National Semiconductor

MM54C915/MM74C915 7-Segment-to-BCD Converter

General Description

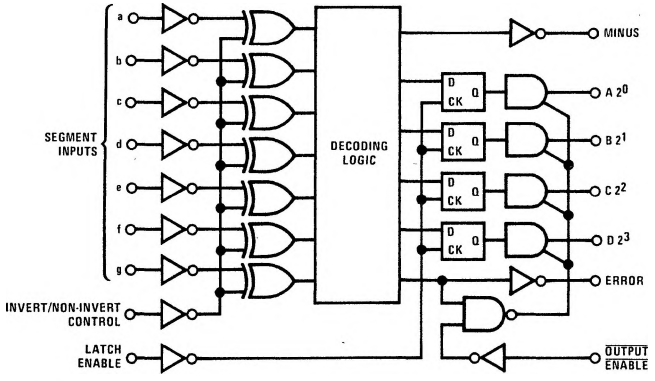
The MM54C915/MM74C915 is a monolithic complementary MOS (CMOS) integrated circuit, constructed with N and P-channel enhancement-mode transistors. This circuit accepts 7-segment information and converts it into BCD information. The true state of the Segment inputs can be selected by use of the Invert/Non-invert control pin. A logical "0" on the Invert/Non-invert control pin selects active high true decoding at the Segment inputs. A logical "1" on the Invert/Non-invert control pin selects active low true decoding at the Segment inputs. In addition to 4 TTL compatible BCD outputs, an Error output and Minus output are available. The Error output goes to an active "1" whenever a non-standard 7-segment code appears at the Segment inputs. The BCD outputs are forced into a TRI-STATE® condition when an error is detected. This allows the user to program his own error code by tying the BCD outputs to V_{CC} or Ground via high value resistors (~ 500k). The BCD outputs may also be forced into TRI-STATE by a logical "1" on output enable ($\overline{OE}$).

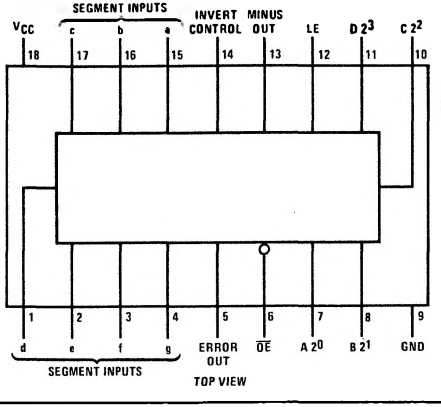
The Minus output goes to a logical "1" whenever a minus code is detected and is useful as a microprocessor interrupt. The BCD outputs are in a flow-though condition when Latch Enable (LE) is at a logical "0", and latched when LE is at a logical "1". The inputs will not clamp signals to the positive supply, allowing simple level translation from MOS to TTL.

Features

- Wide supply range — 3V–15V
- High noise immunity — 0.45 V_{CC} (typ.)
- TTL compatible fan out — 1 TTL load
- Selectable active true inputs
- TRI-STATE outputs
- On-chip latch
- Error output
- Minus output

Logic and Connection Diagrams





Absolute Maximum Ratings

Voltage at Any Output	$-0.3V$ to $V_{CC}+0.3V$
Voltage at Any Input	$-0.3V$ to 18V
Operating Temperature Range	
MM54C915	$-55°C$ to $+125°C$
MM74C915	$-40°C$ to $+85°C$
Storage Temperature Range	$-65°C$ to $+150°C$
Package Dissipation	500 mW
Operating V_{CC} Range	3V to 15V
Maximum V_{CC}	18V
Lead Temperature, (Soldering, 10 seconds)	$300°C$

DC Electrical Characteristics Min/max limits apply across temperature range, unless otherwise noted.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
CMOS TO CMOS						
$V_{IN(1)}$	Logical "1" Input Voltage	V_{CC} = 5V	3.3	4.5		V
		V_{CC} = 10V	8	9		V
		V_{CC} = 15V	12.5	13.5		V
$V_{IN(0)}$	Logical "0" Input Voltage	V_{CC} = 5V		0.5	1.5	V
		V_{CC} = 10V		1	2	V
		V_{CC} = 15V		1.5	2.5	V
$I_{IN(1)}$	Logical "1" Input Current	V_{IN} = 15V		0.005	1	μA
$I_{IN(0)}$	Logical "0" Input Current	V_{IN} = 0V	−1	−0.005		μA
$V_{OUT(1)}$	Logical "1" Output Voltage	I_O = 10 μA				
		V_{CC} = 5V		4.5		V
		V_{CC} = 10V		9		V
		V_{CC} = 15V		13.5		V
$V_{OUT(0)}$	Logical "0" Output Voltage	I_O = 10 μA				
		V_{CC} = 5V		0.5		V
		V_{CC} = 10V		1		V
		V_{CC} = 15V		1.5		V
I_{CC}	Supply Current	V_{CC} = 5V		0.25	1	mA
		V_{CC} = 10V		0.75	2.5	mA
		V_{CC} = 15V		1.00	3	mA
CMOS/TTL INTERFACE						
$V_{IN(1)}$	Logical "1" Input Voltage					
	MM54C915	V_{CC} = 4.5V	$V_{CC}-1.7$			V
	MM74C915	V_{CC} = 4.75V	$V_{CC}-1.7$			V
$V_{IN(0)}$	Logical "0" Input Voltage					
	MM54C915	V_{CC} = 4.5V			0.8	V
	MM74C915	V_{CC} = 4.75V			0.8	V
$V_{OUT(1)}$	Logical "1" Output Voltage	I_O = −360 μA				
	MM54C915	V_{CC} = 4.5V	2.4			V
	MM74C915	V_{CC} = 4.75V	2.4			V
$V_{OUT(0)}$	Logical "0" Output Voltage	I_O = 1.6 mA				
	MM54C915	V_{CC} = 4.5V			0.4	V
	MM74C915	V_{CC} = 4.75V			0.4	V
OUTPUT DRIVE (Short Circuit Current)						
I_{SOURCE}	Output Source Current P-Channel	T_A = 25°C, V_O = 0V, (Note 2)				
		V_{CC} = 5V	−1.75	−3.3		mA
		V_{CC} = 10V	−8	−15		mA
		V_{CC} = 15V	−15	−25		mA
I_{SINK}	Output Sink Current N-Channel	T_A = 25°C, V_O = V_{CC} (Note 2)				
		V_{CC} = 5V	5	8		mA
		V_{CC} = 10V	20	30		mA
		V_{CC} = 15V	30	50		mA

AC Electrical Characteristics $T_A = 25°C$

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
t_{pd0}, t_{pd1}	Propagation Delay Time to	C_L = 50 pF				
	Logical "0" or a Logical "1"	V_{CC} = 5V		500	1000	ns
		V_{CC} = 10V		300	600	ns
		V_{CC} = 15V		300	600	ns
t_{0H}, t_{1H}	Propagation Delay Time From	R_L = 10k, C_L = 10 pF				
	Logical "0" or Logical "1"	V_{CC} = 5V		110	200	ns
	into High Impedance State	V_{CC} = 10V		75	130	ns
		V_{CC} = 15V		60	110	ns
t_{H0}, t_{H1}	Propagation Delay Time From	R_L = 10k, C_L = 50 pF				
	High Impedance State to a	V_{CC} = 5V		150	250	ns
	Logical "0" or Logical "1"	V_{CC} = 10V		80	140	ns
		V_{CC} = 15V		70	125	ns
t_S	Input Data Set-Up Time	C_L = 50 pF				
		V_{CC} = 5V		500	1000	ns
		V_{CC} = 10V		300	600	ns
		V_{CC} = 15V		300	600	ns
t_H	Input Data Hold Time	C_L = 50 pF				
		V_{CC} = 5V		−150	0	ns
		V_{CC} = 10V		−100	0	ns
		V_{CC} = 15V		−100	0	ns
C_{IN}	Input Capacitance	Any Input, (Note 3)		5	7.5	pF
C_{OUT}	TRI-STATE Output Capacitance	Any Output, (Note 3)		10		pF

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: These specifications apply to transient operation. It is not meant to imply that the device should be operated at these limits in sustained operation.

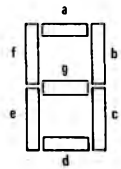
Note 3: Capacitance is guaranteed by periodic testing.

Truth Table

CHARACTER AT SEGMENT INPUTS	BCD OUTPUTS D 2^3	C 2^2	B 2^1	A 2^0	NON-BCD OUTPUTS ERROR	MINUS
0	0	0	0	0	0	0
1	0	0	0	1	0	0
1	0	0	0	1	0	0
2	0	0	1	0	0	0
3	0	0	1	1	0	0
4	0	1	0	0	0	0
5	0	1	0	1	0	0
6	0	1	1	0	0	0
6	0	1	1	0	0	0
7	0	1	1	1	0	0
8	1	0	0	0	0	0
9	1	0	0	1	0	0
9	1	0	0	1	0	0
	1	1	1	1	0	0
-	X	X	X	X	1	1
All other input	X	X	X	X	1	0
combinations	X	X	X	X	1	0

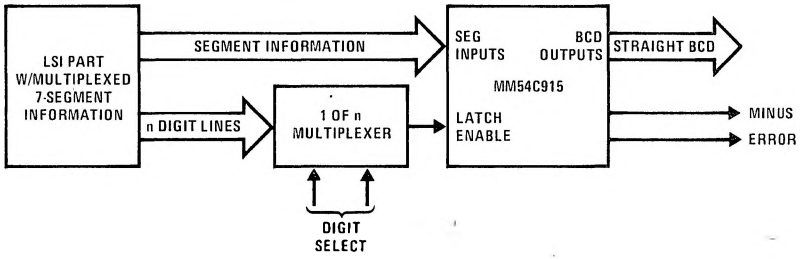
X = represents TRI-STATE condition

SEGMENT IDENTIFICATION



Typical Applications

Multiplex 7-Segment to Straight BCD



Memory Expansion from 7-Segment Outputs