15 mm clear spherical bulbs and M.E.S. bases. As the valve heater secondary on the mains transformer from which they are energized is designed for 6.3 V valves, a tapping (marked "**b**" in our circuit diagram) is provided specially for the lamps.

External Speaker.—Two sockets are provided at the rear of the chassis for the connection of a low impedance (about 2 Ω) external speaker. A screw-type switch beside them permits the external speaker to be muted.

Capacitor C1.—This is a small "top" aerial coupling, made by winding a thin enamelled copper wire over a thicker one. It is mounted directly on the **L3, L6, L7** coil unit.

Drive Cord and Scale Replacements

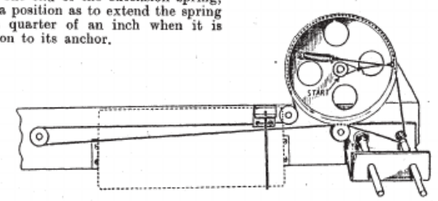
Replacing Scale.—The glass scale plate may be replaced, if it becomes obsolete or broken, without removing the chassis. It is only necessary to invert the cabinet, protecting its top with a soft cloth, and remove the two wood screws holding the lower white ornamental rail to the bottom of the cabinet, and withdraw the rail, when the glass scale can be removed by drawing it towards the bottom edge of the cabinet.

When replacing, it is advisable to tuck in some cotton wool along the ends of the glass to prevent it from rattling.

Replacing Drive Cord.—The length of the drive cord is 48 in, and a suitable material is Cutty Hunk twine, which is available from dealers in fishing tackle.

Tie a loop in one end of the cord, slip it over the grooved boss marked "Start" in the sketch below, and turn the gang to maximum capacitance. Thread the cord through the hole in the groove in the periphery of the drum, then through the two holes in the pointer carrier (starting and finishing at the back of the carrier).

The cord should now be fed round the *three* pulleys as shown in the sketch below, then under the control spindle, round it one complete turn, passing *behind* the first line, up to the drum and through the hole in the groove. Now tie off the cord on one end of the extension spring, in such a position as to extend the spring about a quarter of an inch when it is hooked on to its anchor.



Sketch showing the course taken by the drive cord. Particular care must be taken to turn it round the control spindle in the right direction, as described in the text.

The pointer can be slid along the cord if the spring is unhooked to slacken the cord, and with the gang at maximum, the carrier should be in about the position shown in our sketch. Final adjustment can be made with the chassis in the cabinet by adjusting the position of the drum on the gang spindle, after slackening the fixing screw.

Chassis Divergencies.—The oscillator circuit M.W. and L.W. fixed trimming capacitors **C10, C11** may have values in some cases which are different from those quoted in our tables. The A.V.C. line decoupling resistor **R8** is shown in our diagram as it was found in our chassis. In the makers' diagram it was shown connected between the earthy ends of the control grid circuits of the controlled valves, instead of between these and the A.V.C. diode anode.

CIRCUIT ALIGNMENT

I.F. Stages.—Connect signal generator leads to control grid (top cap) of **V1** and chassis via a 0.1 μF capacitor, and connect a 100,000 Ω shunt resistor between the same two points. Feed in a 465 kc/s (645.16 m) signal, and adjust the cores of **L16, L17, L18** and **L19** for maximum output. Remove shunt and capacitor.

R.F. and Oscillator Stages.—Transfer signal generator leads to **A** and **E** sockets, via a suitable dummy aerial. The pointer should register with the ends of the four scales at minimum and maximum positions of the gang. It may be adjusted while in the cabinet at the low wavelength end of the scales if the fixing screw on the drive drum is slackened.

M.W.—Switch set to M.W., tune to 200 m on scale, feed in a 200 m (1,500 kc/s) signal, and adjust **C31,** then **C27,** for maximum output. Check calibration at 500 m (600 kc/s).

L.W.—Switch set to L.W., tune to 1,200 m on scale, feed in a 1,200 m (250 kc/s) signal, and adjust **C32,** then **C28,** for maximum output. Check calibration at 2000 m (150 kc/s).

S.W.1.—Switch set to S.W.1 (Short), tune to 14 m on scale, feed in a 14 m (21.43 Mc/s) signal, and adjust **C30,** then **C26,** for maximum output, while rocking the gang for optimum results. Check calibration at 50 m (60 Mc/s).

S.W.2.—No adjustments are provided for this (Trawler) band, the only likely variation being in the position of the wiring. The calibration should be checked at 60 m (50 Mc/s) and 200 m (150 kc/s). Any adjustment attempted should be made at 60 m.

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