Siemens-Hell Transmitter „S“
Tsend 62a

and
Operating Instructions
St Bs 1213/1 e
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I. Description

A) General

The Siemens-Hell Perforated Tape Transmitter (Fig. 6) serves the purpose of translating the information punched on a perforator tape into a form suitable for keying a radio transmitter at a speed of 5 or 5.5 characters/sec. The tape, on which the individual characters have been punched previously according to the 5-unit code (CCIT Alphabet No. 2), is scanned in the transmitter, and the 5-unit code groups are translated via selector bars and cam contacts into the corresponding Siemens-Hell pulse trains. It has been possible to reduce the size of the new tape transmitter (compared with the earlier type, T send 17) by placing the cam contacts on both sides of the transmitter cam shaft. Furthermore a number of substantial improvements suggested by years of experience were introduced. For example, in the new transmitter each character is transmitted while the following is being scanned. This results in the time available for the scanning process being doubled, thereby reducing the strain on the parts. The parts of the perforated tape transmitter are combined in units which can be replaced easily and quickly. The transmitter is delivered with a built-in oscillator (Fig. 14). The scanning mechanism together with the appropriate setting members is built into a special unit, the scanning head (Fig. 11), which can be easily removed and replaced. The scanning head contains a push-button which permits the transmission of the interval signal during pauses in the transmission. A push-button is also provided for the transmission of a continuous signal for starting and stopping the Siemens-Hell printers.

B) Technical Data

1. Perforated Tape punched according to CCIT Alphabet No. 2
2. Speed of Transmission 5 or 5.5 characters/sec.
3. Telegraph Speed 245 or 269.5 bauds
4. Adjustable voice frequency
900 c/s, by connecting a and b on terminal strip A
1000 c/s, by connecting a and c on terminal strip A
1500 c/s, by connecting a and d on terminal strip A

5. Output Level
at 900 c/s, adjustable from -4 to +1.5 nepers
(-34.8 to +13 db.)
at 1000 c/s, adjustable from -4 to +1.6 nepers
(-34.8 to +13.9 db.)
at 1500 c/s, adjustable from -4 to +1.8 nepers
(-34.8 to +15.6 db.)

6. Frequency drift
less than 1 c/s for mains voltage fluctuations of ± 10%

7. Motor supply voltage 220 volts A.C.
   (the motor can also be delivered for 125 volts A.C.)

8. Power consumption of the motor about 30 va.

9. Constant speed 3000 or 3300 r.p.m.

10. Oscillator supply voltage 220,(150, 110) volts A.C.

11. Mains fuse for the oscillator 200 ma.

12. Power consumption of the oscillator about 20 va

13. Output impedance of the oscillator 600 ohms

14. Oscillator tube "R1" EP 14

15. Rectifier tube "R2" EZ 11

16. Dimensions of the perforated tape transmitter

   Length 440 mm (17.3")
   Depth 320 mm (12.6")
   Height 210 mm (8.3")
   Weight about 20 kgm (44 lb.)

The 3-digit part numbers given in the following description and the accompanying illustrations are the same as the order numbers of these parts if the number 30 is prefixed to the part number. For example, the order number of cam 690/1 is 30690. The number after the oblique stroke indicates the illustration referred to. All other numbers of several figures such as 2530/... or 915/202/... are already complete order numbers.
C) Construction

The Siemens-Hell Perforated Tape Transmitter is constructed on the building block principle, consisting in the main of the cast aluminium alloy base plate (Fig. 9), the lever frame with the code levers (Fig. 572/7), the contact frame with the transmitter contacts and their control levers (Fig. 585/7), the transmitter shaft with the cams (Fig. 10), the scanning head for scanning the perforated tape (Fig. 11), the motor (Fig. 13) and the tube oscillator (Fig. 14). The motor is mounted on the base plate and secured by a strap (26853/8). The remaining units can also be removed and replaced quite easily by removing a few screws.

D) Principle of Operation

1. Scanning Process

The motor drives the transmitter shaft via gears (694/8 and 609/6) at a speed of one revolution per character. The cam (690/1) which is mounted on the transmitter shaft moves the feed lever (729/1) momentarily to the right against the action of a spring (752/1) once per revolution of the transmitter shaft. The feed lever (729/1) turns its axle, and with it the slotted disc (724/1 and 724/12), clockwise. The lever (718/1 and 718/12), whose pin engages in the slot of disc (724/1), is thus turned anticlockwise, its left-hand edge thereby pushing the scanners (740/1) downwards. The scanning pins are thus withdrawn from the holes of the perforated tape so that the tape can be stepped for the scanning of the next row of holes (see 2. Tape Feed). As the transmitter shaft continues its revolution, the feed lever (729/1 and 725/11) returns to the left, the lever (718/1) turns clockwise again, and the 5 scanners are drawn upwards by their springs (743/1 and 743/11). The scanning pins are either arrested in their upward movement by the perforated tape which has already been fed forward, or pass through the holes in the latter
according to the code punched in the tape at this point. Thus according to whether the scanners meet a hole or not, they take up an upper or lower position. Immediately afterwards the setting lever (751/1 and 751/11) is moved to the left against the action of the spring (752/1 and 752/11) by a second cam (623/1 and 623/10), turning its axle anticlockwise. The pivot frame (746/1 and 746/12), which is rigidly mounted on this axle, is thus turned anticlockwise, thereby moving the 5 transfer levers (748/1 and 748/11) to the right. The 5 transfer levers which are individually pivoted in the pivot frame thus meet a projection on their respective scanners with their lower or upper lugs according to whether the scanning pins on the scanners have passed through a hole in the perforated tape or not. Consequently the transfer levers (748/1) are turned clockwise or anticlockwise respectively. Each of the transfer levers (748/1) engages with its lower end in a selector bar (557/1 to 561/1) and pushes it correspondingly to the left (hole in tape) or to the right (no hole in tape).

2. Tape Feed

In order to be able to adjust the height of the scanners, the slotted disc (724/2) of feed lever (729/2) is fastened to lever (723/2 and 723/12) by a screw so that it may be rotated with respect to this lever. The feed pawl (725/2 and 725/12) is pivoted on the end of lever (723/2) and is pressed against the pin (720/2 and 720/12) by the spring (728/2 and 728/12). As the feed lever (729/2) moves to the right, lever (723/2) is raised. The spring (728/2) holds the feed pawl (725/2) against the pin (720/2) during the motion of the feed pawl, so that its path is determined by the shape of the inner surface of the pawl and the position of the pin. At the moment when the lever (719/1) has pushed the scanners so far that the scanning pins lie 0.2 mm
below the surface of the paper guide channel (716/11), the
feed pawl steps the feed ratchet, and with it, the pin wheel
(734/2), so that the next row of perforations lies exactly
above the scanning pins. The moment at which the stepping
motion begins, and the final position of the pin wheel at
the end of the stepping motion, can be adjusted exactly by
turning the eccentrically mounted pin (720/2 and 720/12). The
feed ratchet, pin wheel and disc (731/2) are mounted on a com-
mon sleeve which is pressed by a powerful leaf spring (730/2)
against the plastic bush (736/2), whose recess contains a
felt lubricating washer, and which is backed by the axle
flange (732/2). This friction brake prevents movement of the
pin wheel and consequently of the perforated tape when the
feed pawl returns.

The perforated tape passes over the fixed rod (717/2 and
717/12) and under the rod of the movable locking lever (753/2
and 753/12) to the scanning head. If the tape becomes taut,
so that it is in danger of being torn, the locking lever
(753/2) is drawn upwards and its catch locks the feed lever
(729/2) in its right-hand position. Further tape feed and scann-
ing are thus suppressed, and can be started again by depress-
ing the locking lever (753/2) by hand against the action of
the spring (757/2 and 757/11) until it is engaged by the leaf
spring (737/2).

3. Transmission Process

The rectangular slots in the selector bars (557 - 561/3), which
have been set in the scanning process, form a continuous groove
at a particular place corresponding to the code combination.
The corresponding code lever (574/3) is drawn into this groove
by its leaf spring (577/3) as soon as the rocker bar (525/3),
which is controlled via the rocker (521/3) by the cam (624/3),
moves downwards. As the code lever moves downwards into the groove, it pulls down the intermediate lever (576/3) against the action of the leaf spring (578/3). The corresponding control lever (588/3) is thus released, and is pulled to the left by the spring (600/3), so that its left-hand lug rises in the slot of the contact bracket (592/3), turning the latter with its contact set clockwise about its axle. This causes the contact set (2530/3) to enter into the corresponding cam base (628 to 653/3 and /10) at the beginning of the pulse train to be transmitted by the cam. In this operative position, the lug of the control lever is in the perpendicular portion of the slot in the contact bracket (592/3) so that the line of action of the force exerted by the contact set (2530/3) passes through the axis of rotation of the control lever; consequently, there is no tendency for the contact bracket to be released from the control lever during the operation of the contact set by the cam, the contact set being held securely against the cam without the application of additional force. Shortly after the control lever (588/3) has been released by the intermediate lever, the rocker bar (525/3) rises again and withdraws the engaged code lever (574/3) from the groove in the selector bars, thereby releasing the latter for resetting according to the next character. When the respective cam has completed the transmission of the character determined by its contour, the cam (625/3) operates via the rocker (511/3 and 511/9) a second rocker bar (517/3), which returns the control lever (588/3) to its rest position in which it is locked by its appertaining intermediate lever (576/3).

The contact sets take up more room than their corresponding cams, so that the former had to be more widely spaced than the latter. To keep the length of the machine down to a reasonable size, the contact sets have been arranged on each side of the
transmitter can shift in such a manner that each cam operates a contact set on a side opposite to that of the neighbouring cam.

The 32 combinations available with the use of the 5-unit code are insufficient for the transmission of all the letters, figures and other symbols. Consequently, various hole combinations are used to transmit both a letter and a figure or other symbol. The selection between these is effected by the shift bar (562/3 and 562/3). Then, as a result of the scanning process, the selector bars are set for the "Letters Shift" code group, a continuous groove is formed in line with the left-hand slot in the shift bar thereby permitting the letters shift lever (574/3) to engage in the groove. This letters shift lever has no associated contact set, but depresses the horizontal arm of the crank (563/3), whose lower arm shifts the shift bar to the left. The shift bar is held in this position by the engaging mechanism (533/3). Of the two code levers assigned to a code group used for transmitting two symbols, only the one corresponding to that on the letters side finds a continuous groove across the 5 selector bars and the shift bar, and can thus bring its contact set into the operative position, whereas the code lever for the figures side is prevented from engaging in the selector bars by the shift bar. Figures shift is effected in a similar manner by means of the figures shift bar and crank on the right-hand side.

4. Interval Signal

If, during a pause in the transmission, the interval signal is to be transmitted, the push-button (762/2 and 762/6) for the interval signal should be depressed. This causes the intermediate member (758/2) to move the lower arm of locking lever (753/2) to the right out of engagement with the leaf spring (737/2) and catch the feed lever (729/2), thereby suppressing
tape feed and scanning. At the same time a small pin on the push-button, which engages a release lever (764/2) whose other end passes under a special code lever (574/2), releases this code lever which now drops independently of the setting of the selector bars and lays its contact set against the transmitter cam for the interval signal. The code lever for the interval signal is locked again by depressing the right-hand push-button (762/2 and 762/7) or by depressing the locking lever (753/2). To restart scanning of the perforated tape, the locking lever (753/2) should in any case be depressed by hand.

5. Oscillator

The perforated tape transmitter is delivered with a built-in oscillator. The oscillator produces the voice frequency alternating voltage which is keyed by the transmitter contacts. The electrical connection between the oscillator and the perforated tape transmitter is established by a 6-point plug and socket connection. The oscillator and perforated tape transmitter can be switched on and off independently by separate switches on the rear side and right-hand side respectively. An indicator lamp (922/215/14), which can be seen through a window (922/921/6) in the top of the cover, lights up when the oscillator is switched on.

D) Circuit Description of the Perforated Tape Transmitter
(St Str 1211/2) Fig. 4

The mains leads to the perforated tape transmitter are connected via the switch contacts S1, S2 and the interference suppressor 6 St3 bk 3 a to contacts II1 and II2 of the 5-point motor plug-and-socket strip. The mains leads are also connected in parallel to the contact I3, I4 of the 6-point oscillator plug-and-socket strip. When the switch "S" is switched on, contacts SII and SIII
close and switch on the motor. Simultaneously, contact S₁ closes, connecting the transmitter contacts K₁-K₅₀ via the contacts I₂ and I₅ of the 6-point plug-and-socket connector and via the oscillator to the a/b wires of the transmitter output. The push-button WT, for transmitting a continuous signal for starting and stopping the Siemens-Hell printers, is wired in parallel with the transmitter contacts.

The motor is a commutator motor wound for 220 volts A.C. (contacts II₁, II₂) with tappings for connection to 110 volts D.C. (contacts II₄, II₅). The motor has to operate at a constant speed of 3,000 r.p.m. for a transmission speed of 5.0 characters/sec. or 3,300 r.p.m. for a transmission speed of 5.5 characters/sec. The motor speed is kept constant by means of a centrifugal contact governor (5724/13), which is mounted on the motor shaft, and connected in the motor circuit via two sliprings. The motor is designed to run at a higher speed than that mentioned above when the tungsten governor contacts remain closed. The centrifugal governor is so adjusted that the contacts open when the nominal speed is exceeded, thereby switching in the resistors W₁ and W₂ into the motor circuit. This reduces the motor current and consequently the motor speed so that the centrifugal contacts close again. This process is repeated during each revolution of the governor, i.e., so rapidly that the speed is kept absolutely constant. The condenser C₁ and resistor W₂ form a spark suppression circuit for the centrifugal contacts.

F) Circuit Description of the Oscillator
(St Str 1942/1) Fig. 5

This unit is a self-contained Hartley oscillator. The necessary voltages are taken from the mains transformer "N" whose primary has tappings for connection to 220, 150 and 110 volts A.C. mains, and is provided with 3 separate secondary windings. Winding V supplies the heater current for the rectifier tube R₁, winding IV that for the
oscillator tube $R_1$. The indicator lamp $P_1$ is connected in parallel with the heater of tube $R_1$ and lights up when the oscillator unit is switched on. Winding III together with the rectifier tube $R_2$ and the smoothing circuit $C_1-C_4$ and $W_1$ provide the anode current for the oscillator tube $R_1$.

The mains is connected to the mains transformer via the fuse $S_1$ by means of the switch $S_2$. The tubes take about 1 minute to warm up. When the anode current begins to flow through winding 11-12 of the feed-back transformer $SU$, a magnetic field is built up in the latter, thus inducing a voltage in winding 13-14. The resulting surge excites a damped oscillation in the tuned circuit, thereby applying an alternating voltage to the grid of tube $R_1$, whose anode current varies accordingly. The A.C. component of the anode current excites the tuned circuit via the feed-back transformer $SU$ in the same phase and compensates the losses, so that the oscillation is maintained. The feed-back transformer has a further winding 1-2: the A.C. voice frequency voltage induced in this winding is keyed by the transmitter contacts and sent on to the radio transmitter.

The frequency of the output voltage of the oscillator can be set to 900, 1000 or 1500 c/s by connecting various condensers in the tuned circuit. This is done by connecting the appropriate link on the terminal strip $A_1$ as follows:

- link between a and b for 900 c/s
- link between a and c for 1000 c/s
- link between a and d for 1500 c/s

II. Packing

For delivery the perforated tape transmitter is normally mounted on a shock-absorbing transportation board (824) in a transportation case. To unpack the machine, the lid should be removed and the two wooden blocks fastened in diagonally opposite corners should also
be removed. The machine can then be lifted out on its transportation board, to which it is fastened from below by four hexagon screws. These four screws should be removed with a 10 mm socket wrench through the clearing holes provided for this purpose in the base plate of the transportation board. The rubber feet for the perforated tape transmitter, which are mounted on the upper side of the transportation board, should be unscrewed and screwed into the base plate of the transmitter in the 4 tapped holes (M 3 thread) provided beside the 4 larger tapped holes (M 6 thread) for the mounting screws.

III. Installation Servicing

A) Connecting the Transmitter
   Mains Connection
   The safety (Schuko) mains plug of the perforated tape transmitter should be plugged into a safety (Schuko) socket of the 220 volts A.C. mains.

   The mains socket must have a good earth connection

   Telegraph Connection
   The output lead with the coaxial plug should be plugged into the socket leading to the radio transmitter.

B) Switching on the Oscillator
   The oscillator switch (917/704/8) on the rear side of the machine should be switched on. The indicator lamp (922/215/14) on the top side of the oscillator lights up, indicating that the oscillator is on.
   (Warming up period is about 1 minute).

C) Adjusting the Output Level
   The output level should be preset when the perforated tape transmitter is put into service. For this purpose, remove the cover of the tape transmitter. Connect a vacuum tube voltmeter with an input impedance greater than 40,000 ohms to the terminals a/b on the terminal strip (932/102/9) in parallel to the output line.
order to maintain a high signal/noise ratio, the output should be adjusted to a fairly high level, normally to +1 neper (+6.7 db.). With the output line connected for operation (see III.A) and the push-button (508/6) for continuous signal depressed, turn the potentiometer (919/603/14) of the oscillator until the vacuum tube voltmeter shows 2.1 volts. However, if this relatively high output level causes interference on neighbouring lines, it should be reduced. On completion of this adjustment, replace the cover.

IV. Operation

A) Switching on the Perforated Tape Transmitter
The mains switch of the perforated tape transmitter located on the right-hand side of the base plate, should be switched on ("Ein") (motor starts). This switch also switches the output line through to the transmitter contacts at the same time.

B) Inserting the Perforated Tape
The locking lever (753/2) should be raised in order to stop the feed (Vorschub aus). Open the hold-down plate (10245/11) of the scanning head, and pass the perforated tape over the guide rod (717/2) and under the rod of locking lever (753/2) into the paper guide channel so that the pins of the pin wheel engage the feed holes in the perforated tape. Close the hold-down plate (10245/11) again.

C) Starting the Siemens-Hell Printers
The Siemens-Hell printers are started by depressing the push-button for continuous signal (508/6) for about 3 sec. (remote control unit of the printers).

D) Switching on the Tape Feed
The locking lever (753/2) should be pressed downwards, thereby switching on the tape feed (Vorschub ein).
E) Transmitting the Interval Signal
If no information is to be sent for a short interval during a transmission, the interval signal is transmitted to indicate that the transmission is not yet finished. By pressing the push-button (762/2 and 762/6) (Pausenzeichen "ein"), the interval signal contact set is laid against its cam (675/10) and tape feed is suppressed. The interval signal is switched off by depressing the push-button (762/2 and 762/6) (Pausenzeichen "aus"). To continue transmission of the information on the perforated tape, the locking lever (753/2 and 753/6) should be pushed down (Vorschub "ein"). To save paper in the far-end printers during longer idle periods, it is recommended to stop the printers (see section IV, F) and transmit the interval signal or the station identification code.

F) Stopping the Siemens-Hall Printers
The far-end printers are stopped by their remote control units when the push-button for continuous signal is depressed for 10 to 12 seconds. After stopping the printers, at least 1 minute should be allowed to elapse for the thermal relays to cool down before switching the printers on again.

G) Switching Off the Perforated Tape Transmitter
Before switching off the perforated tape transmitter, the tape feed should be suppressed by raising the locking lever (753/2 and 753/6) to the "Vorschub aus" position. The perforated tape transmitter is switched off by means of switch (917/703/3), and the oscillator by means of switch (907/704/8).

V. Maintenance
A) Checking the Speed
The speed of the built-in motor (30704/13) is kept constant by the centrifugal governor (5724/13). The latter is so de-
signed that no readjustment is necessary in practical operation. The speed is checked by observing the stroboscopic pattern on the periphery of the governor through the aperture of a vibrating tuning fork of 125 c/s for a transmission speed of 5 characters/sec. or 137.5 c/s for a transmission speed of 5.5 characters/sec. If the stroboscopic image appears to wander in the direction of rotation of the motor (see arrow on motor), the speed is too high. If the stroboscopic image appears to wander in the opposite direction, the speed is too low. Should a readjustment of the speed become necessary after a long service period or after replacing the governor contacts, the cover of the governor should be removed with the aid of an offset screwdriver, and the tensioning nut (5758/13) of the spring suspension turned in the appropriate direction by means of a screwdriver.

D) Replacing the Motor and Governor Brushes

The motor and governor brushes should be replaced when they are worn down to a length of about 5 mm. Each time the brushes are changed, the condition of the commutator and the sliprings should be checked. If the surface is dirty, it should be cleaned with a suitable solvent (e.g. carbon tetrachloride). An even dark shiny surface (patina) need not be cleaned in this way. If, after cleaning, it is observed that the surface is rough or pitted, it should be smoothed with the motor running by means of fine grain emery paper; the commutator should then be cleaned of dust with the motor switched off. When inserting new brushes, only brushes with a preformed running surface should be used.

C) Replacing the Governor Contacts

The governor contacts should be checked after about 1,000 hours of service. If they are heavily pitted, they should be replaced. To do this, the motor must be removed. The strap
should be removed, and the motor lifted upwards out of the machine. Next the governor brushes should be drawn out. The screw (9157) between the governor casing and the sliprings, which fastens the governor on the motor shaft, should be removed. The governor can now be slid off the motor shaft. The governor spring (5756/13) should be carefully unhooked from the contact lever (5729/13) with the aid of adjusting pliers (Caution! Do not let the spring snap together). The two screws which hold the axle (5732/13) should be unscrewed, and the contact lever (5729/13) lifted out. The contacts can be removed and replaced with a 5.5 mm hexagon wrench.

D) Cleaning and Lubricating

The scanning head should be cleaned of paper dust frequently with a dust brush and rag.

The machine should be cleaned of dust and superfluous oil every 4 weeks. When carrying out cleaning operations, the contacts should be covered with a clean cloth free of fluff. The machines leave the factory oiled and greased. The new machine should be re-oiled three times at intervals of 50 service hours each, and then after every 200 service hours or at least every month. Only high quality lubricants should be used for oiling and greasing. Suitable oil and grease (e.g. Shell-BG 8 oil and Shell-F1 2 grease) can be obtained from our factory. Pure mineral oils of the same grade, and greases to a base of lithium soap with a drop point of at least 150° C can also be used. All bearing and sliding surfaces and also spring suspension points should be lightly oiled. Particular attention should be paid to light but regular lubrication of the cams until a thin film of oil has formed over the running surface. The contact sets should remain free of oil. When lubrication has been completed, the contacts should be cleaned, preferably with a contact cleaner. The ball bearings should be greased annually. To do this, the ball bearings should be removed, thoroughly
cleaned with petrol, packed with grease, and then replaced.

VI. Changing the Speed of Transmission (5 or 5.5 characters/sec.)

The machines are delivered from the factory for a transmission speed of 5 characters/sec. If it is desired to operate the perforated tape transmitter at a speed of 5.5 characters/sec., a governor spring (5768) can be obtained from the factory and exchanged for the governor spring (5756/13). The motor speed should then be adjusted with the aid of a 137.5 o/s tuning fork as described in Section V, A.
Fig. 4

Siemens-Hell Perforated Tape Transmitter T send 62a

(1) Telegraph connection lead with CD-type coaxial plug T ltg 144 K
(2) Mains lead T ltg 362a with mains plug and earthing contact
(3) Transmitter contacts
(4) T sum 10a as per St Str 1942/1
(5) Plug strip
(6) Motor with governor

Fig. 5

Oscillator T sum 10a

(1) Link between a and b = 900 c/s
   " a " c = 1000 c/s
   " a " d = 1500 c/s
(2) To the transmitter contacts
(3) Connection to the plug strip
(4) Mains
(5) Transmitter contacts
(6) Output

Tube base connections seen from below