HT1632C
32×8 & 24×16 LED Driver

特性：

- 工作电压：2.4-5.5V
- 多种 LED 显示方案 – 32 ROW/8COM 和 24 ROW/16COM
- 综合显示存储器 – 64*4 显示 RAM（32 ROW/8COM 下），96*4 RAM（24 ROW/16COM 下）
- 16 个级别脉宽调制控制亮度
- 综合的 256KHz RC 振荡器
- 串行的 MVU 接口 –$\overline{CS}$, $\overline{RD}$, $\overline{WR}$, DATA
- 有 数据模式和命令模式
- 可选的 NMOS 输出渠道和 PMOS 输出渠道
- 52 引脚的 QFP 封装形式

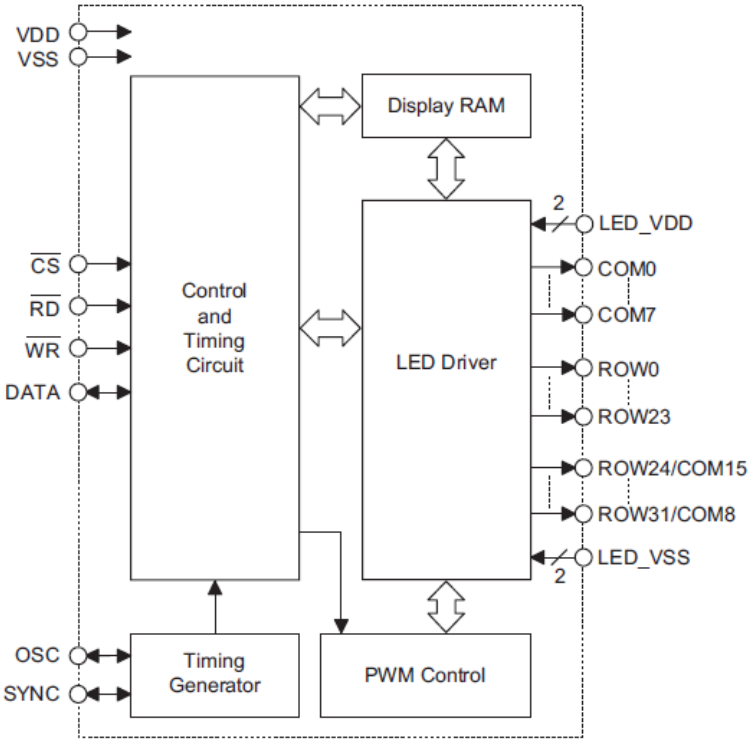
应用：

- 工业仪表控制
- 数字钟，温度计，计数器，电压表显示
- 仪表数据的读出
- LED 显示
- 其他消费场合

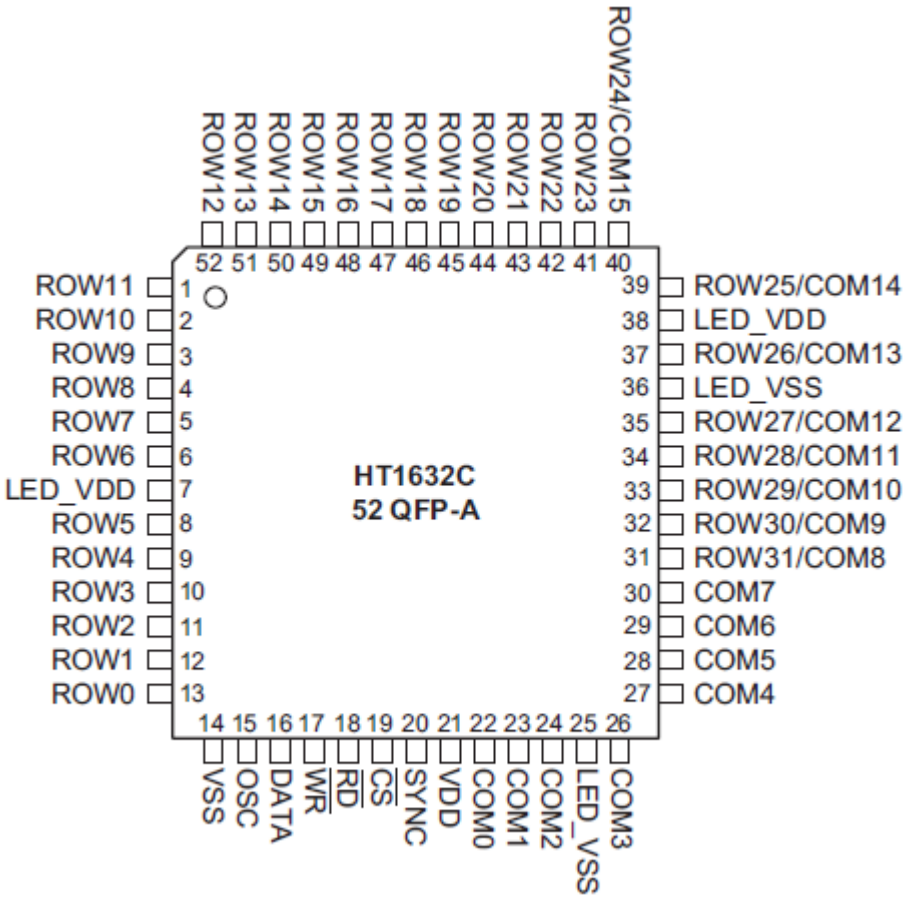
功能简述：

- HT1632C 是存储器交换 LED 显示控制驱动芯片，可以选择多重的 ROW/COM 模式，即 32ROW/8COM 和 24ROW/16COM，可以用来驱动点阵 LED。该芯片提供了软件设置的 16 个级别的脉宽调制控制输出，可以调整 LED 循环显示的亮度。利用串行接口串行输入，可以方便的进入命令模式 COMMAND MDOE 和数据模式 DATA MODE，只需要四五行的命令就可以建立起主控芯片和 HT1632C 的通信。通过 HT1632C 便可以进行持续的输出显示，在 LED 等的显示中具有广泛的应用。

结构图：


VDD
VSS
Display RAM
2
LED_VDD
CS
RD
WR
DATA
Control and Timing Circuit
LED Driver
COM0
COM7
ROW0
ROW23
ROW24/COM15
ROW31/COM8
2
LED_VSS
OSC
SYNC
Timing Generator
PWM Control

引脚排列：


ROW24/COM15
ROW12 ROW13 ROW14 ROW15 ROW16 ROW17 ROW18 ROW19 ROW20 ROW21 ROW22 ROW23
52 51 50 49 48 47 46 45 44 43 42 41 40
ROW11 1
ROW10 2
ROW9 3
ROW8 4
ROW7 5
ROW6 6
LED_VDD 7
ROW5 8
ROW4 9
ROW3 10
ROW2 11
ROW1 12
ROW0 13
HT1632C
52 QFP-A
39 ROW25/COM14
38 LED_VDD
37 ROW26/COM13
36 LED_VSS
35 ROW27/COM12
34 ROW28/COM11
33 ROW29/COM10
32 ROW30/COM9
31 ROW31/COM8
30 COM7
29 COM6
28 COM5
27 COM4
14 15 16 17 18 19 20 21 22 23 24 25 26
VSS OSC DATA WR RD CS SYNC VDD COM0 COM1 COM2 LED_VSS COM3

引脚描述：

节点名称	I/O	描述
ROW0~ROW23	O	行驱动，这些引脚驱动 LED
ROW24/COM15~ ROW31/COM8	O	驱动 LED 输出端或者公共输出端，每个 COM 引脚是双键的
COM0~COM7	O	公共输出端，每个 COM 引脚是双键的
SYNC	I/O	如果主触发模式或者外部扩展触发模式被选择，则同时存在的频率振荡信号将从 SYN 引脚输出；如果被动模式被选择，则频率振荡信号将从 SYN 引脚输入。
OSC	I/O	RC 振荡主模式被选择时，系统时钟源将从片内 RC 振荡器产生，并且从 OSC 脚输出；如果主触发模式或者外部扩展触发模式被选择，则系统时钟将从 OSC 脚输入。
DATA	I/O	通过拉高电阻器来实现数据的输入和输出
/WR	I	在/WR 的上升沿 DATA 写入数据
/RD	I	在/RD 的下降沿 DATA 读出数据
/CS	I	但/CS 为高电平时，数据和命令的读入和写出将被禁止，串行接口电路复位；如果/CS 位低电平，则可以进行数据和命令的传输
LED_VDD	--	驱动电路正电源输入，每个 LED_VDD 是双键
LED_VSS	--	驱动电路负电源输入，每个 LED_VSS 是双键
VSS	--	芯片工作逻辑电路负电源（地）
VDD	--	芯片工作逻辑电路正电源

极限参数：

输出电压----------VSS – 0.3V ~ VSS+6V　　存储温度----- - 50° C ~ 125° C

输入电压----------VSS – 0.3V ~ VDD+0.3V　　工作温度----- - 40° C ~ 85° C

D.C. Characteristics

V_{DD}=2.4V~5.5V, Ta=25°C (Unless otherwise specified)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	2.4	5.0	5.5	V
I_{DD}	Operating Current	5V	No load, LED ON, on-chip RC oscillator	—	0.5	1.0	mA
I_{STB}	Standby Current	5V	No load, power down mode	—	1	5	μA
V_{IL}	Input Low Voltage	5V	DATA, $\overline{WR}$, $\overline{CS}$, $\overline{RD}$	0	—	$0.3V_{DD}$	V
V_{IH}	Input High Voltage	5V	DATA, $\overline{WR}$, $\overline{CS}$, $\overline{RD}$	$0.7V_{DD}$	—	5	V
I_{OL1}	OSC, SYNC, DATA	5V	V_{OL}=0.5V	10	20	—	mA
I_{OH1}	OSC, SYNC, DATA	5V	V_{OH}=4.5V	–5	–10	—	mA
I_{OL2}	ROW Sink Current	5V	V_{OL}=0.5V	10	—	—	mA
I_{OH2}	ROW Source Current	5V	V_{OH}=4.5V	–40	—	—	mA
I_{OL3}	COM Sink Current	5V	V_{OL}=0.5V	250	—	—	mA
I_{OH3}	COM Source Current	5V	V_{OH}=4.5V	–40	—	—	mA
R_{PH}	Pull-high Resistor	5V	DATA, $\overline{WR}$, $\overline{CS}$, $\overline{RD}$	10	30	60	kΩ

电源参数：

A.C. Characteristics

V_{DD}=2.4V~5.5V, Ta=25°C (Unless otherwise specified)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
f_{SYS}	System Clock	5V	On-chip RC oscillator	230	256	282	kHz
f_{LED}	LED Duty Cycle & Frame Frequency	5V	1/8 duty	—	f_{SYS}/2624	—	Hz
		5V	1/16 duty	—	f_{SYS}/2624	—	Hz
f_{CLK1}	Serial Data Clock ($\overline{WR}$ pin)	5V	Duty cycle 50%	—	—	1	MHz
f_{CLK2}	Serial Data Clock ($\overline{RD}$ pin)	5V	Duty cycle 50%	—	—	500	kHz
t_{CS}	Serial Interface Reset Pulse Width	—	$\overline{CS}$	250	—	—	ns
t_{CLK}	$\overline{WR}$, $\overline{RD}$ Input Pulse Width	5V	Write mode	0.5	—	—	μs
			Read mode	1.0	—	—	
t_r, t_f	Rise/Fall Time Serial Data Clock Width (Figure 1)	—	—	—	50	100	ns
t_{su}	Setup Time for DATA to $\overline{WR}$, $\overline{RD}$ Clock Width (Figure 2)	—	—	50	100	—	ns
t_h	Hold Time for DATA to $\overline{WR}$, $\overline{RD}$, Clock Width (Figure 2)	—	—	100	200	—	ns
t_{su1}	Setup Time for $\overline{CS}$ to $\overline{WR}$, $\overline{RD}$, Clock Width (Figure 3)	—	—	200	300	—	ns
t_{h1}	Hold Time for $\overline{CS}$ to $\overline{WR}$, $\overline{RD}$, Clock Width (Figure 3)	—	—	50	100	—	ns

功能特性：

显示存储器 –RAM 静态存储器用来存储所要显示的数据，它被分割为 64*4 位或者 96*4 位，如果显示模式选择的是 32ROW&8COM, 则 RAM 大小为 64*4 位，如果选择的是 24ROW&16COM，则 RAM 大小为 96*4 位. RAM 中存放的数据将会直接用来驱动 LED.如果 RAM 数据为 1，则相应的发光二极管被点亮，RAM 中的数据可以 写入、读出以及读修改写。RAM 可以从第 0 位开始读写到指定位置。

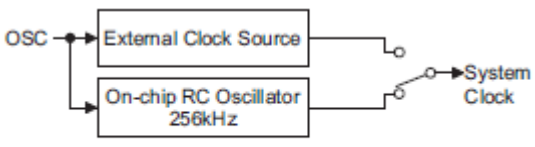
	COM7	COM6	COM5	COM4		COM3	COM2	COM1	COM0	
ROW0					01H					00H
ROW1					03H					02H
ROW2					05H					04H
ROW3					07H					06H
ROW4					09H					08H
ROW5					0BH					0AH
ROW6					0DH					0CH
ROW7					0FH					0EH
ROW8					11H					10H
ROW9					13H					12H
ROW10					15H					14H
ROW11					17H					16H
ROW12					19H					18H
ROW13					1BH					1AH
ROW14					1DH					1CH
ROW15					1FH					1EH
ROW16					21H					20H
ROW17					23H					22H
ROW18					25H					24H
ROW19					27H					26H
ROW20					29H					28H
ROW21					2BH					2AH
ROW22					2DH					2CH
ROW23					2FH					2EH
ROW24					31H					30H
ROW25					33H					32H
ROW26					35H					34H
ROW27					37H					36H
ROW28					39H					38H
ROW29					3BH					3AH
ROW30					3DH					3CH
ROW31					3FH					3EH
	D3	D2	D1	D0	Addr. / Data	D3	D2	D1	D0	Addr. / Data

32 ROW & 8 COM for 64×4 Display RAM

	COM15	COM14	COM13	COM12		.....	COM3	COM2	COM1	COM0	
ROW0					03H						00H
ROW1					07H						04H
ROW2					0BH						08H
ROW3					0FH						0CH
ROW4					13H						10H
ROW5					17H						14H
ROW6					1BH						18H
ROW7					1FH						1CH
ROW8					23H						20H
ROW9					27H						24H
ROW10					2BH						28H
ROW11					2FH	.....					2CH
ROW12					33H						30H
ROW13					37H						34H
ROW14					3BH						38H
ROW15					3FH						3CH
ROW16					43H						40H
ROW17					47H						44H
ROW18					4BH						48H
ROW19					4FH						4CH
ROW20					53H						50H
ROW21					57H						54H
ROW22					5BH						58H
ROW23					5FH	.....					5CH
	D3	D2	D1	D0	Addr. / Data		D3	D2	D1	D0	Addr. / Data

24 ROW & 16 COM for 96×4 Display RAM

系统时钟：



System Oscillator Configuration

TH1632C 的系统时钟用来产生系统工作的时钟频率，LED 驱动时钟。系统时钟可以取自片内的 RC 振荡器（256KHz），或者使用 S/W 设置由外部时钟输入。系统振荡器构造如图所示。当 SYS DIS 命令被执行时，系统时钟停止，LED 工作循环将被关闭，这条指令只能适用与片内 RC 振荡器。一旦系统时钟停止时，LED 显示为空白，时基也会丧失其功能。LED_OFF 命令用来关闭 LED 工作循环。LED 工作循环被关闭之后，用 SYS DIS 命令节省电源开支，充当省电命令。但是如果是片外时钟源被选择的话，使用 SYS DIS 命令不能够关闭振荡器以及执行省电模式。晶体振荡器可以通过 OSC 管脚提供时钟频率，在这种情况下，系统将不能进入省电模式。在系统上电时，HT1632C 处在 SYS DIS 状态下。

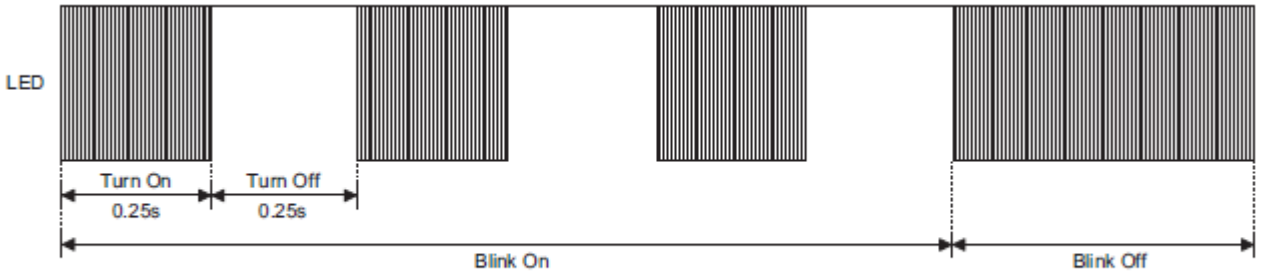
LED 驱动：

HT1632C 含有 256（32*8）和 384（24*16）模式的 LED 驱动，可以被设定成 32*8 或者 24&16 显示模式，通过 com 输出可以选择 N-MOS 或者 P-MOS 输出渠道。这些特性使得 HT1632C 可以适应多种不同的 led 应用场合。LED 驱动时钟源于系统时钟。驱动的时钟一般情况下选择单片振荡器 256KHz 或者扩展的外部振荡器。LED 相对应的控制情况如表所示。其中粗体的 1 0 0 标识位命令模式。如果命令被连续输出则其前面的标识将被将省略。LED OFF 命令将会通过关闭其工作循环来关闭 LED 的显示，LED ON 命令通过打开 LED 工作循环来驱动 LED 显示。

Name	Command Code	Function
LED OFF	**100**00000010X	Turn off LED outputs
LED ON	**100**00000011X	Turn on LED outputs
Commons Option	**100**0010abXXX	ab=00: N-MOS open drain output and 8 common option ab=01: N-MOS open drain output and 16 common option ab=10: P-MOS open drain output and 8 common option ab=11: P-MOS open drain output and 16 common option

闪光灯

HT1632C 具有闪烁功能，闪烁功能使得所有的 LED 闪烁，闪烁速率为 0.25s 开 0.25s 关。通过执行闪烁打开 BLINK ON 和闪烁关闭 BLINK OFF 来实现。



Example of Waveform for Blinker

命令格式：

S/W 设置可以配置 HT1632C，有两种命令模式来配置 HT1632C 的资源以及传输 LED 显示数据。命令模式标识为 1 0 0，命令模式由系统配置命令、系统时钟选择命令、LED 配置命令和运行命令组成。数据模式包括数据的读、写、读修改写指令。右图是数据模式 ID(标识)和命令模式 ID（标识）。

Operation	Mode	ID
Read	Data	1 1 0
Write	Data	1 0 1
Read-Modify-Write	Data	1 0 1
Command	Command	1 0 0

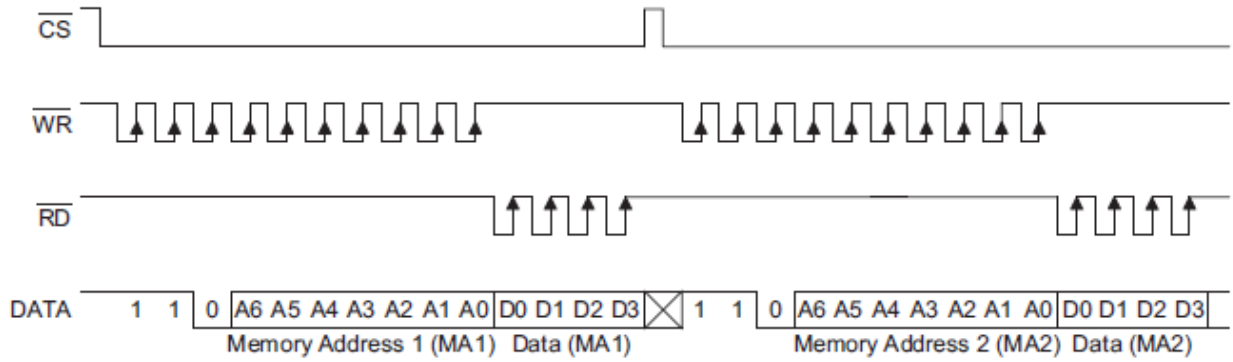
制式选择应该在命令和数据被传输前选择，如果命令被连续传输，则命令模式标识(ID)1 0 0 可以被省略。如果系统工作在非连续命令或者非连续数据地址时，则/CS 引脚应该被置 1 ，先前的操作模式也会被复位，一旦/CS 被置 0，一个新的操作标识一定要被输入。

外部特性：

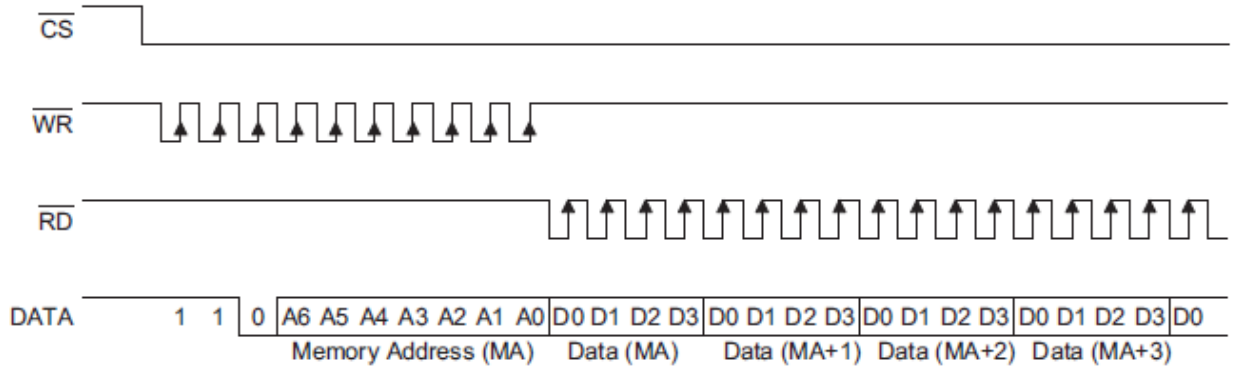
MCU与HT1632C通信只需要4根线便可。/CS用来使能串行接口信号的传输以及终止其与外部MCU的通信。如果/CS被置1，则数据和命令的传输被禁止。If the CS pin is set to 1, the data and command issued between the host controller and the HT1632C are first disabled and then initialized 。DATA引线用来串行传输数据，/RD引线用来输入读时钟，，RAM数据在/RD的下降沿被读出，该数据将会在DATA引线上被传输。/WR引线用来输入写时钟，数据，地址和命令将会在DATA引线上被输入在/WR的下降沿。推荐：MCU在同一个脉冲的上升沿读数据，在下降沿写数据。

Timing Diagrams

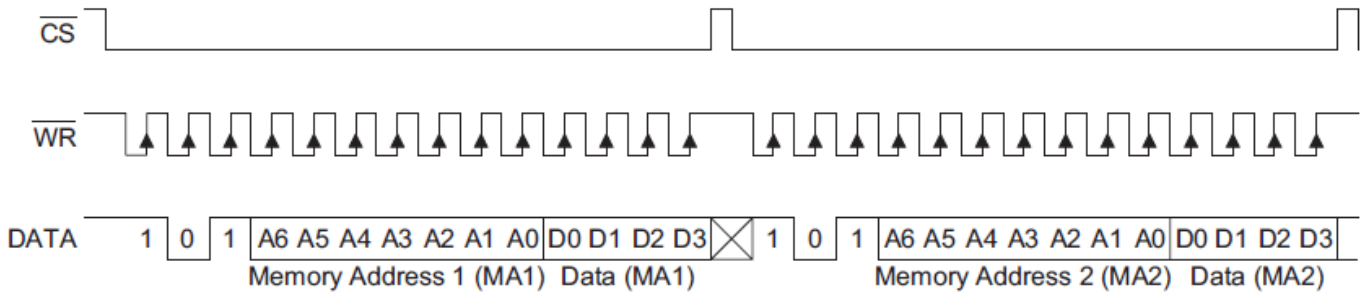
READ Mode – Command Code = 1 1 0



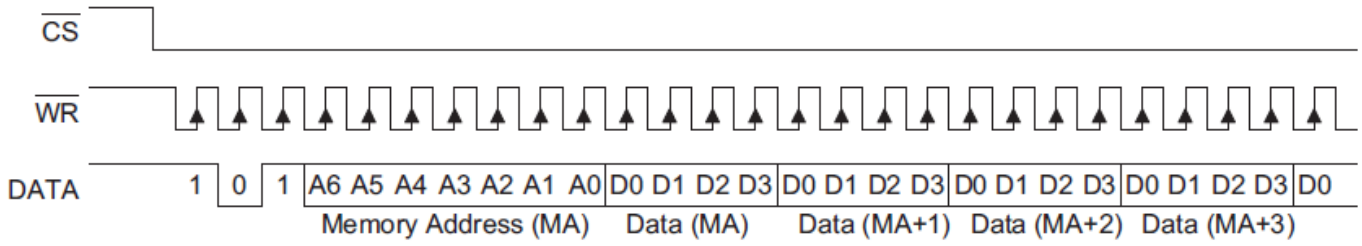
READ Mode – Successive Address Reading



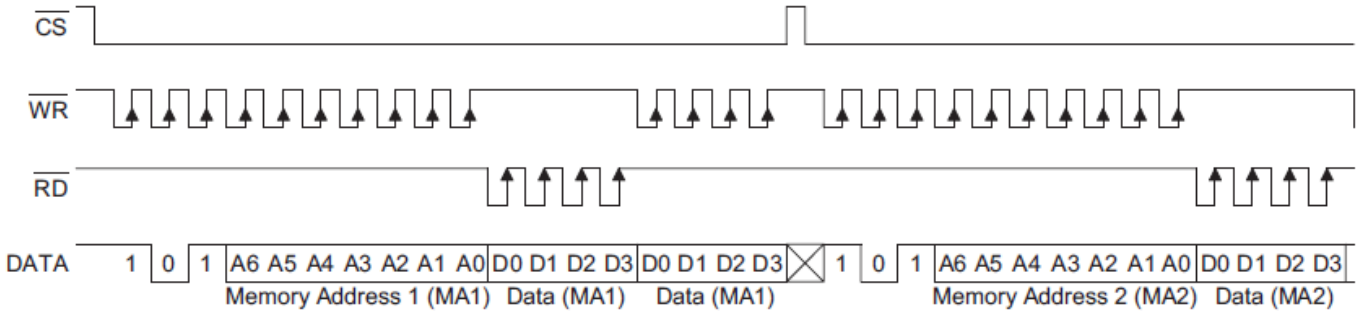
WRITE Mode – Command Code = 1 0 1



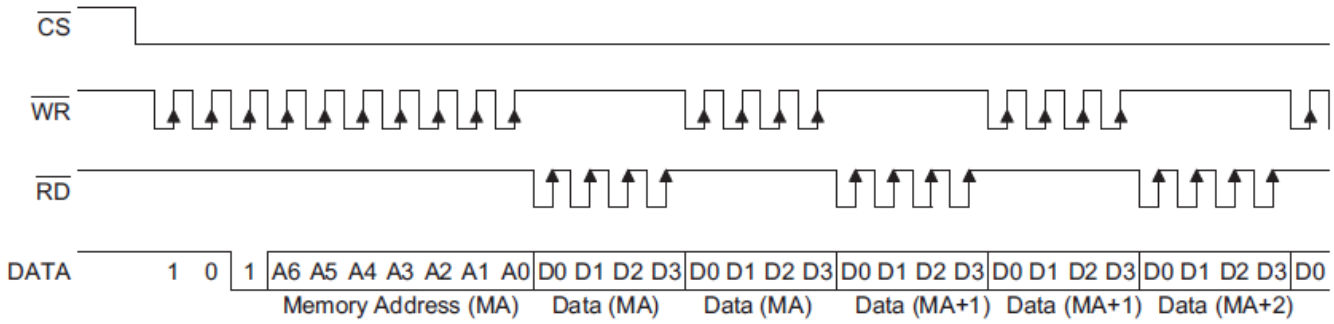
WRITE Mode – Successive Address Writing



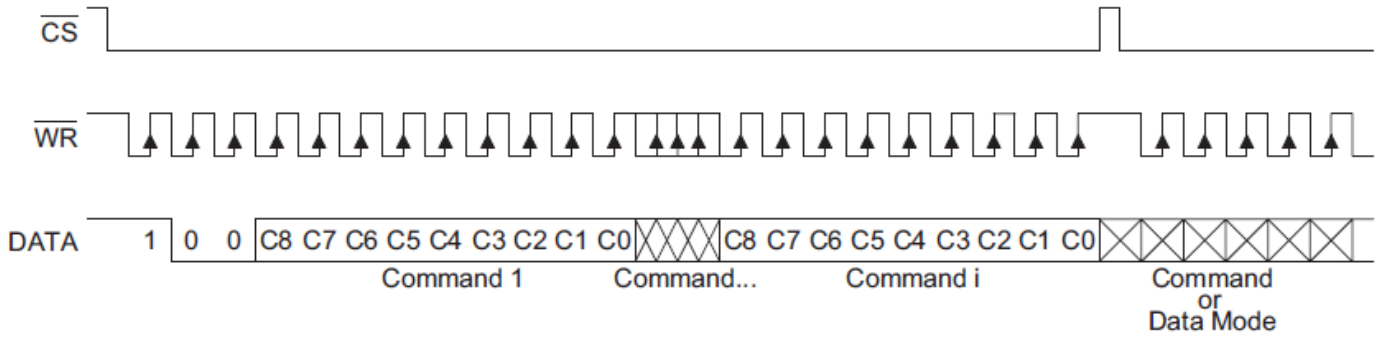
READ-MODIFY-WRITE Mode – Command Code = 1 0 1



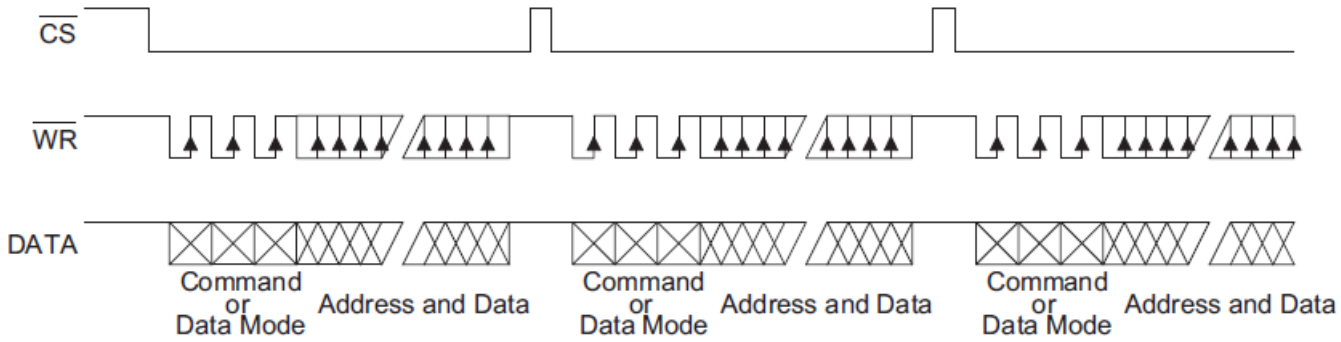
READ-MODIFY-WRITE Mode – Successive Address Accessing



Command Mode – Command Code = 1 0 0



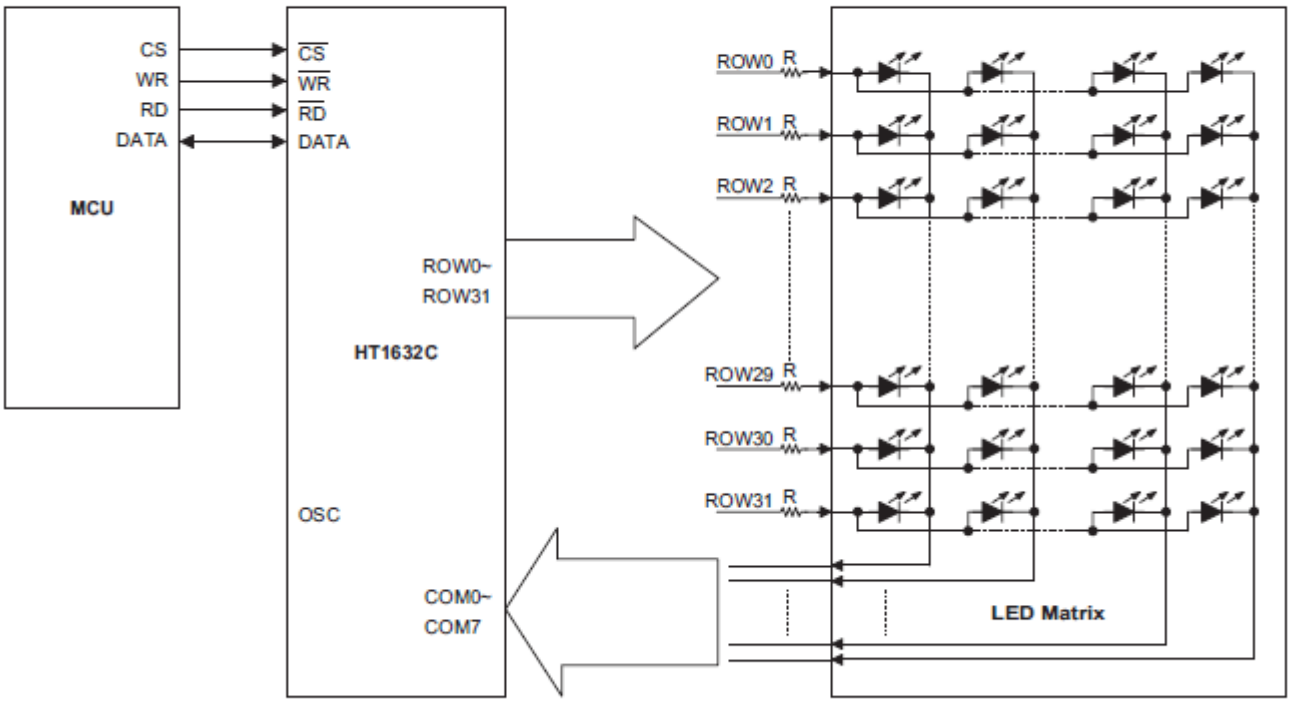
Mode – Data and Command Mode



Application Circuits

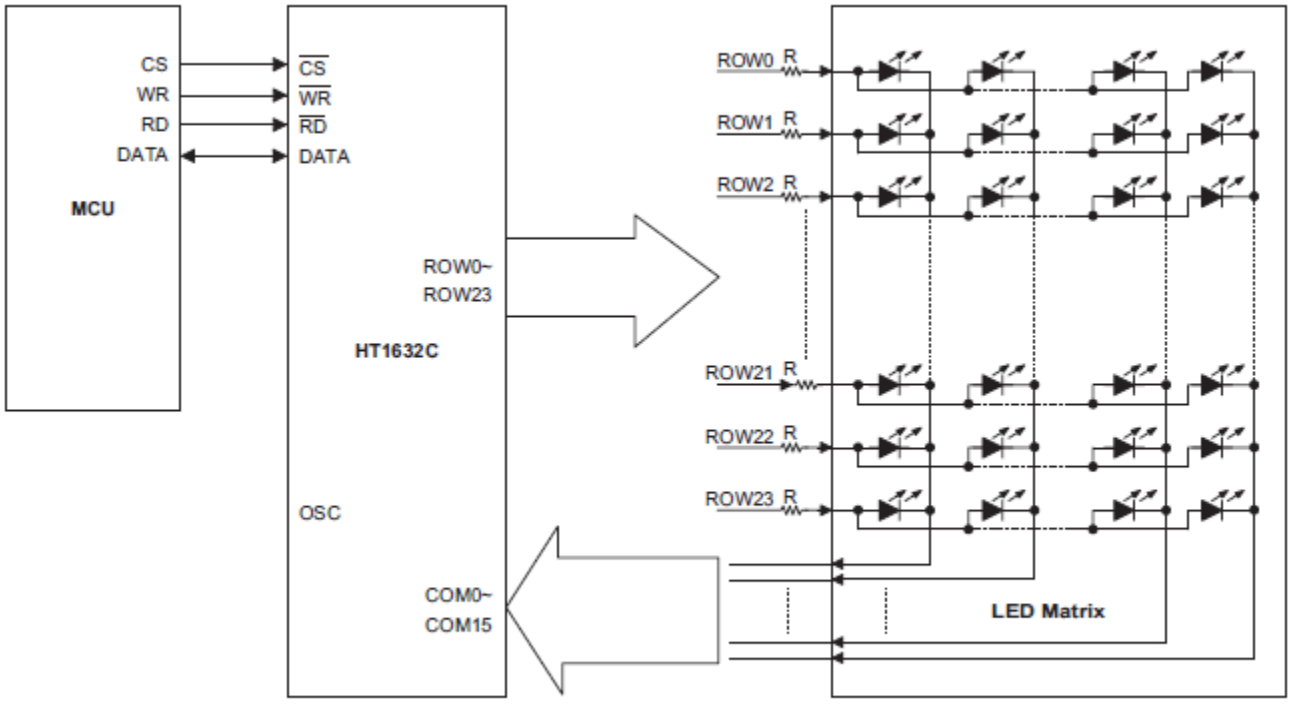
Low Power LED Application (Direct Drive)

- 32 ROW × 8 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

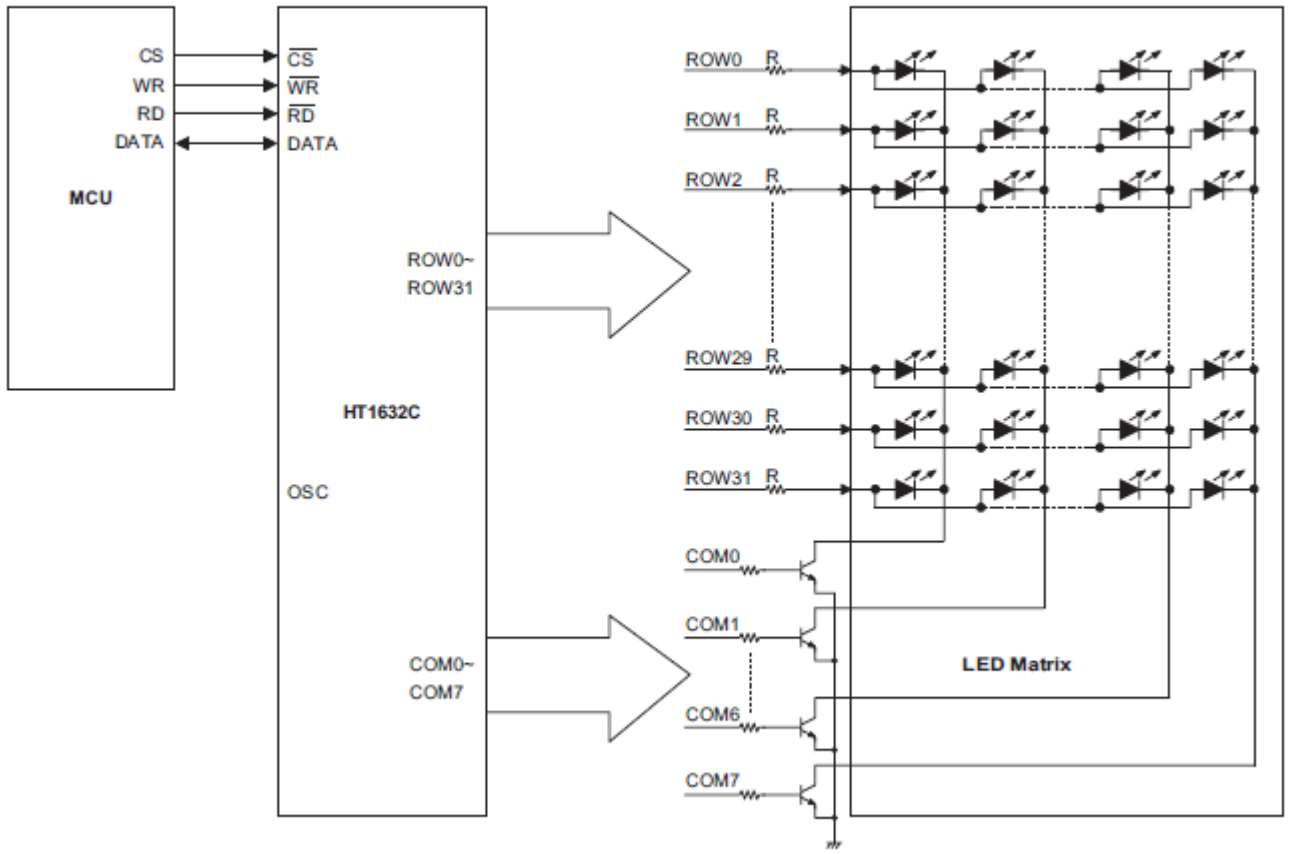
- 24 ROW × 16 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

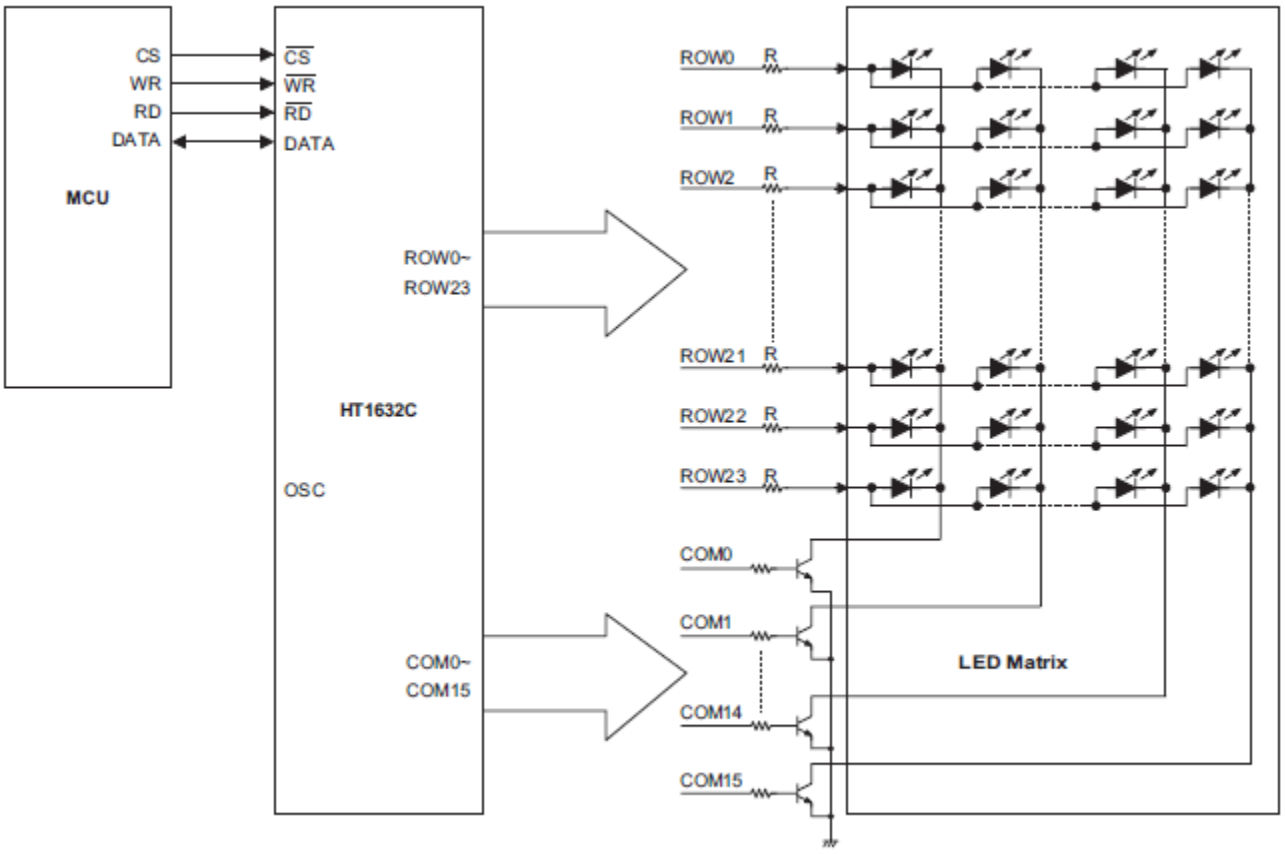
Middle Power LED Application (COM with Transistor Buffer)

- 32 ROW × 8 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

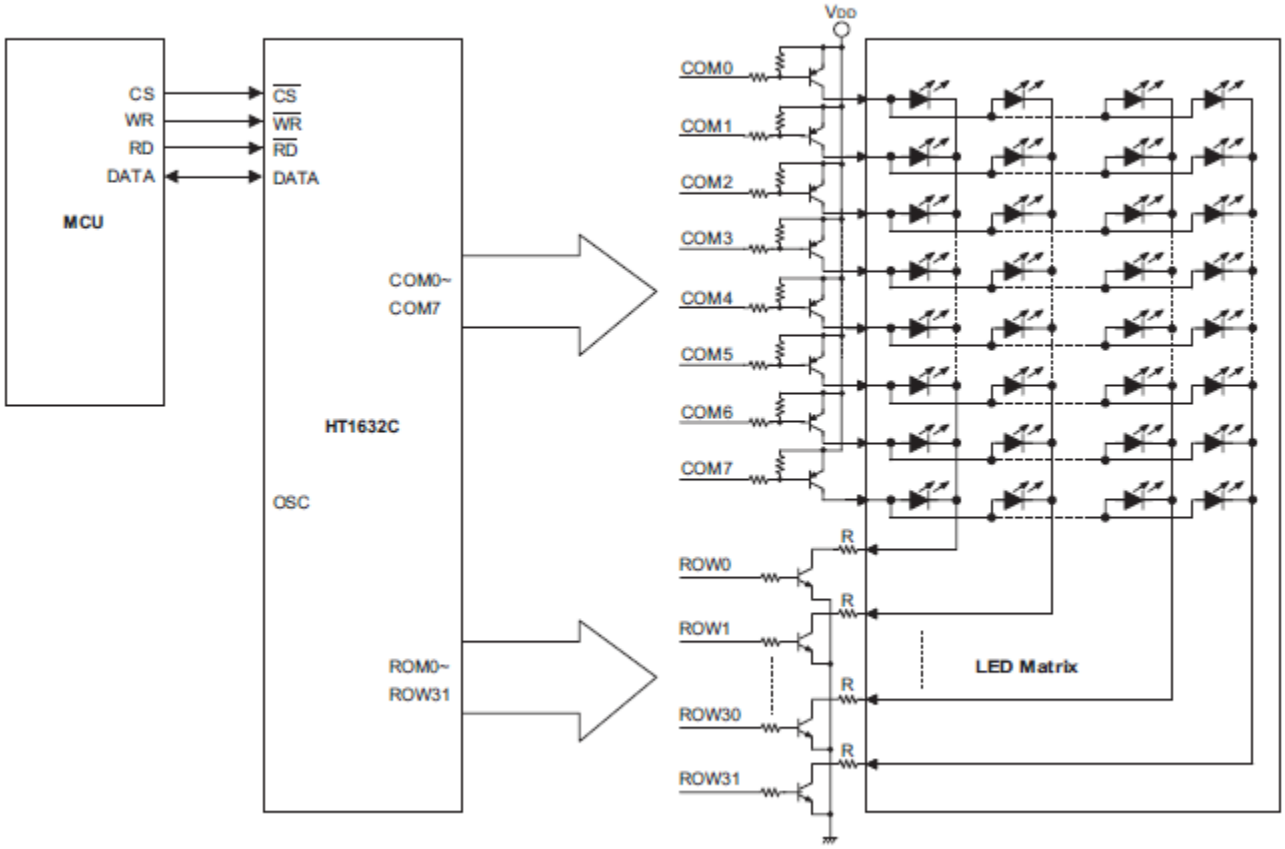
- 24 ROW × 16 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

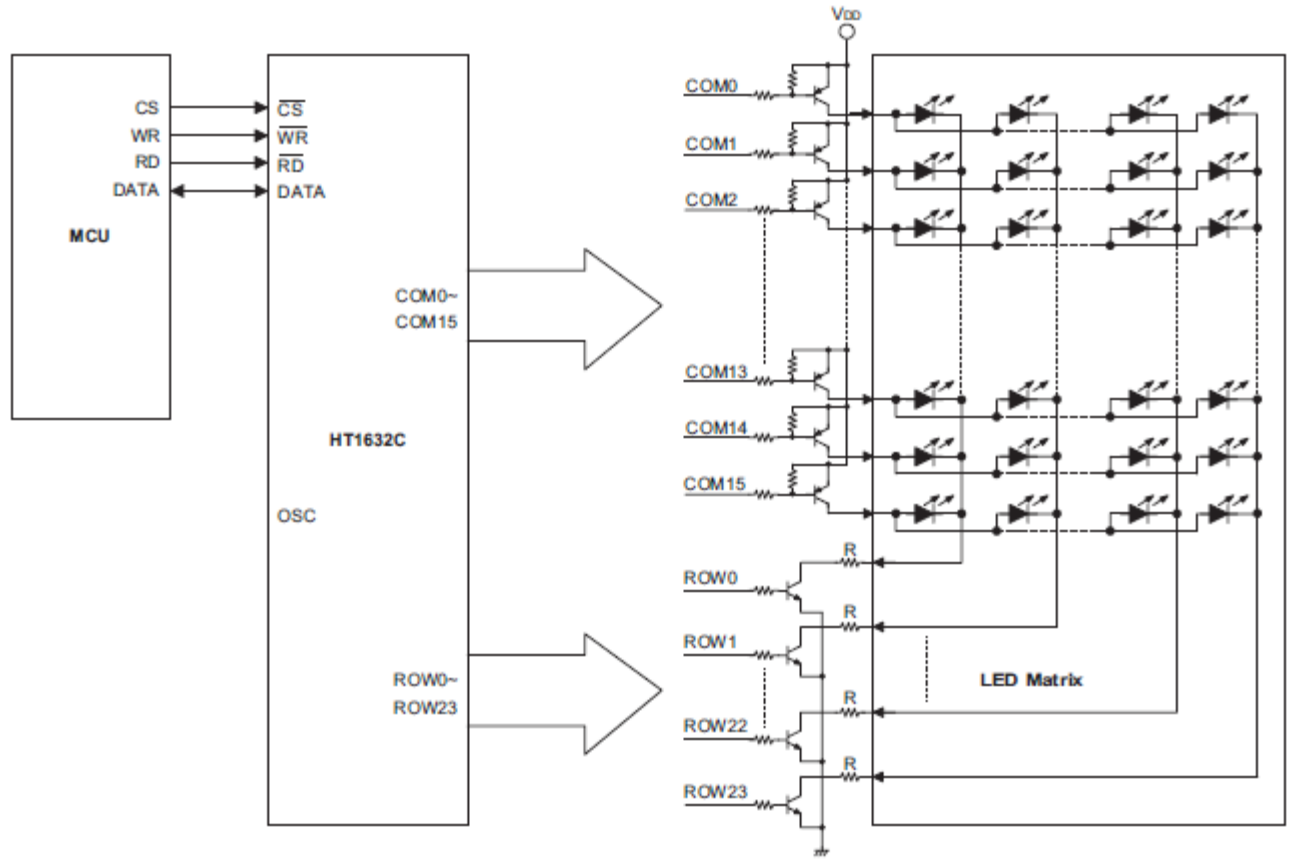
High Power LED Application (ROW & COM with Transistor Buffer)

- 32 ROW × 8 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

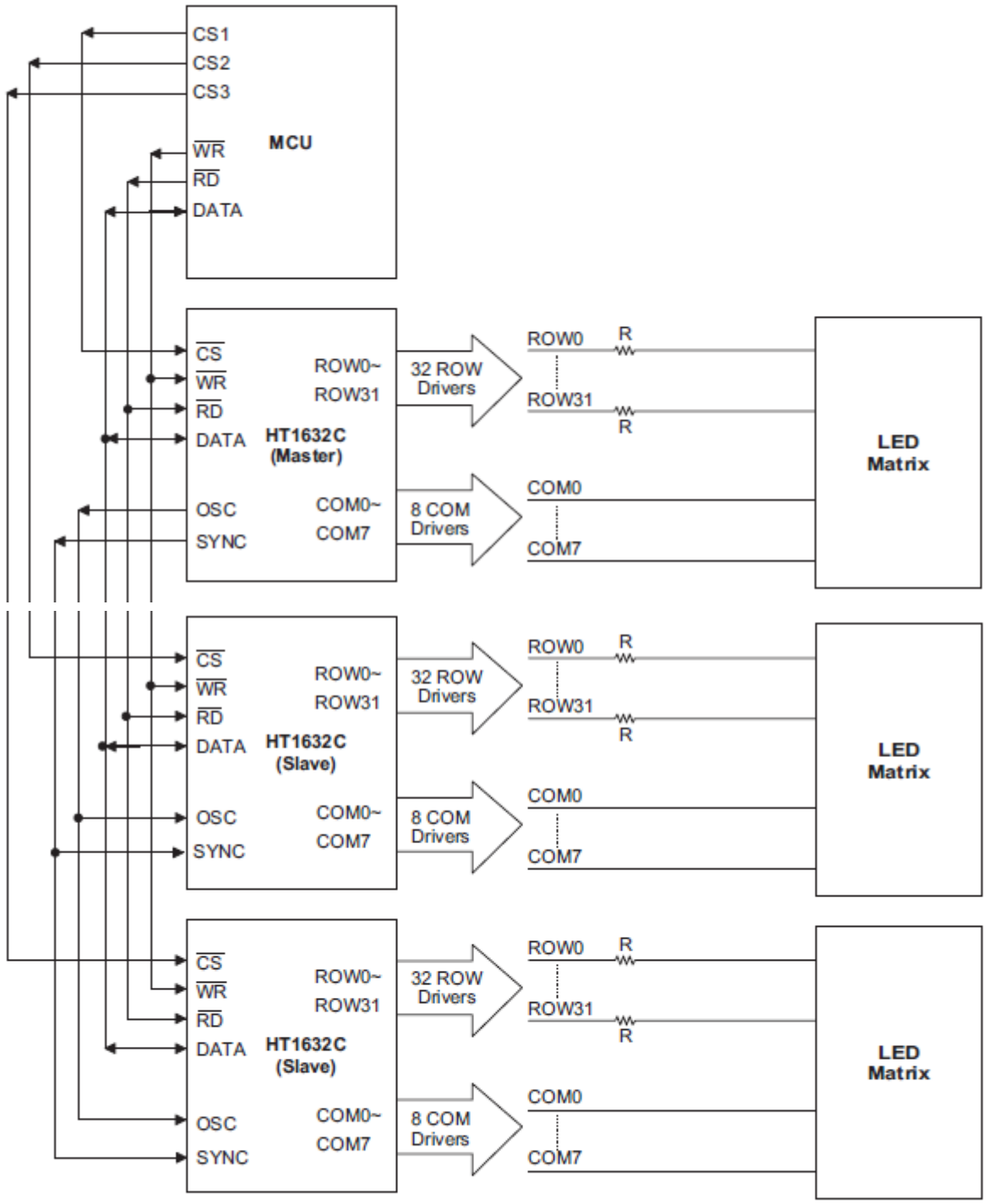
- 24 ROW × 16 COM example



Note: Values of the "R" resistors are selected depending on the power consumption of the LEDs.

Cascade Function

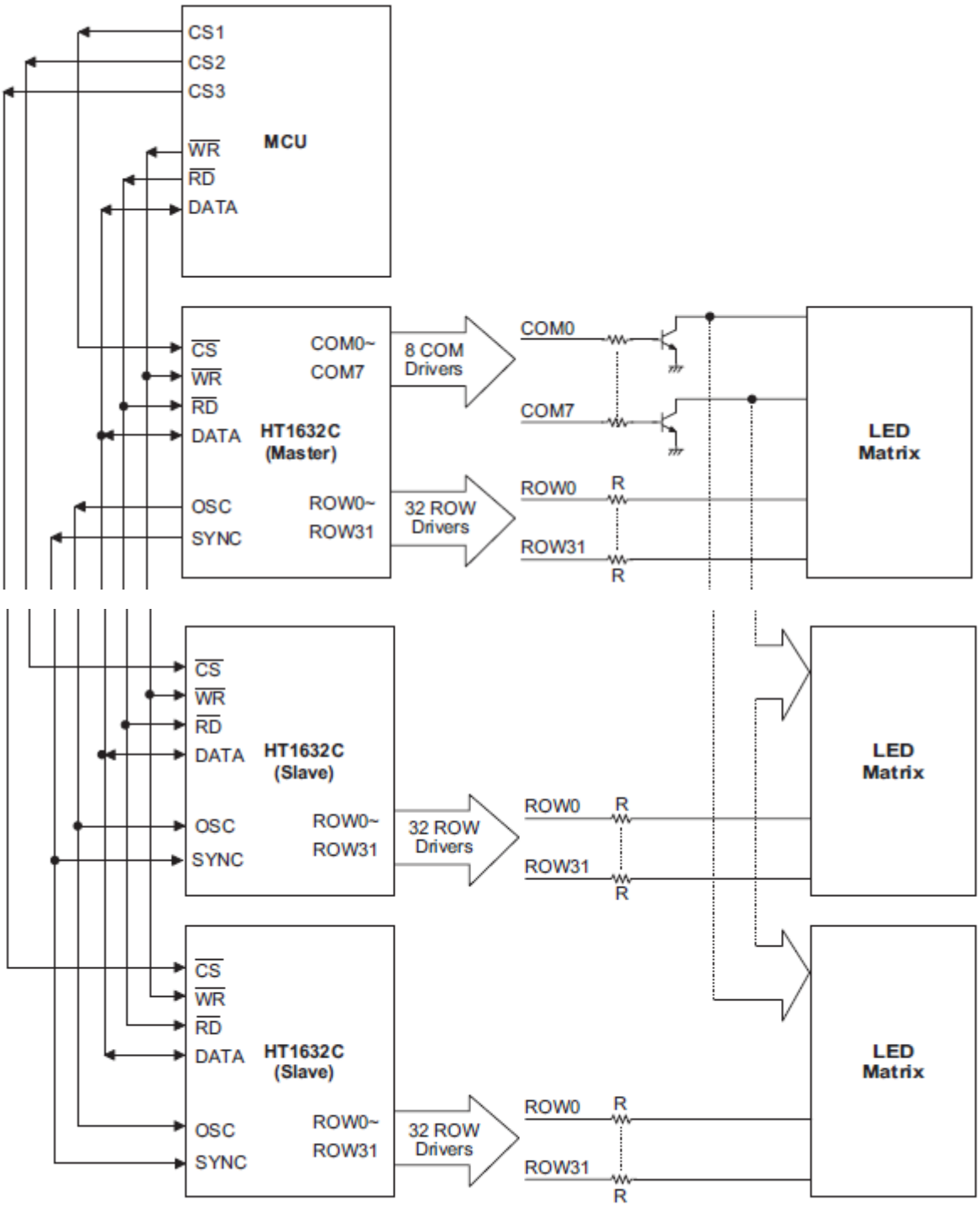
- 32 ROW × 8 COM example (direct drive)



Note: 1. It also can set cascade mode by software. User must set the Master in master mode and Slaves in slave mode with command. The $\overline{CS}$ pin must be connected to MCU individually for independent read and write.

2. Values of the "R" resistors are selected depending on the power consumption of the LEDs.

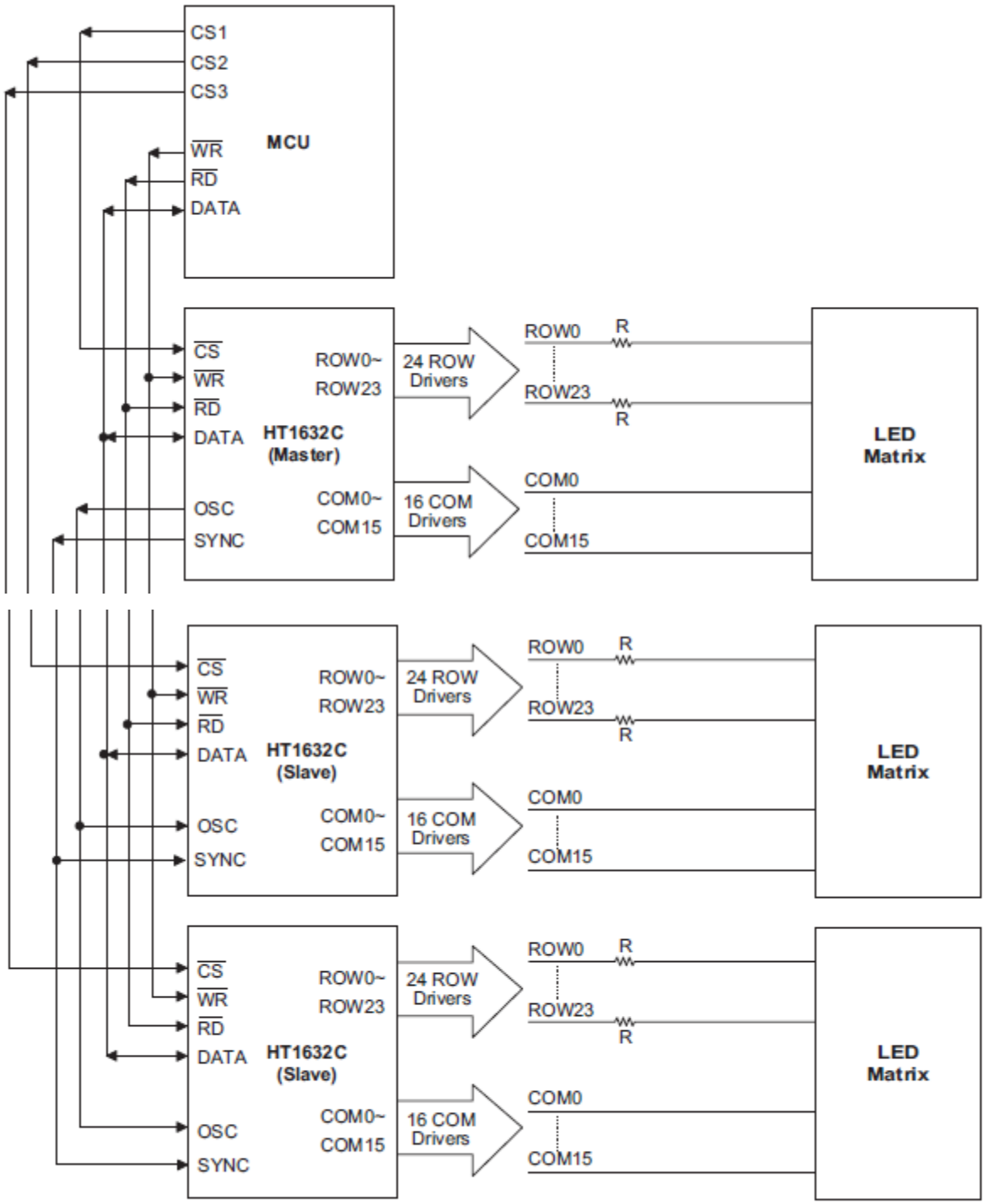
- 32 ROW × 8 COM example (COM with transistor buffer)



Note: 1. It also can set cascade mode by software. User must set the Master in master mode and Slaves in slave mode with command. The $\overline{CS}$ pin must be connected to MCU individually for independent read and write.

2. Values of the "R" resistors are selected depending on the power consumption of the LEDs.

- 24 ROW × 16 COM example (direct drive)



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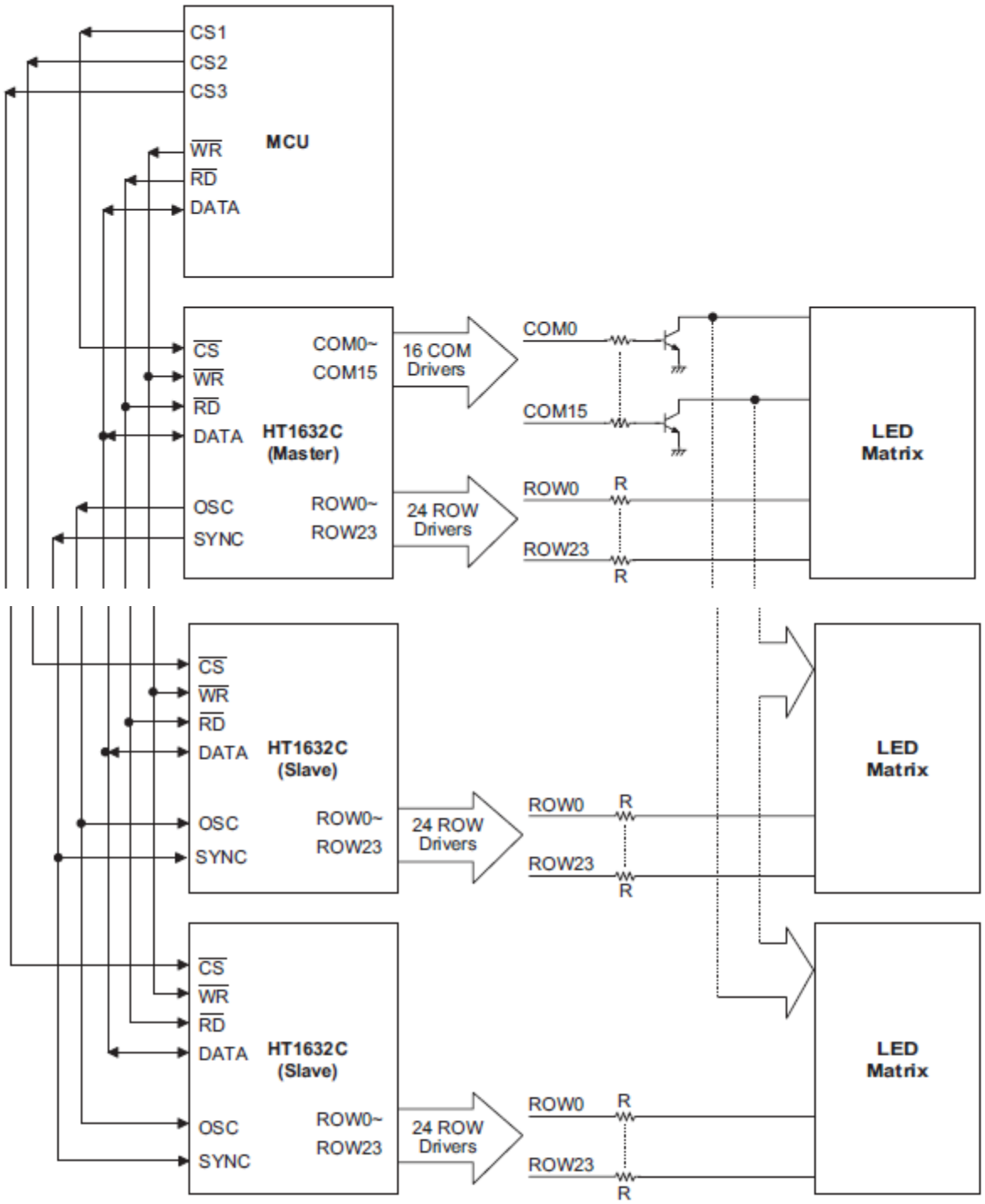
1. It also can set cascade mode by software. User must set the Master in master mode and Slaves in slave mode with command. The $\overline{CS}$ pin must be connected to MCU individually for independent read and write.
2. Values of the "R" resistors are selected depending on the power consumption of the LEDs.

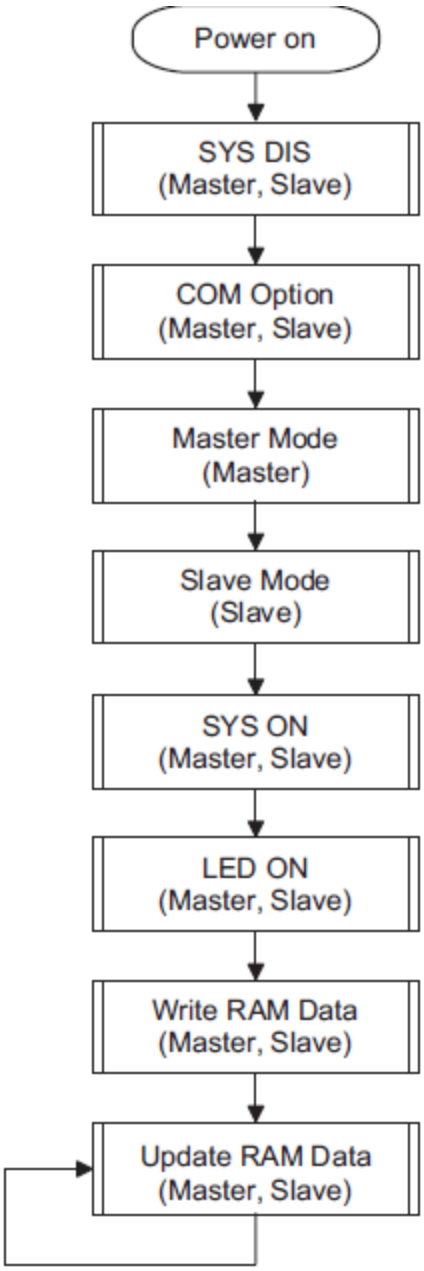
- 24 ROW × 16 COM example (COM with transistor buffer)



Note: 1. It also can set cascade mode by software. User must set the Master in master mode and Slaves in slave mode with command. The $\overline{CS}$ pin must be connected to MCU individually for independent read and write.

2. Values of the "R" resistors are selected depending on the power consumption of the LEDs.

一般设计流程：


Power on
SYS DIS
(Master, Slave)
COM Option
(Master, Slave)
Master Mode
(Master)
Slave Mode
(Slave)
SYS ON
(Master, Slave)
LED ON
(Master, Slave)
Write RAM Data
(Master, Slave)
Update RAM Data
(Master, Slave)

命令：

Command Summary

Name	ID	Command Code	D/C	Function	Def.
READ	1 1 0	A6A5A4A3A2A1A0D0D1D2D3	D	Read data from the RAM	
WRITE	1 0 1	A6A5A4A3A2A1A0D0D1D2D3	D	Write data to the RAM	
READ-MODIFY-WRITE	1 0 1	A6A5A4A3A2A1A0D0D1D2D3	D	Read and Write data to the RAM	
SYS DIS	1 0 0	0000-0000-X	C	Turn off both system oscillator and LED duty cycle generator	Yes
SYS EN	1 0 0	0000-0001-X	C	Turn on system oscillator	
LED Off	1 0 0	0000-0010-X	C	Turn off LED duty cycle generator	Yes
LED On	1 0 0	0000-0011-X	C	Turn on LED duty cycle generator	
BLINK Off	1 0 0	0000-1000-X	C	Turn off blinking function	Yes
BLINK On	1 0 0	0000-1001-X	C	Turn on blinking function	
SLAVE Mode	1 0 0	0001-0XXX-X	C	Set slave mode and clock source from external clock, the system clock input from OSC pin and synchronous signal input from SYN pin	
RC Master Mode	1 0 0	0001-10XX-X	C	Set master mode and clock source from on-chip RC oscillator, the system clock output to OSC pin and synchronous signal output to SYN pin	Yes
EXT CLK Master Mode	1 0 0	0001-11XX-X	C	Set master mode and clock source from external clock, the system clock input from OSC pin and synchronous signal output to SYN pin	
COM Option	1 0 0	0010-abXX-X	C	ab=00: N-MOS open drain output and 8 COM option ab=01: N-MOS open drain output and 16 COM option ab=10: P-MOS open drain output and 8 COM option ab=11: P-MOS open drain output and 16 COM option	ab =00
PWM Duty	1 0 0	101X-0000-X	C	PWM 1/16 duty	
	1 0 0	101X-0001-X	C	PWM 2/16 duty	
	1 0 0	101X-0010-X	C	PWM 3/16 duty	
	1 0 0	101X-0011-X	C	PWM 4/16 duty	
	1 0 0	101X-0100-X	C	PWM 5/16 duty	
	1 0 0	101X-0101-X	C	PWM 6/16 duty	
	1 0 0	101X-0110-X	C	PWM 7/16 duty	
	1 0 0	101X-0111-X	C	PWM 8/16 duty	
	1 0 0	101X-1000-X	C	PWM 9/16 duty	
	1 0 0	101X-1001-X	C	PWM 10/16 duty	
	1 0 0	101X-1010-X	C	PWM 11/16 duty	
	1 0 0	101X-1011-X	C	PWM 12/16 duty	
	1 0 0	101X-1100-X	C	PWM 13/16 duty	
	1 0 0	101X-1101-X	C	PWM 14/16 duty	
	1 0 0	101X-1110-X	C	PWM 15/16 duty	
	1 0 0	101X-1111-X	C	PWM 16/16 duty	

Note: X: Don't care

A6~A0: RAM addresses

D3~D0: RAM data

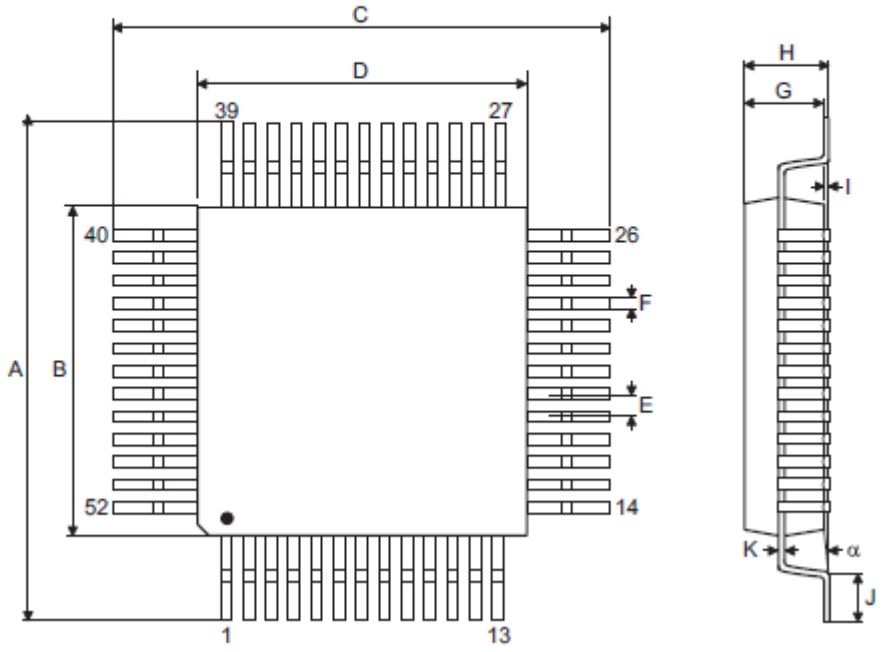
D/C: Data/command mode

Def.: Power on reset default

All the bold forms, namely 1 1 0, 1 0 1, and 1 0 0, are mode commands. Among these, 1 0 0 indicates the command mode ID. If successive commands have been issued, the command mode ID except for the first command will be omitted. The source of the tone frequency and of the time base clock frequency can be derived from an on-chip RC oscillator or an external clock. Calculation of the frequency is based on the system frequency sources as stated above. It is recommended that the host controller should initialize the HT1632C after power on reset, for power on reset may fail, which in turn leads to the malfunction of the HT1632C

Package Information

52-pin QFP (14mm×14mm) Outline Dimensions



Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	17.3	—	17.5
B	13.9	—	14.1
C	17.3	—	17.5
D	13.9	—	14.1
E	—	1.0	—
F	—	0.4	—
G	2.5	—	3.1
H	—	—	3.4
I	—	0.1	—
J	0.73	—	1.03
K	0.1	—	0.2
α	0°	—	7°

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NOTE:

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错误疏漏之处在所难免，有任何问题请参考原英文资料，请联系HOLTEK公司，同时欢迎大家加我**QQ:337072753**