1 MAIN FEATURES

- Serial data encoding for TMS 1000 or TMS 9940 decode.
- 64 + 64 Channel capacity.
- Direct drive of IR emitters.
- Ceramic resonator controlled oscillator.
- 6 to 9 volt battery operation.
- Automatic minimum transmission of four codes.
- Optional end code selection.
- Simple matrix keyboard.
- Low standby power.

2. FUNCTIONAL DESCRIPTION (see block diagram and timing diagram)

2.1 Power Up

In the standby condition the circuit consumes only leakage current (≃ 5 uA). When a key is pressed it first powers up and resets the counter chain. After a debounce period (9 mS) the key closure is verified and transmission is inhibited until a valid key closure is detected during the following keyboard scan.

2.2 Data Encoding and Transmission

When a valid key closure is found, the code associated with the path successfully strobed through the key matrix, together with a start bit and expansion bit (s) is loaded into an 8 bit PISO shift register. Then follow four transmission/space cycles irrespective of the state of key closure, during which time the shift register data is also recirculated.

SN76741N Each logical '1' transmission data bit consists of a 3.13 mS burst of 41 kHz carrier.

SN76751N Each logical '1' transmission data bit consists of a 1.56 mS burst of 41 kHz carrier followed by a 1.56 mS gap. This results in a return to zero (RZ) code which halves the transmitted current drain. However, if the associated receiver is based on a sampling technique it will now be necessary to maintain twice as accurate a sampling tolerance. Comparative codes for the two devices are shown in fig.7.

The transmitter output stage consists of an open collector transistor with a typical sink capacity of 100 mA. allowing great flexibility of the I.R. diode drive configuration and enabling direct drive if desired. After four code transmissions the keyboard is interrogated; if the key is up the circuit proceeds to power down; if not, the shift register is reloaded and transmission is continued until a key-up is detected. After a complete code transmission the circuit then proceeds to power down.

Key Roll Over. If the key command is changed during transmissions the new code will be loaded and transmitted as soon as a group of four of the original codes have been completed.

Simultaneous Key Closure. This will cause the highest order key on the highest order strobe line to be loaded except in the cases where the multiple closure is on the same KI line. In these cases no transmission will take place due to wire-anding of the keyboard strobe pulses. If full simultaneous key press operation is necessary then a series resistor (typical value 47K) should be placed in each KS line.

2.3 Power Down

Provision is made for the activation of an end code transmission. If selected this causes an all ones end code to be sent once before the circuit powers down to its quiescent state.

2.4. Expansion and Keyboard Configuration

Depending on the number of device input lines being used, either one or two expansion bits may be set by grounding the expansion pin (s). This provides the following maximum keyboard possibilities.

	Channels	Keyboard	Expansion Bit
(a)	64	8 x 8	Expansion bits open cct.
(b)	64 + 64	8 x 8	Expansion bit 1 switched
(c)	32 + 32 + 32 + 32	8 x 4	Both expansion bits switched

2.5. Transmission Codes

The 8 bit transmitted code is related to the hardware as follows:-

BIT NO.	FUNCTION
1.	Start bit (always one)
2.	Strobe line code, bit 1. (lsb)
3.	Strobe line code, bit 2.
4.	Strobe line code, bit 3. (msb)
5.	Input line code, bit 1. (lsb)
6.	Input line code, bit 2.
7.	Input line code bit 3, or Expansion bit 2.
8.	Expansion bit 1.

The resulting code transmissions are detailed in Fig. 3. Clearly if the end code option is used then the all ones code cannot be also used as a command code.

Two examples of a typical minimum transmission are shown in Fig. 4. If the end code option is not selected then an implied all zero end code(no transmission) takes place. This can either be detected as a unique code in its own right or else detected as an extended code spacing - either case indicating the key-up condition.

3. ELECTRICAL CHARACTERISTICS

3.1. Absolute Maximum Ratings (All Voltages with respect to OV)

Supply Voltage V_{cc}	11 Volts
Input Voltages	2 Volts
Output Voltages	V_{cc}
Output Current(I. R. drive output)	150 mA.
Operating free air temperature range	-20°C. to +70°C.
Storage temperature range	-55°C to 150°C

3.2. Electrical Characteristics at Recommended Operating Guidelines

Parameter	Min.	Typ.	Max.	Units
Supply Current @ I_{OL} = OmA. V_{cc} = 10V		8		mA
Supply Current @ I_{OL} = 100mA SN76741N		20		mA
(code dependent) SN76751N		14		mA
Standby current consumption		5		µA
I_{IL} Low level input current (Exp 1, Exp 2, End code pins)			-100	µA
Supply Voltage V	4.4	6 to 9V	10.0	Volts
V_{IL} Low level input voltage (Exp 1, Exp 2, End code pins)		0	0.3	Volts
V_{OL} Low level output voltage (O/P pin at I_{OL} = 100 mA.)		.5		Volts
Carrier frequency with 455KHz resonator *		40.9		KHz.
Data Pulse Width " " " SN76741N		3.13		mS.
SN76751N		1.56		mS

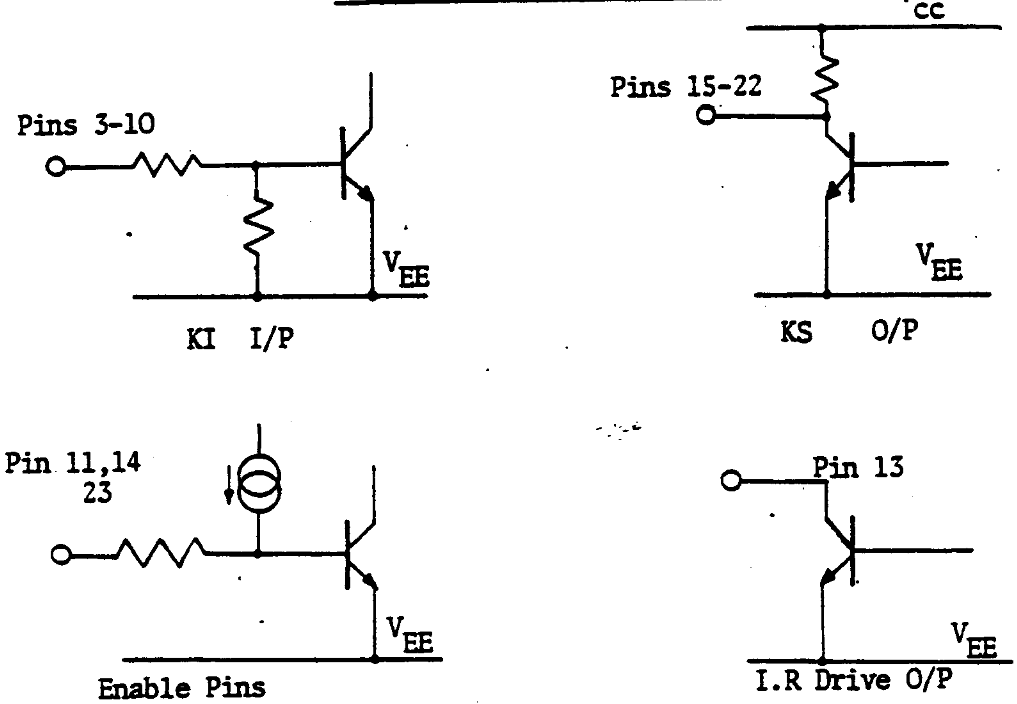
* Murata SFB455R

4. PIN LISTING

Package: 24 Pin DIL

Pin No.		
1	Osc)	Oscillator Connections
2	Osc)	
3	KI 1)	
4	KI 2)	
5	KI 3)	
6	KI 4)	Inputs from Keyboard
7	KI 5)	
8	KI 6)	
9	KI 7)	
10	KI 8)	
11	Expansion Bit 2	
12	VEE	
13	I.R. Diode Drive Output	
14	Expansion Bit 1.	
15	KS a)	
16	KS b)	
17	KS c)	Strobes to Keyboard
18	KS d)	
19	KS e)	
20	KS f)	
21	KS g)	
22	KS h)	
23	End Code Select	
24	Vcc	

Input/Output Configurations



5. SYSTEM CONFIGURATION

Fig.5 shows two example systems. The first illustrates direct drive of the infra red emitting diodes using the saturating output of the SN76741/751. The drive current is therefore defined by the forward characteristics of the diodes, the battery supply and a series resistor. The SN76741/751 is capable of sinking up to 100mA in this mode.

If larger drive currents are required a constant current buffer stage can be used. In the example of (5b) a visible l.e.d. is used to provide a voltage reference which defines the constant current in conjunction with a small value emitter resistor in the buffer transistor. This mode of operation adds the bonus of a visible indication to the user that the transmitter is functioning.

The keyboard requirements allow great flexibility according to the situation requirements. Single pole keys are used in any size matrix xXy

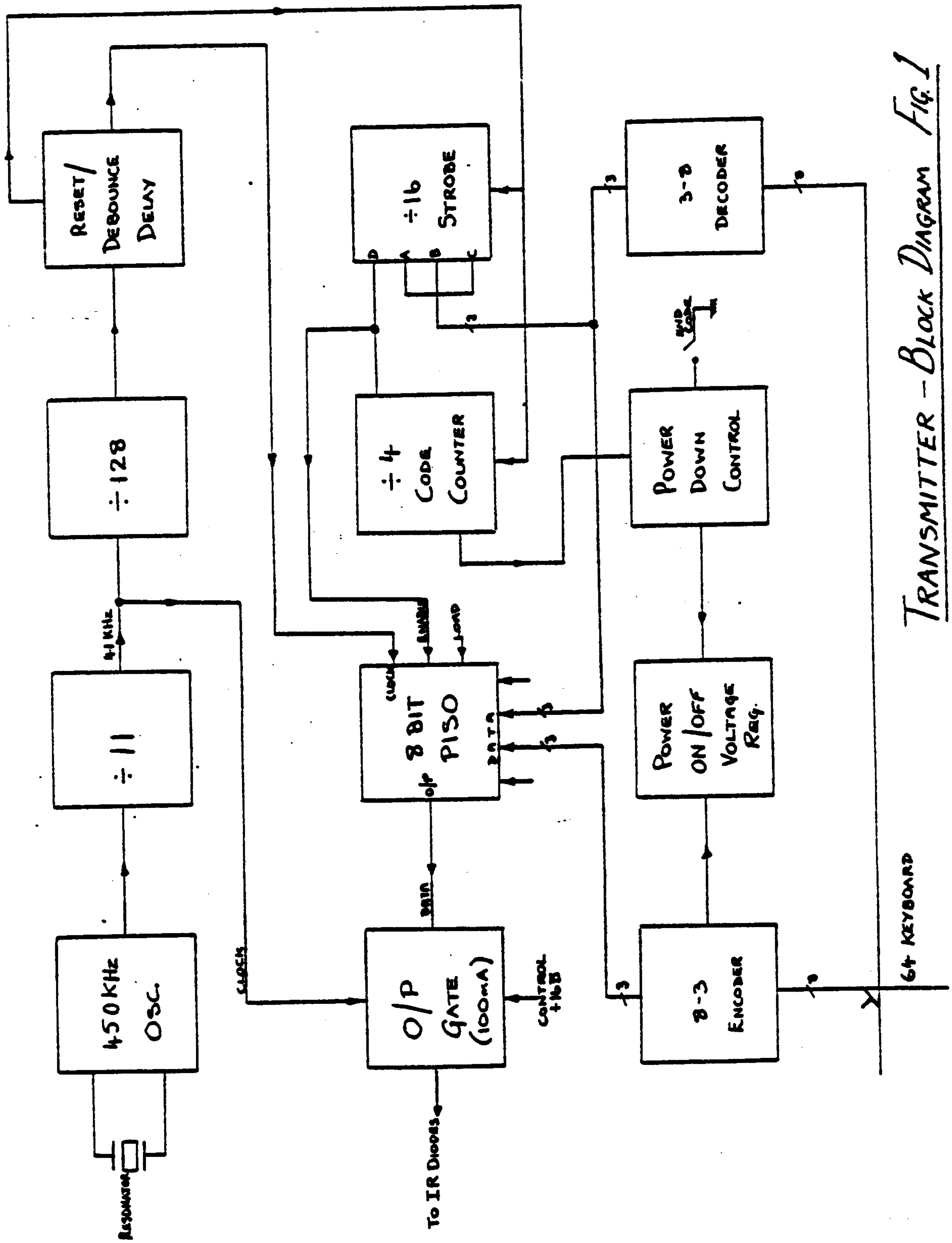
where $x \times y \geq$ the number of commands required

and $x \leq 8$ and $y \leq 8$

Fig.6 illustrates the distribution of codes and average I.R. diode current (100mA peak) according to the number of '1's in the transmitted code.

Fig. 5a and 5b show the use of small value capacitors between each used strobe output lines (KS) and ground. These capacitors are not critical in value (typically 220pF) and are necessary to ensure correct power off of the transmitter. Without these capacitors, if the keyboard capacitance is sufficiently large then it is possible for current to be fed into the input lines during the power down period when the strobe output lines transit up to the battery voltage. Under these conditions the transmitter could continue to cycle on with code transmission inhibited.

Care must also be taken to ensure that the load current, which will be switched on and off at the carrier frequency (40.9KHz), does not cause excessive voltage spikes on the device V_{cc} or inductive coupling onto the input lines. This can be achieved by correct routing of the load current and by decoupling the supply pins of the device.



TRANSMITTER – BLOCK DIAGRAM FIG. 1

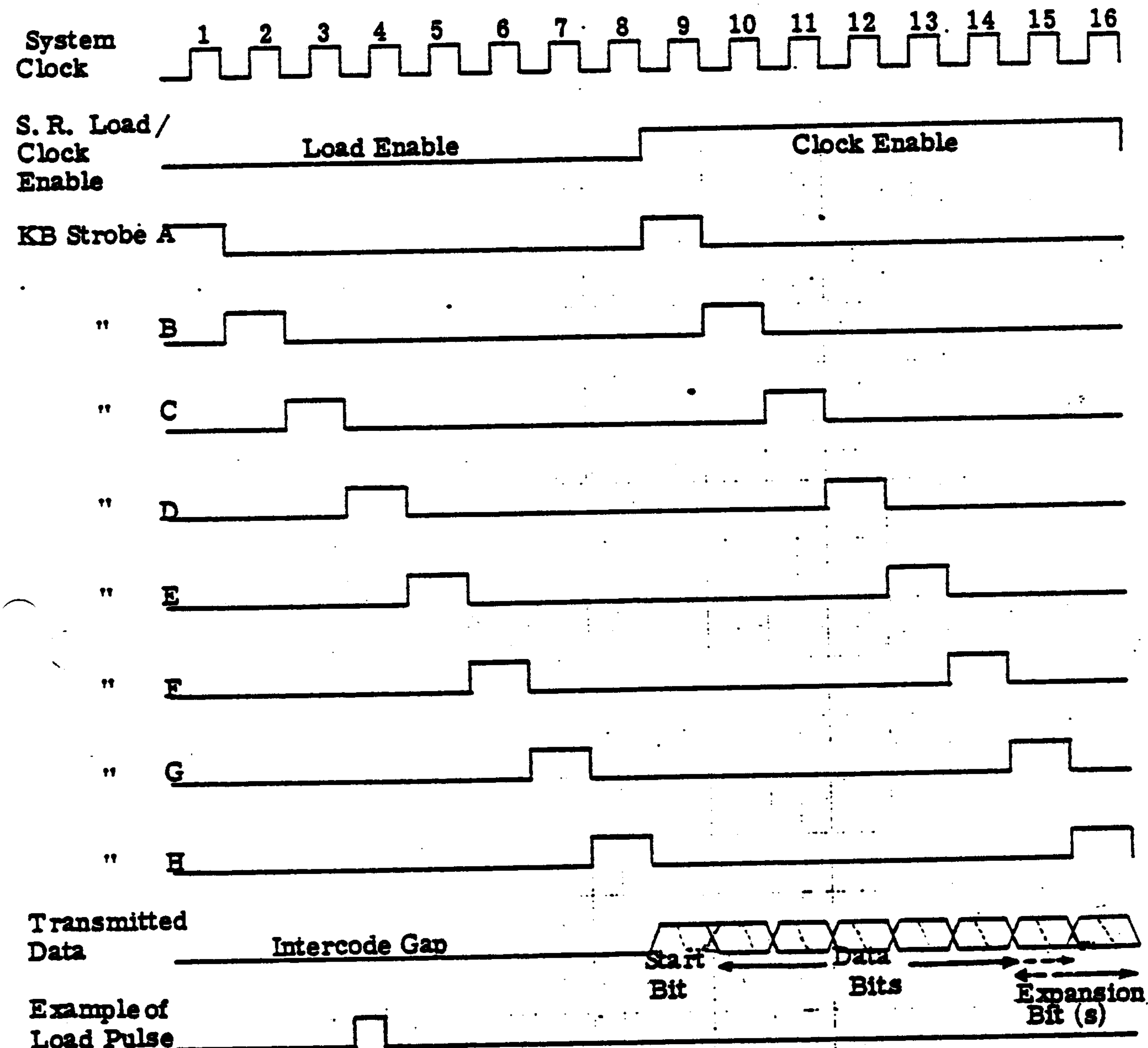


FIG 2. I. R. TRANSMITTER TIMING DIAGRAM

FIG. 3. DATA ENCODING (IN HEX)

Input Lines	a	b	c	d	e	f	g	h
8	71	73	75	77	79	7B	7D	7F
7	61	63	65	67	69	6B	6D	6F
6	51	53	55	57	59	5B	5D	5F
5	41	43	45	47	49	4B	4D	4F
4	31	33	35	37	39	3B	3D	3F
3	21	23	25	27	29	2B	2D	2F
2	11	13	15	17	19	1B	1D	1F
1	01	03	05	07	09	0B	0D	0F

Strobe Lines

64 Code Sequence   Expansion bit 1 = zero

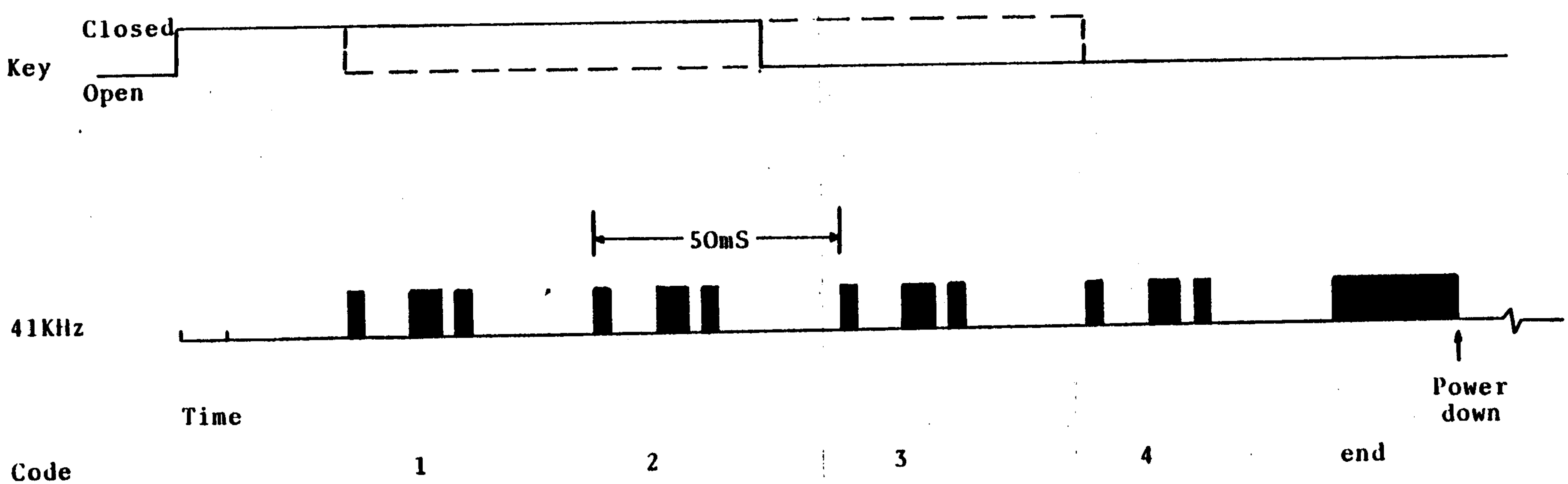
NOTE: The transmitted data consists of start bit & strobe line code followed by input line code. e.g. 71 in above table is transmitted as 10001110.

Input Lines	a	b	c	d	e	f	g	h
8	F1	F3	F5	F7	F9	FB	FD	FF*
7	E1	E3	E5	E7	E9	EB	ED	EF
6	D1	D3	D5	D7	D9	DB	DD	DF
5	C1	C3	C5	C7	C9	CB	CD	CF
4	B1	B3	B5	B7	B9	BB	BD	BF
3	A1	A3	A5	A7	A9	AB	AD	AF
2	91	93	95	97	99	9B	9D	9F
1	81	83	85	87	89	8B	8D	8F

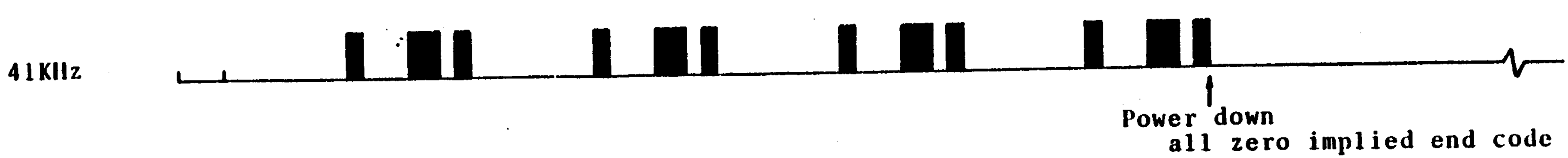
Strobe Lines

+64 Code Sequence   Expansion bit 1 = one.

*not permitted if end code option is used.

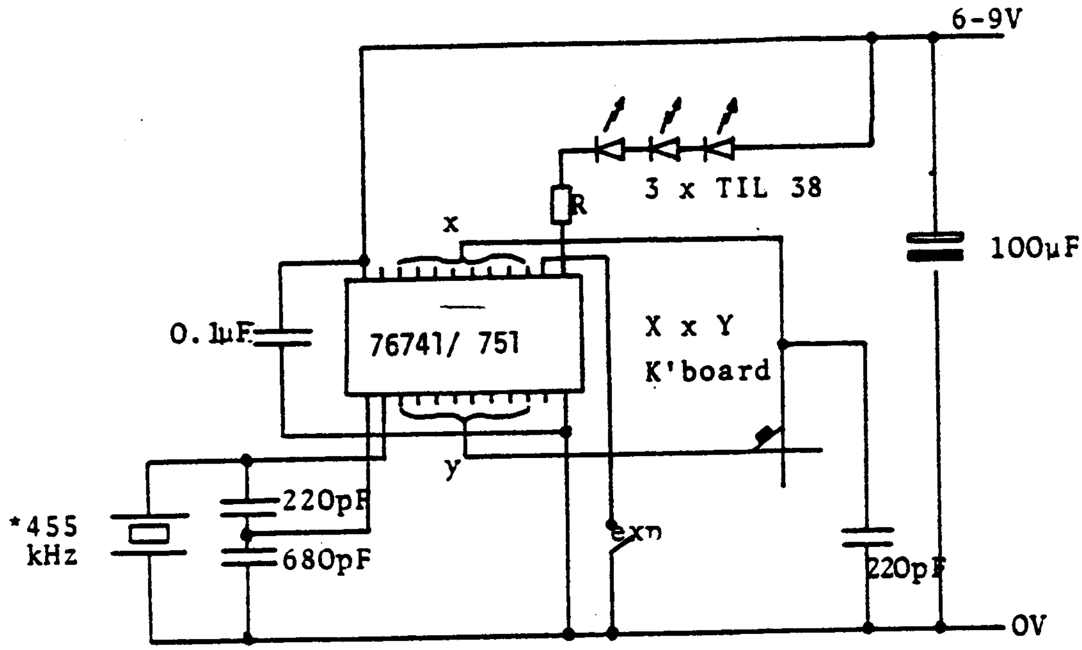


Minimum transmission of code B1 (with end code selected) SN76741N



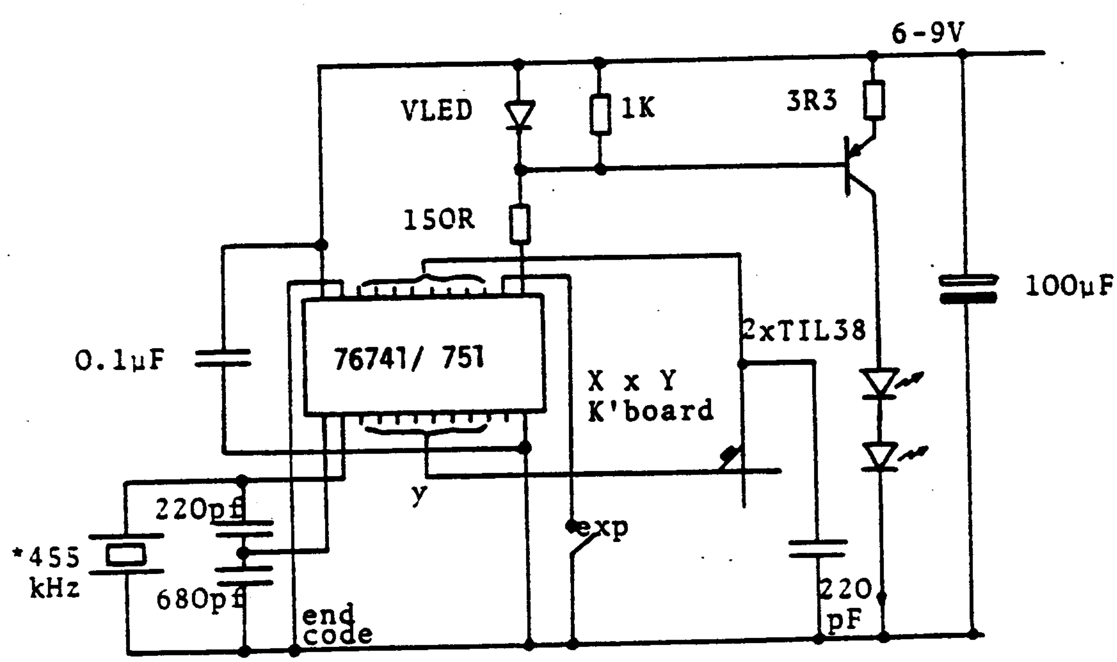
Minimum transmission of code B1 (end code not selected) SN76741N

FIGURE 4. TYPICAL TRANSMISSION FORMATS . (SN76741N)



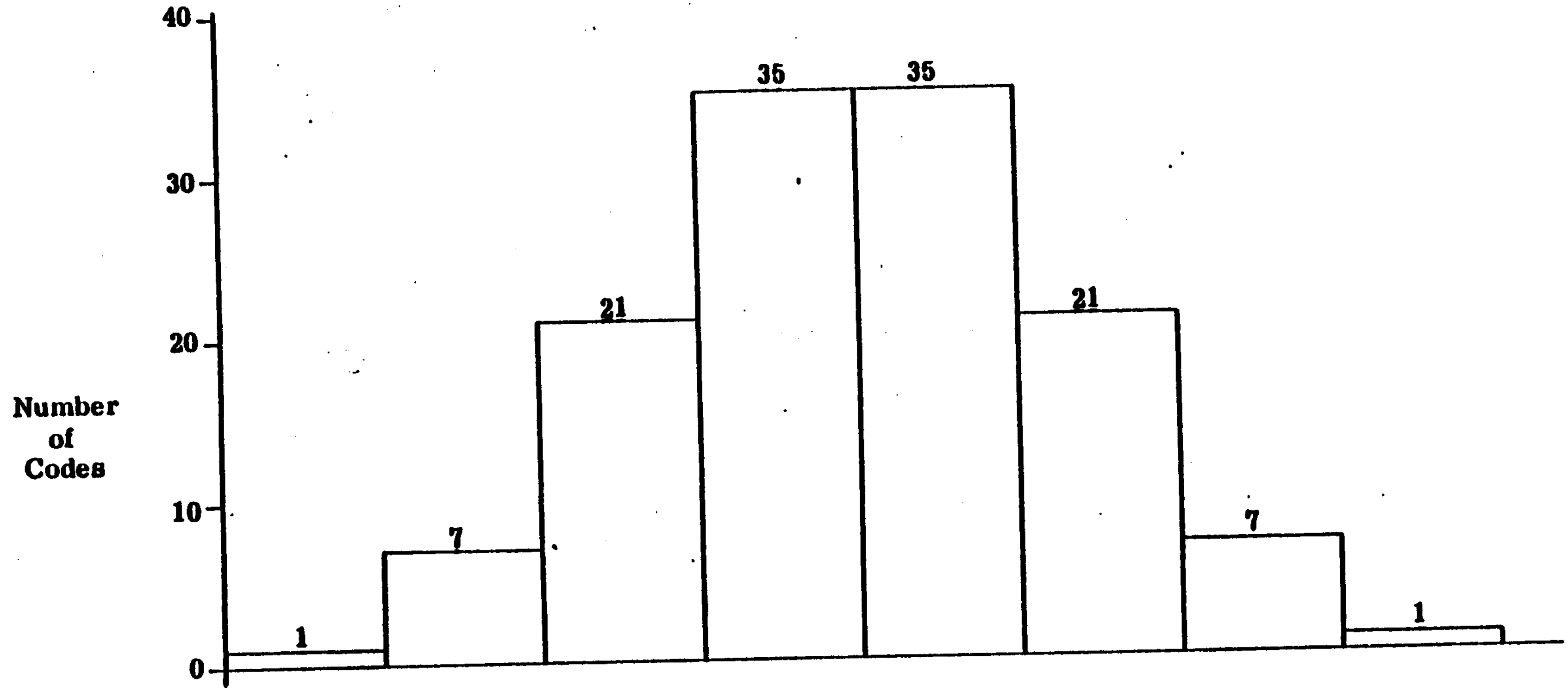
a) xy + xy channels with direct drive output

*e.g. Murata SFB 455R



b) xy + xy channels with end code and constant current output

FIG.5. TYPICAL SYSTEMS



No of '1's in Code	1	2	3	4	5	6	7	8	
Av. Diode Cur't mA(100mA)Peak	3.12	6.25	9.37	12.5	15.6	18.8	21.8	25	76741
Cumalative No. of Codes.	1	8	29	64	99	120	127	128	
Av. Diode Cur't (mA) (100mA pk)	1.56	3.13	4.69	6.25	7.8	9.4	10.9	12.5	76751

FIGURE 6. CODE DISTRIBUTION

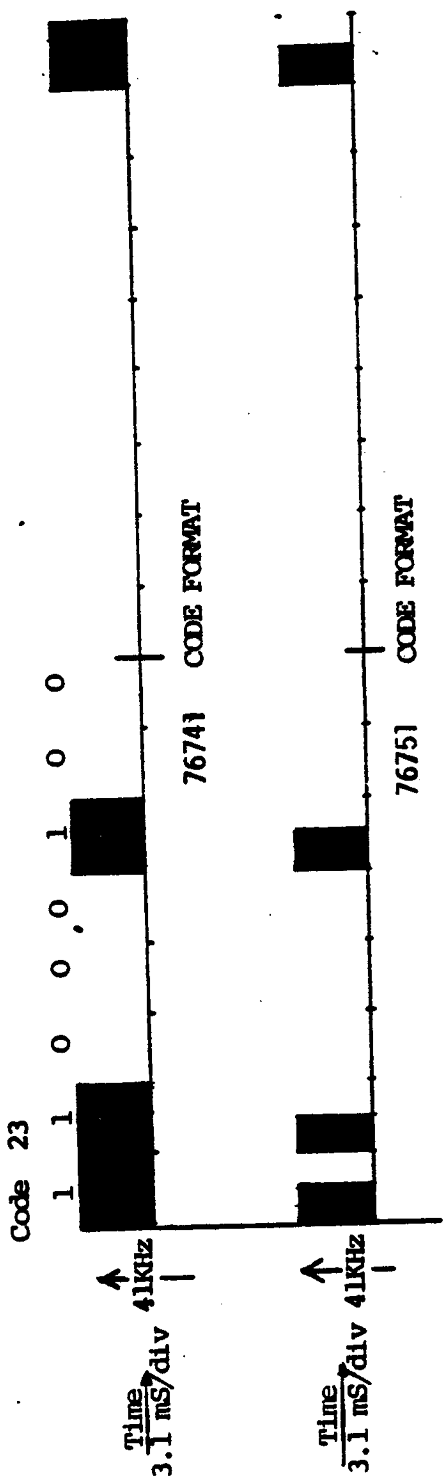


FIG.7 COMPARATIVE CODES

REMOTE CONTROL TRANSMITTERS

DEVICE TYPE	SN76741N (76831N24)	SN76742N (76831N16)	SN76751N (76841N24)	SN76752N (76841N16)	SN76881*	SN76891*	SN7688[illegible]
NUMBER OF PINS	24	16	24	16	16	16	24
PARENT BAR TYPE	831	831	831 (MASK OPT)	831 (MASK OPT)	881	891 (881 MASK OPT)	881
MINIMUM CODES TRANSMITTED	4	4	4	4	2	2	2
I_{OUT}(mA)	100	100	100	100	50	50	50
CODING FORMAT	NRZ	NRZ	RZ	RZ	NRZ	NRZ	NRZ
CARRIER DUTY CYCLE	50%	50%	50%	50%	18	18	18
CODE SPACE RATIO	1:1	1:1	1:1	1:1	1:3	1:3	1:3
MAXIMUM NUMBER OF CHANNELS	64+64	30	64+64	30	30	30	64+64
I_{CC}(AVERAGE)mA	20	20	14	14	6	6	6
MAXIMUM NUMBER OF CHANNELS (BAR POTENTIAL)	128	128	128	128	128	64	128
EXTERNAL DRIVE REQUIRED	NO	NO	NO	NO	YES	YES	YES
MINIMUM TIME BETWEEN TWO DIFFERENT CODES	200ms	200ms	200ms	200ms	200ms	200ms	200ms

The SN76832N receiver is compatible with all the above transmitters.

*PREFERRED DEVICE TYPES

03-902, SB, 1/12/81