MOS INTEGRATED CIRCUIT

M 255

RHYTHM GENERATOR

- INTERNAL TEMPO OSCILLATOR
- 6 PROGRAMMABLE RHYTHMS
- DRIVES 5 SOUND GENERATORS
- MASK PROGRAMMABLE RESET COUNTS: 12 or 16
- DOWN BEAT OUTPUT
- EXTERNAL RESET
- LOW POWER DISSIPATION: < 100 mW
- PIN-TO-PIN COMPATIBLE WITH MM 5871
- PUSH-PULL OR OPEN DRAIN OUTPUTS AVAILABLE
- STANDARD CONTENT AVAILABLE

The M 255 is a monolithic rhythm generator specifically designed for electronic organs and other musical instruments. Constructed on a single chip using P-channel silicon gate technology it is supplied in a 16-lead dual in-line plastic package.

ABSOLUTE MAXIMUM RATINGS*

V_{GG} **	Source supply voltage	-20 to 0.3	V
V_I **	Input voltage	-20 to 0.3	V
I_o	Output current for down beat (pin 3)	20	mA
I_o	Output current (at other pins)	3	mA
T_{stg}	Storage temperature	-65 to 150	°C
T_{op}	Operating temperature	0 to 70	°C

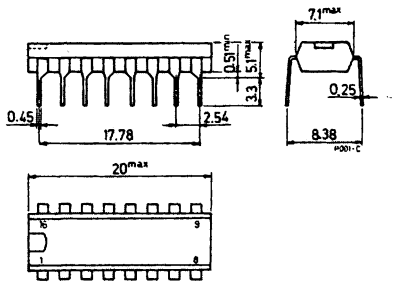
* Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other condition above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

** All voltages value are referred to V_{SS} pin voltage.

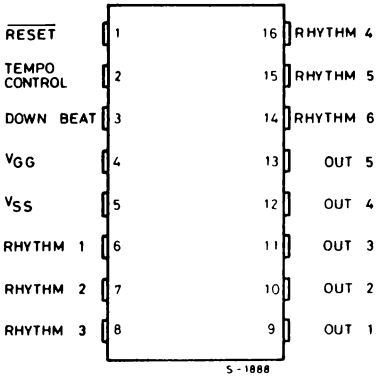
ORDERING NUMBERS: M 255 B1 XX for dual in-line plastic package
M 255 B1 AB for standard music content

MECHANICAL DATA

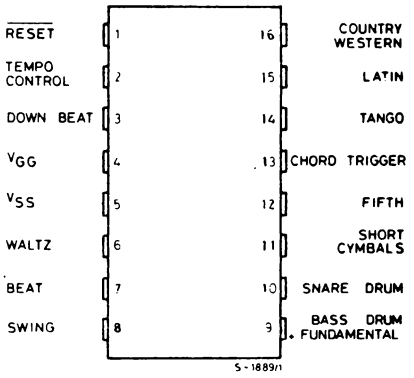
Dimensions in mm



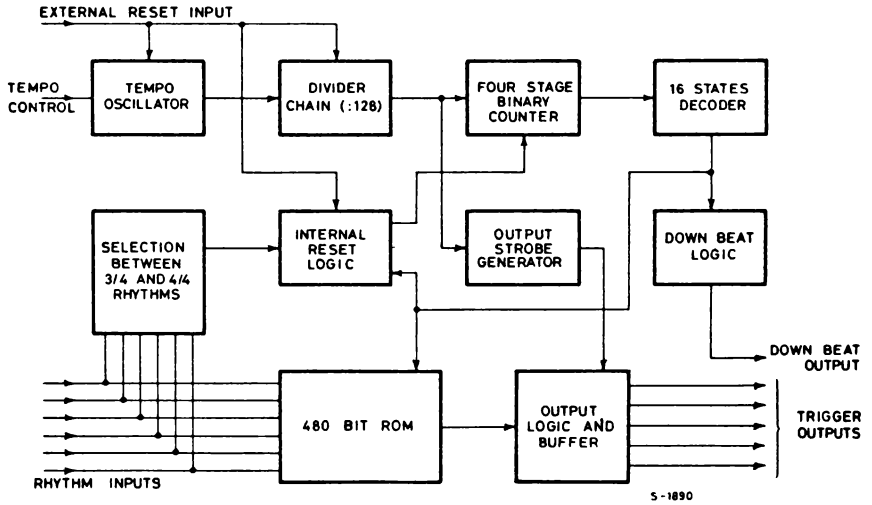
CONNECTION DIAGRAMS



Standard content configuration
M 255 B1 - AB



BLOCK DIAGRAM



GENERAL CHARACTERISTICS

The M 255 circuit comprises:

a) One pin for tempo control. The external network employs a capacitor and two resistors: one fixed and the other variable.

b) Six pins for rhythm selection. Internal pull-down is provided for all inputs. Rhythms are selected by connecting to V_{SS} the corresponding inputs.

c) One pin for external reset. The reset is applied when pin 1 is connected to V_{GG}. During normal operation pin 1 is connected to V_{SS}.

d) Five output pins. The following options are available:
- push-pull outputs
- open drain outputs
- trigger outputs (no external pulse shaping required)
- continuous outputs
- active high or active low outputs.

Full details concerning these options are given later.

e) Low impedance down beat output through which a LED can be driven.

f) 2 supply pins.

OPERATION

When the power supply is connected to the V_{GG} pin, the internal oscillator starts driving the counter and strobe generator. As long as no rhythm is selected no signal can flow from the output section. The output signal is present when one or more rhythms are selected. The internal counter has a 16 state (i.e. 16 elementary times) cycle and an internal reset signal is generated when the sixteenth state is decoded. Rhythms with a 3/4 time originate the internal reset when the 12th state is decoded. The down beat output is synchronized with the counter state 1 and its duration equals that of one elementary time. Rhythms with 8 or 6 elementary times are also programmable, in which case they are written twice in the ROM. The associated down beat signal can flow either every 8 (6) or every 16 (12) elementary times according to the option chosen. When the external reset is applied the counter is reset to state 1 and the oscillator and strobe generator are stopped. The down beat output is ON during the entire external reset condition since the first elementary time is decoded. For the same reason the content of the first elementary time is immediately available on the outputs as soon as the external reset is removed. The trigger outputs are pulse shaped and their width equals 1/32 of one elementary time. Pulse width is proportional to clock period but always remains 1/32 of a beat time. The clock frequency can be controlled by the external 1 Mohm potentiometer; the control range is greater than one decade.

PROGRAMMING THE OPTIONS

The five outputs of the M 255 may have different options which must be specified together with the ROM truth table. This can be done as shown in the table below:

Line		OUT. 1	OUT. 2	OUT. 3	OUT. 4	OUT. 5
1	Continuous or Trigger Output	T	T	C	T	T
2	Open drain or Push Pull	O	O	O	O	O
3	Posit. or Negat. Trigger Edge	+	+	+	–	–

T : Trigger: The output is in the form of a pulse whose width equals 1/32 of one elementary time. The pulse can be either positive or negative going according to the option chosen in line 3.

C : Continuous. No pulse shaping is provided and the output goes high or low according to line 3 choice for the duration of one elementary time. If such an output is selected in two or more consecutive elementary times it will stay continuously high (low).
O : Open drain output.
P : Push-pull output.
+ : The output is normally at V_{GG} and goes high when active.
– : The output is normally at V_{SS} and goes low when active.

The following constraints must be observed:
1) Only one of the five outputs may be continuous (C); the other four must be trigger (T).
2) If the open drain solution is used all outputs must be open drain (O).
3) If the push-pull solution is used all outputs labelled T must be push-pull (P) and the one labelled C must be open drain (O).

The down beat signal can be programmed to occur either every 8 (6) or every 16 (12) elementary times. The choice is made as shown in the example below:

	16 (12)	8 (6)
Down beat		X

In this case the down beat signal occurs every 8 (6) elementary times irrespective of the fact that there might be some 1x16 or 1 x 12 rhythms.

STATIC ELECTRICAL CHARACTERISTICS

(Positive logic, V_{GG} = -11.5 ± 20%, V_{SS} = +5 ± 20%, T_{amb} = 0 to 70°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
RHYTHM AND RESET INPUTS						
V_{IH}	High voltage		V_{SS}-1		V_{SS}	V
V_{IL}	Low voltage		V_{GG}		V_{SS}-4.1	V
INSTRUMENT OUTPUTS Open Drain configuration						
R_{ON}	Output resistance (ON state)	R_L = 10 KΩ		125	250	Ω
V_{OH}	Output high voltage	R_L = 10 KΩ	V_{SS}-0.3		V_{SS}	V
I_{LO}	Output leakage current	$V_{EXT.RES.}$ = V_{IH} T_{amb} = 25°C			-10	µA
Push-Pull configuration						
R_{ON}	Output resistance at high output level	I_{OH} = -1 mA V_o = V_{OH}		250	500	Ω
V_{OL}	Output low voltage	Capacitive load	V_{SS}-15.2		V_{SS}-7.5	V
V_{OH}	Output high voltage	Capacitive load	V_{SS}-0.6			V

RC Input: this input oscillates between two negative levels whose value depends on the supply voltage level.
With V_{GG} = -17 and V_{SS} = 0V, V_{RC} low = -8.7V and V_{RC} high = -3.2V.
This input is protected, like the others, from electrical discharges.

STATIC ELECTRICAL CHARACTERISTICS (continued)

Parameter		Test conditions	Min.	Typ.	Max.	Unit
DOWN BEAT OUTPUT						
R_{IN}	Internal resistance to V_{GG}	$V_o=V_{SS}-5V$		400	600	kΩ
R_{ON}	Output resistance (ON state)	$V_o=V_{SS}-0.5V$		250	500	Ω
V_{OH}	Output high voltage	Capacitive load	$V_{SS}-0.6$			V
V_{OL}	Output low voltage	Capacitive load	$V_{SS}-17.7$		$V_{SS}-10.7$	V
POWER DISSIPATION						
I_{GG}	Supply current	$T_{amb}=25°C$ I_o (pin 3)= 0		5	10	mA

DYNAMIC ELECTRICAL CHARACTERISTICS (Positive logic $V_{GG}=-11.5 \pm 20\%, 5 \pm 20\%$, $T_{amb}=0$ to 70°C unless otherwise specified)

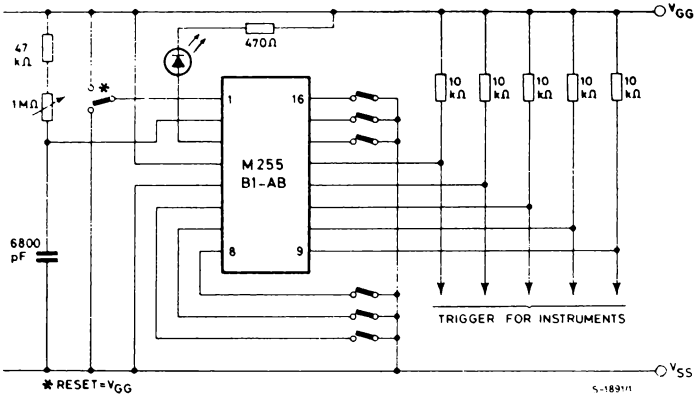
Parameter	Test conditions	Min.	Typ.	Max.	Unit
TEMPO CONTROL (RC)					
Minimum tempo	C to V_{SS}= 6800 pF R to V_{GG}= 1.05 MΩ	2.5*			Hz
Maximum tempo	C to V_{SS}= 6800 pF R to V_{GG}= 47 KΩ			35*	Hz

* These values depend on power supply voltages and temperature.

PERCENTAGE VARIATIONS of MAX. and MIN. TEMPO DUE TO V_{GG} and TEMPERATURE CHANGES

Parameter	Test conditions	Min.	Typ.	Max.
Max. tempo variation due to V_{GG} change	$V_{SS}-V_{GG}$ from 13 to 20V		4%	6%
Min. tempo variation due to V_{GG} change	$V_{SS}-V_{GG}$ from 13 to 20V		4%	6%
Max. tempo variation due to temperature change	T from 25°C to 70°C		2%	3%
Min. tempo variation due to temperature change	T from 25°C to 70°C		2%	3%

TYPICAL APPLICATION FOR M 255 B1-AB



COMPLETING THE TRUTH TABLE

The ROM truth table has been organized in 16 rows which represent the elementary times and 30 columns (6 groups of 5). The timing for the beats required for each instrument is programmed by crossing the appropriate box. The options for outputs and down beat must also be filled in as explained. Table 1 shows the content and the options programmed in the M 255 B1-AB standard content.

TRUTH TABLE of M 255 B1-AB (standard content)

	RHYTHM 1					RHYTHM 2					RHYTHM 3					RHYTHM 4					RHYTHM 5					RHYTHM 6				
Counter state	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5	OUTPUT1	OUTPUT2	OUTPUT3	OUTPUT4	OUTPUT5
1	X		X			X		X		X	X		X			X		X			X	X	X			X	X			X
2								X										X					X		X					
3		X			X		X	X		X								X			X		X							
4						X		X			X	X	X		X		X	X		X	X	X	X		X					
5		X			X	X		X										X					X			X	X			X
6								X		X			X			X		X					X		X					
7	X		X	X			X	X			X		X	X		X		X	X		X	X	X	X	X					
8								X										X					X							
9		X			X	X		X		X								X			X		X		X	X	X			X
10						X		X			X	X	X	X	X		X	X		X			X							
11		X			X		X	X										X				X	X		X					
12						X		X		X			X			X		X	X				X							
13						X		X															X		X	X	X			X
14							X	X														X	X		X					
15						X		X													X		X	X		X	X	X	X	X
16						X	X	X	X												X		X	X	X					
Option on the Outputs											O1		O2		O3		O4		O5							16 (12)		8 (6)		
Continuous or Trigger Output											T		T		T		T		T		Down beat					X				
Open drain or push-pull											O		O		O		O		O											
Positive or Negative Trigger Edge											+		+		+		+		+											