Equipping the Model 28 Stunt Box

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Perhaps the most unique and important feature of the Model 28 series of teletype equipment is the stunt box. This is the device that permits the machine to perform or respond to mechanical and electrical signals and further control external equipment. Several references that pertain to the stunt box are as follows:

a. TTY Corp Bulletin, Section Nr. 573-115-103, Description and Operating Principles, 28 Stunt Box.

b. TTY Corp Bulletin, Section Nr. 573-115-200, Installation of Function Parts on a 28 Stunt Box.

c. The 28 Stunt Box, A Bell System color brochure that, unfortunately, is out of print, but nevertheless a good reference, if you can find one!

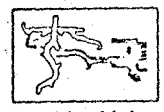
d. Mouse Machine Modifications, by Irv Hoff, 8 parts, printed in RTTY Journal 1970-71.

e. TTY Corporation Bulletins 216B (Desc), 217B (Tech & Adj), 1149B (Parts) Model 28 KSR (Additional Bulletins for ASR as required). (While not everyone will have ready access to the above references, they are listed in the interest of providing as complete a list as possible. The TTY Corp. Bulletins may be purchased from that company.)

Behind the front plate of the printer unit there are eight code bars that can shift left (marking) or right (spacing) when the appropraite signal is received. The second through sixth code bars are directly associated with the five elements of the received teletype signal, while the top (first), seventh, and eighth code bars are positioned independent of, or indirectly from the received code. Of these latter code bars, most amateurs will be interested primarily in the bottom two; the seventh usually being the "zero" code bar used by amateurs for auto CR-LF, and the eighth being the letters-figures shift bar. The top bar is infrequently used for such things as call sign recognition activation/inhibit, mechanical SEL-CAL operation, or excessive line feed protection in which case it will be moved between the print or non-print positions upon receipt of the proper code, but is generally locked into the print condition by a small clip on the outside left of the printer, at the end of the code bar assembly. These three bars are moved left or right by means of a shirt fork mounted on top of the stunt box that engages a post over the code bar assembly. The stunt box itself is an assembly that mounts behind the code bars and contains various function bars to interact with the eight code bars. When you look from the back of the machine (with paper roll/spindle removed) you see the top and back of the stunt box, with unshift-on-space screw on the top left, then the figs/ltrs shift slide, and perhaps some electrical switches. Protruding and visible from the rear of the stunt box are pawls, levers, spring plates, and the rear tip of the function bars. A large flat vertical blade (stripper blade) goes across the rear of the stunt box, and is an integral part of the box on Mark III printers (on Mark I this blade sticks through a slot on each end of the printer and is externally operated). This stripper blade releases latched levers on its downward motion, and releases operated function bars on its upward travel. On every complete rotation of the main printer shaft, each function bar is allowed to move forward under spring action against the code bars in front of it. If the code received (and code bar alignment) is such that it coincides with the times on any individual function bar, that bar then moves fully forward so as to engage the pawl in its slot. All function bars then are then moved rearward and those pawls that have been engaged are carried rearward sufficiently so the pawl rotates its associated function lever backward. This lever is the piece that actually accomplishes the desired operation, such as opening or closing a switch, space suppression, line feed, letters shift, sequential operations, etc.

Essentially, each of the 42 slots in the stunt box may be made to perform a function by installing the appropriate function bar, lever, pawl, and spring plate in that slot. The function bar is "coded" by tines on the end adjacent to the code bars which are set either right or left of center to correspond to "mark" or "space" position of the code bars which move in accordance with the received signal. Figure 1 is a chart depicting various function bar coding. Functions performed by the stunt box can be classified as required and optional. Required functions are those of carriage return, line feed, letters and figures shift, all of which are usually assigned to specific slots. Normally,

FUNCTION BARS . . . *how they are coded*



Function bars are literally the "passkeys" to the performance of functions. In their forward motion into the "lock-like" code bars – they search for an opening.

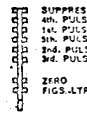
Like keys . . . function bar projections vary . . . and they vary in several ways. The number of tines and the way they are angled . . . left, for marking and right, for spacing usually varies from one function bar to the next.

Shown below in front views are function bars with tine arrangements corresponding to the 5-level signal characters that will allow these function bars to move completely forward.

Coding Function Bars
As indicated in this diagram . . . by snapping off tines, "universal" function bars can be coded for any one of the code characters.

Fig. 1

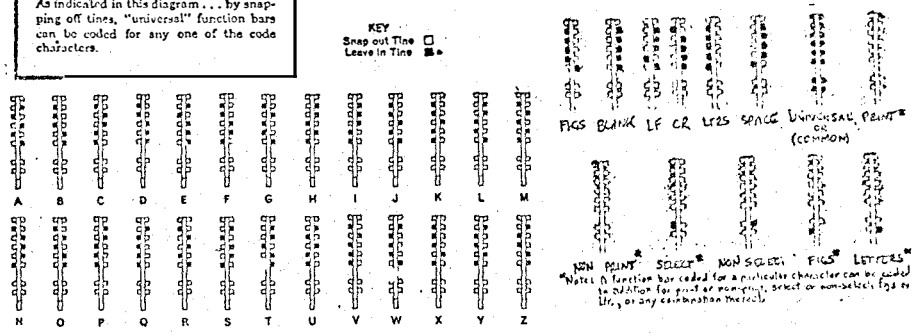
Universal Function Bar



Front View

Illustrated above is a side view of the fully loaded bar called the "universal" function bar. At left is the front view of this bar with tines identified as to the kind of typing unit code bars they contact.

KEY
Snap out Tine □
Leave in Tine ■



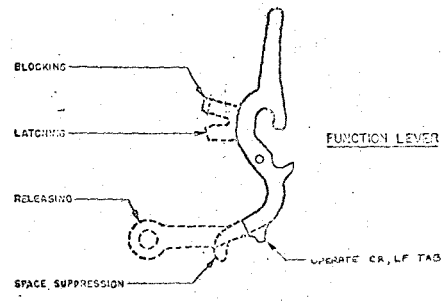
space suppression is also provided with certain of these functions. Optional functions are any desired by the individual to respond for bell, WRU, reperf control, and may be assigned to any of the slots not used by required functions. The required functions require certain slots to be used for specific operations; on all but a very few old printers, slots are originally equipped with the following minimum functions furnished:

Slot 1 - Space (unshift-on-space usually equipped by disabled)
Slot 2 - Figures
Slot 3 - Letters
Slot 5 - Carriage Return
Slot 40 - Line Feed
Any Slots - Space Suppression for CR, Blank, LF

As Irv Hoff carefully explained in his Mouse Machine articles, this original setup should be modified for amateur use so that a printer will have the "standard three" features commonly desired for RTTY use. (Non-overline, Auto CR-LF, Unshift on Space). This amateur modified setup then uses these slots with functions bars coded as indicated:

SLOT **CODE**

Slot 1 - Space (with top mounted screw backed out for unshift on space enable)
Slot 2 - Figures
Slot 3 - Letters
Slot 4 - Auto CR-LF (for Auto CR)



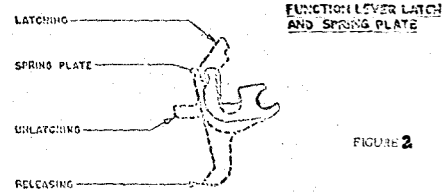


FIGURE 2

Slot 5 - Line Feed to provide CR on receipt of LF
Slot 39 - Auto CR-LF (for Auto CR)
Slot 40 - Line Feed (normal LF) (space suppression may be on either LF Function bar)
Any Other Slot - Special; Space suppression for CR and Blank (by using a specially coded function bar to respond to both CR

or Blank, thereby saving one slot. This special coding is accomplished by breaking off the top tine of either a CR or a Blank bar, allowing it to respond to both functions.)

With this lineup you will have a printer that does all the things you will really need for practical RTTY operation; the only initially strange characteristic of this configuration is that nothing will happen locally when you type a CR, and both CR and LF will occur whenever a LF is typed. And, you have 34 empty slots to code for any options you may desire!

Now, here is the interesting part of the entire stunt box study - just how do you use these 34 slots? Customary, of course, is equipping one slot with a function bar coded for upper case S, or bell. Many machines also have this installed at the factory. If you don't like a raucous bell in the shack, you can instead hook up a chime as has been done by several enthusiasts.

Perhaps here is the place to briefly cover the variable features of the levers and plates used to equip slots to respond to sequential characters. The function bar is obviously coded for the desired action. Function levers (there are more than two dozen kinds!) can be obtained that:

a. Operate electrical switches
b. Suppress spacing
c. Latch for one character
d. Latch until released upon specific code
e. Operate sequentially
f. Operate top slides (Figs/Ltrs)
g. Move bottom T-bars (blank-blank, CR, LF)
h. Perform practically any combination of the above!

There are three different spring plates; plain, latching (one character), and latching (bail release). Figure 2 is a pictorial explanation of Lever and Plate variations. Sequential operation is used for the many station control features that are being used by many amateurs throughout the world with Model 28 machines. From figure 2 it can be seen that blocking and latching arms are available together or separately on a function lever. Assume you want to have the sequence "Figs - Blank - H" operate an electrical switch (commonly used for transmitter turn-off (N.C.) or as part of a longer sequence for WRU turn-on (N.O.). You would use a latching sequential lever in the "Figs" and "Blank" slots, and a plain lever** in the "H" slot. Of course, each slot that has a latching lever would have a latch spring plate and a normal pawl. Over the "H" slot you would mount an appropriate switch. Now when the character "Figs" is received, not only does the Figs bar in slot 2 operate, but so will the one you have added for this sequence. This additional "Figs" bar and pawl moves rearward and will rotate and latch its associated lever, and the lever's blocking arm which curves around behind the next higher slot will move out of the way allowing it to operate on the next cycle. Similarly, if the very next character is a "Blank", the lever in that slot will unblock the next higher slot, where you have an "H" bar. If the next received character is an "H", the function lever in that slot will rotate and operate the switch mounted on top of the stunt box. Note that if any other character or garble is received in the midst of the sequence, the switch will not operate, as the stripper blade will unlatch all latched function levers on the next received character. As long as the blocking arm of the lever is not latched out of the way, the function bar of the next higher slot can not be "selected" or move forward into the code bars.

Sequential operations are the heart of all station control schemes; they always consist of two or more slots coded so as to respond to the desired sequence of characters. The longer sequences are used where more protection is required, such as WRU or reperf turn on; the shorter sequences are adequate for such things as CW ID activation, etc. (Note that codes are usually designed using character sequences that do not commonly occur in normal conversation.)

Here is where your work comes in - deciding what features you want in your station. A worksheet has been prepared to assist in planning your particular stunt box configuration. When considering optional function, it is essential that an electrical diagram for your station control scheme be made at the same time. A sample of a filled-in worksheet together with its associated station control is attached as Figures 3 and 4. This station control scheme is essentially that published by Irv. Hoff, W6FFC, in the May 71 RTTY Journal, and modified for reperf control, 4 N's deactivation, and CW ID changes. Figure three has been laid out with the author's call sign and for use with a Model 28 ASR, and in addition to the "standard three" features, has as options the following:

a. WRU
b. Reperf remote on/off
c. Fig-Bl-H shut down
d. CW ID
e. Bell on Bell, BK, and call sign

f. Station control arm/disable

It should be emphasized here that each individual should analyze his own requirements and equipment **before** he decides on what kind of station control he needs or wants. This sample is just one approach to the problem, and is not in any way the only or necessarily best way of accomplishing the task. (Several other approaches to station control are possible, from more mechanical use of the stunt box to a "pure" electronic logic approach.)

Figure four is the associated circuit diagram that was made to complement the stunt box layout. It would be helpful if the reader would place these two figures side by side as he proceeds through the following explanation.

One factor that becomes apparent when a stunt box is removed from the printer is that there are only certain specific places that shift forks and switches may be mounted on top of the box, due to the location of the drilled and tapped holes. Since our example does not use any shift forks other than the normal space-figs-ltrs fork on the left end of the box, it will suffice to say that additional shift forks can only be mounted where the two large tapped holes are found across the top of the stunt box. Electrical switches can be placed more frequently; however, to get maximum utilization out of the switch assemblies, they too should be planned (also for neatness and economy). Switch blocks come in double or quadruple units, and are attached so that they will work over one to four slots, beginning with an odd

KL7HKB
M28 STUNT BOX CONFIGURATION

WRU
REPERF ON/OFF
AUTO TURNOFF
BELL ON BK

SLOT	FUNCTION BAR DESC	FUNCTION BAR P/N	LEVER* P/N	PLATE TYPE**	OTHER EQUIP & REMARKS
1	SPACE	155129	152642	SPRING	ENABLE UNSHIFT ON SPACE
2	FIGS	152666	152641	SPRING	FIG-LTRS SHIFT SLIDE
3	LTRS	152665	152641	SPRING	
4	SC CR LF	152671	152642	SPRING	AUTO CR-LF
S5	LF (P)	153435	152641	SPRING	LF 152668 PERMISSIBLE
6	N	152689	152121	LATCH	
S7	N	152689	152121	LATCH	
8	N	152689	152121	LATCH	
S9	N	152689	152642	SPRING	N.C. SWITCH - DISARM CONTROL
10	FIGS	152666	152121	LATCH	
S11	BL	152669	152121	LATCH	
12	H	152683	152642	SPRING	N.C. SWITCH - TURN OFF TX
S13	LTRS	152665	152121	LATCH	
14	H	152683	152121	LATCH	
S15	K	152686	152121	LATCH	
16	B	152677	152121	LATCH	N.O. SWITCH - RING BELL ON CR
S17	FIGS	152666	152121	LATCH	N.O. SWITCH - ARM CONTROL
18	UC BL	152693	152121	LATCH	
S19	UC H	152673	152642	SPRING	N.O. SWITCH - TURN ON WRU
20	UC S	152672	152298	LATCH	N.O. SWITCH - RING BELL
S21	UC BL	152693	152121	LATCH	
22	UC Z	153161	152642	SPRING	N.O. SWITCH - TURN ON REPERF
S23	UC BL	152693	152121	LATCH	
24	UC D	153521	152642	SPRING	N.C. SWITCH - TURN OFF REPERF
S25	B	152677	152121	LATCH	
26	K	152686	152642	SPRING	N.O. SWITCH - RING BELL ON BK
S27					
28					
S29					
30	CR/BL	SPECIAL	152641	SPRING	REMOVE TOP TINE OF BAR - SHIFT SW
S31					
32					
S33					
34					
S35					
36					
S37					
38					
S39	SC CR LF	152671	152642	SPRING	AUTO CR-LF
40	LF	152668	152642	SPRING	NORMAL LINE FEED
S41	FIG	152666	152659	LATCH	
42	LF	152668	152641	SPRING	N.O. SWITCH - TURN ON CW ID

FIG 3

* 152641 - SPACE SUPP
152642 - PLAIN
162059 - LATCH, SPACE SUPP
152121 - PLAIN (SEQ, LATCH)
152659 - SPACE SUPP (SEQ, LATCH)
161649 - LATCH (SEQ)
152298 - LATCH, PLAIN
153670 - UNLATCH BAIL

** 152666 - SPRING
154613 - LATCH
152089 - BAIL REL LATCH PL

numbered slot (5).

Beginning in slot 6 is the station control disable sequence of 4 N's. This is shown on figure 4 as SB9 and will open the flow of current to relay K4, a double pole double throw unit. With K4 open, relay K5 cannot operate, thereby preventing unintentional reperf operation.

Slots 10 through 12 are the transmitter turn-off sequence, and shown on figure 4 as SB 12. This switch opens the holding circuit for relay K1, a four-pole double throw unit that is the heart of the station control setup.

Slots 13 through 19 constitute the WRU turn-on, shown as SB 19 on figure 4. Since the last three characters of this sequence are the same as slots 10 through 12, the relay R-C network in figure 4 insures that there is a different effect of the two switches SB12 and SB19. SB19 turns on relay K2, a double pole double throw unit, relay K1, and initiates relay K3, a time-out relay of approximately 30 seconds or so. A word of caution: NEVER operate a WRU without some sort of time out protection; if you wish to become famous overnight, leave it out, get a stuck TD, and thereby leave a carrier on an autostart frequency for several hours! Such operation is not only highly illegal, it also tends to make it hard for your signal to be "heard" for quite some time thereafter!!

Slot 17 has another switch shown as SB17 on Figure 4; this turns on K4 with a fair amount of protection. Subsequent receipt of the sequence B1-Z in slots 21 and 22 will then close SB22 on figure 4, operating K5 which activates the reperf in the ASR by "unblinding" a solid state selector magnet driver (SMD) (TTY part number 177010). This SMD has the ability to follow the DC signal loop, reconstructing the signal to the reperf; by connecting two points together in the SMD (with a 47 ohm resistor) it is put in a "blind" or mark hold condition, without affecting the main loop.

Slots 23 and 24 then open SB24 which opens up the circuit to K5, turning off the reperf by "blinding" the SMD.

Slots 41 and 42 close SB42 which activates an automatic CW IDer (this one designed by WA1DLZ which in turn interrupts the TD until ID is completed at which time the TD is allowed to continue.)

A bell is energized for a short period (less than one revolution of the printer shaft or approximately 160 ms) upon receipt of: an upper case S, slot 20; letters B-K, slot 26; and SB16 respectively, which are connected in parallel to ring a bell or chime as desired.

The other switches on figure 4 are manual for non-automatic control of the transmitter, TD, CW IDer, or reperf. They may be mounted on the keyboard, on

CONTINUED ON PAGE 13

STATION CONTROL

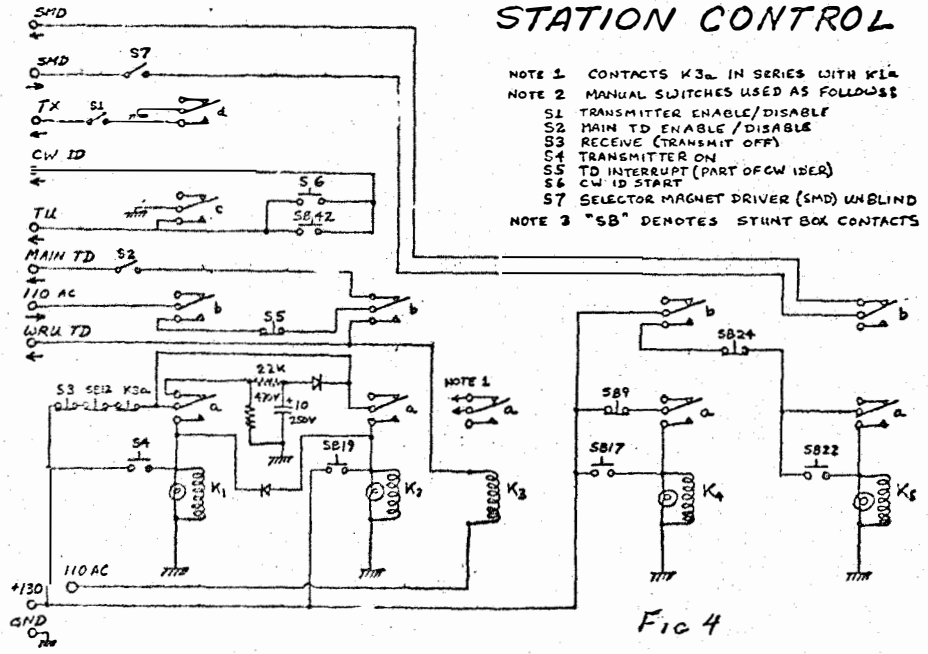


Fig 4

KL7HK8

In the meantime, look for Bud on 29490 khz.

No activity from the Philippines for quite a while but via Gin we hear that DU1POL is now QRV.

We understand that OE9ERI has had contact with XT2AE but further info not available at the moment.

VK9XW has filtered through to the East Coast USA during the early morning hours recently, so keep listening.

QSL's are being mailed for the VP2 MRW operation so a SASE will get a card from Knobby. QTH listed last month.

Ariel, 4X4MR, is out of QSL's for the moment, but it has been suggested that a "homemade" card with all the QSO information does get results.

IC8SMY, while counting as Italy is a good catch for the prefix hunters. He has been quite active and is located at P.O. Box 39, Ischia Porto, 80077, Italy.

Larry, K1LPS/I8, and formerly KG 6NAA, recently traveled through northern Europe and had the opportunity to meet the boys at OZ4EDR and club president of the SARTG, OZ4FF. Larry is on the down side of his duty tour and expects to be "green keying" from Vermont again sometime next year. So you fellows needing Vermont to complete WAS be patient just a while longer.

Mike, OY1M, had some machine troubles causing a short QRT but seems to be back in business again. In addition to the home QTH previously published, he does have a QSL Manager and this route may be more convenient, it is --

R.F. Huntington, W6TCQ
5014 Mindura Drive Torrance, Ca. 90505

Congratulations go to the following stations for --

WAC	Nr. 232	James Sims W5RYA
WAC 14mhz.	Nr. 2	Howard Markwell WØMT
	Nr. 3	James Sims W5RYA
	Nr. 4	Hans Shalk DJ8BT
	Nr. 5	Kungl. Soderman-lands Regemente SL5AR
	Nr. 6	Heinz Lammel DK4ZF
WAC 21mhz.	Nr. 1	Howard Markwell WØMT
	Nr. 2	Hans Schalk DJ8BT

Well, now that everyone has had a good long rest, it is time to get set for the Volta Contest which should take place in about a week or so. OX3JW should be active in this one.

The recent articles published using the UART and FIFO chips has caused a tremendous interest in their use for RTTY terminals. Pete, W6KS, has been making them available at about cost and postpaid stateside and now passes word that he can make them available to DX stations also. Units can be sent at the airmail letter rate and he has had success in doing this to several countries. See Pete's offer in the "Classified Ads" to obtain these hard to get items.

In the next issue we will run the RTTY-DX HONOR ROLL. To up-date your listing, please have the totals to me by 1 December. Those wishing to participate for the first time just send me two numbers, DX worked/DX confirmed, no list or QSL's needed until 100 confirmed is reached.

Since this is the December issue it indicates that another year has passed. In our age bracket there is a tendency to ignore the fact that "time marches on", but regardless, 1975 is just around the corner. Anyway, we wish all of you and your families a very Happy Holiday Season along with sincere thanks for your support of this column by your timely and informative contributions throughout the year.

73 de John

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the ASR front panel over the TD, of just about any convenient spot to the operator. Indicator lamps should be near the switches. The relays themselves can be mounted on the LESU or in the basement of the machine; the only caution is to insure isolation of the CW IDer from noise impluses to prevent false operation.

The foregoing was intended as a quick guide to understanding the M28 Stunt Box. Hopefully, it will give the reader the proper orientation to dig into his machine and learn first hand just what operations occur in the stunt box, and what can be done for his particular desired options. The author wishes to thank all who provided ideas and encouragement for this article, especially Fred WA1DLZ whose assistance was most helpful.

*WRU - Literally "Who are you", but used here to define an automatic short answer back that acknowledges a call.

** A plain lever will permit momentary operation of the electrical switch. It if is important to have the switch operated for an entire character interval (163 ms), a latching lever may be substituted.

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