

# DDR 13-Bit to 26-Bit Registered Buffer

## Recommended Application:

DDR Memory Modules

## Product Features:

- Differential clock signals
- Meets SSTL\_2 signal data
- Supports SSTL\_2 class II specifications on outputs
- low-voltage operation  
- VDD = 2.3V to 2.7V
- Available in 64 pin TSSOP and 56 pin MLF2 packages

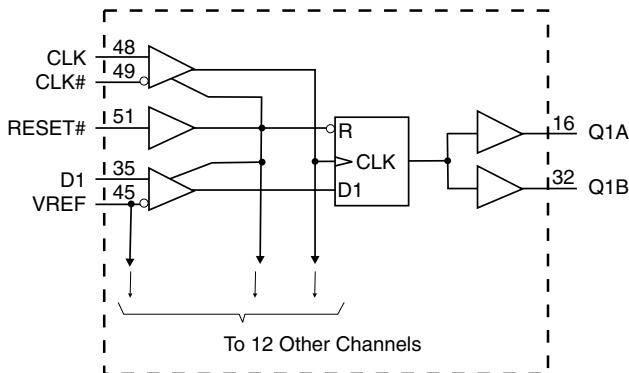
## Truth Table<sup>1</sup>

Inputs				Q Outputs
RESET#	CLK	CLK#	D	Q
L	X or Floating	X or Floating	X or Floating	L
H	↑	↓	H	H
H	↑	↓	L	L
H	L or H	L or H	X	Q <sub>0</sub> <sup>(2)</sup>

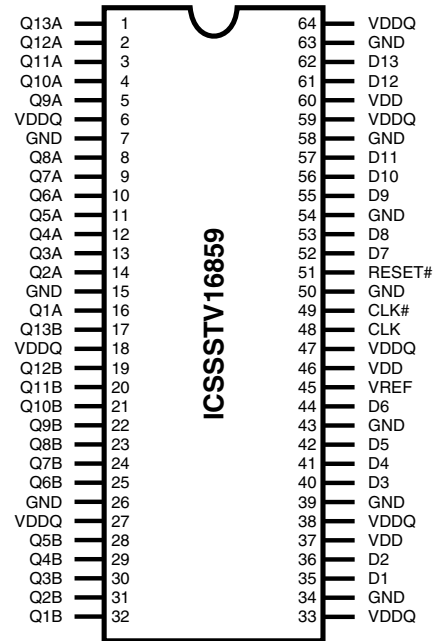
## Notes:

1. H = High Signal Level  
L = Low Signal Level  
↑ = Transition LOW-to-HIGH  
↓ = Transition HIGH -to LOW  
X = Irrelevant
2. Output level before the indicated steady state input conditions were established.

## Block Diagram

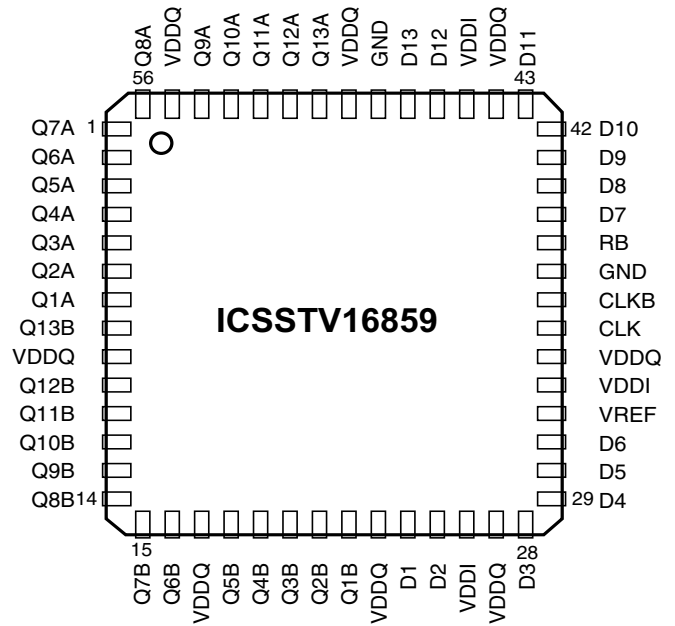


## Pin Configurations



## 64-Pin TSSOP

6.10 mm. Body, 0.50 mm. pitch



## 56 pin MLF2

# ICSSSTV16859



## Preliminary Product Preview

### General Description

The 13-bit to 26-bit ICSSSTV16859 is a universal bus driver designed for 2.3V to 2.7V VDD operation and SSTL\_2 I/O Levels except for the RESET# input which is LVCMOS.

Data flow from D to Q is controlled by the differential clock, CLK, CLK# and RESET#. Data is triggered on the positive edge of CLK. CLK# must be used to maintain noise margins. RESET# must be supported with LVCMOS levels as VREF may not be stable during power-up. RESET# is asynchronous and is intended for power-up only and when low assures that all of the registers reset to the Low State, Q outputs are low, and all input receivers, data and clock are switched off.

The ICSSSTV16859 supports low-power standby operation. When RESET# is LOW, the differential input receivers are disabled, and are allowed. In addition, when RESET# is LOW, all registers are reset, and all outputs are forced LOW. The LVCMOS RESET# input must always be held at a valid logic HIGH or LOW level.

To ensure defined outputs from the register before a stable clock has been supplied, RESET# must be held in the LOW state during power up.

In the DDR DIMM application RESET# is specified to be completely asynchronous with respect to CK and CK#. Therefore, no timing relationship can be guaranteed between the two. When entering RESET#, the register will be cleared and the outputs will be driven LOW quickly, relative to the time to disable the differential input receivers, thus ensuring no glitches on the output. However, when coming out of RESET#, the register will become active quickly, relative to the time to enable the differential input receivers. When the data inputs are LOW, and the clock is stable, during the time from the LOW-to-HIGH transition of RESET# until the input receivers are fully enabled, the design must ensure that the outputs will remain LOW.

### Pin Configuration

PIN NAME	TYPE	DESCRIPTION
Q (13:1)	OUTPUT	Data output
GND	PWR	Ground
VDDQ	PWR	Output supply voltage, 2.5V nominal
D (13:1)	INPUT	Data input
CLK	INPUT	Positive master clock input
CLK#	INPUT	Negative master clock input
VDD	PWR	Core supply voltage, 2.5V nominal
RESET#	INPUT	Reset (active low)
VREF	INPUT	Input reference voltage, 2.5V nominal
Center PAD	PWR	Ground (MLF2 package only)



### Absolute Maximum Ratings

Storage Temperature .....	-65°C to +150°C
Supply Voltage .....	-0.5 to 3.6V
Input Voltage <sup>1</sup> .....	-0.5 to VDD +0.5
Output Voltage <sup>1,2</sup> .....	-0.5 to VDDQ +0.5
Input Clamp Current .....	±50 mA
Output Clamp Current .....	±50mA
Continuous Output Current .....	±50mA
VDD, VDDQ or GND Current/Pin .....	±100mA
Package Thermal Impedance <sup>3</sup> .....	55°C/W

**Notes:**

1. The input and output negative voltage ratings may be excluded if the input and output clamp ratings are observed.
2. This current will flow only when the output is in the high state level  $V_0 > V_{DDQ}$ .
3. The package thermal impedance is calculated in accordance with JESD 51.

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

### Recommended Operating Conditions

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
V <sub>DD</sub>	Supply Voltage	2.3	2.5	2.7	V
V <sub>DDQ</sub>	I/O Supply Voltage	2.3	2.5	2.7	
V <sub>REF</sub>	Reference Voltage V <sub>REF</sub> = 0.5X V <sub>DDQ</sub>	1.15	1.25	1.35	
V <sub>TT</sub>	Termination Voltage	V <sub>REF</sub> -0.04	V <sub>REF</sub>	V <sub>REF</sub> -0.04	
V <sub>I</sub>	Input Voltage	0		V <sub>DD</sub>	
V <sub>IH</sub>	DC Input High Voltage	V <sub>REF</sub> +0.15			
V <sub>IH</sub>	AC Input High Voltage	V <sub>REF</sub> +0.31			
V <sub>IL</sub>	DC Input Low Voltage			V <sub>REF</sub> -0.15	
V <sub>IL</sub>	AC Input Low Voltage			V <sub>REF</sub> -0.31	
V <sub>IH</sub>	Input High Voltage Level	1.7			
V <sub>IL</sub>	Input Low Voltage Level			0.7	
V <sub>ICR</sub>	Common mode Input Range	0.97		1.53	
V <sub>ID</sub>	Differential Input Voltage	0.36			
V <sub>IX</sub>	Cross Point Voltage of Differential Clock Pair	(V <sub>DDQ</sub> /2) -0.2		(V <sub>DDQ</sub> /2) +0.2	
I <sub>OH</sub>	High-Level Output Current			-20	mA
I <sub>OL</sub>	Low-Level Output Current			20	
T <sub>A</sub>	Operating Free-Air Temperature	0		70	°C

<sup>1</sup>Guaranteed by design, not 100% tested in production.



## Preliminary Product Preview

### Electrical Characteristics - DC

$T_A = 0 - 70^\circ \text{C}$ ;  $V_{DD} = 2.5 \text{ V} \pm 200\text{mV}$ ,  $V_{DDQ} = 2.5 \text{ V} \pm 200\text{mV}$ ; (unless otherwise stated)

SYMBOL	PARAMETERS	CONDITIONS	$V_{DD}$	MIN	TYP	MAX	UNITS
$V_{IK}$		$I_I = -18\text{mA}$	2.3V			-1.2	V
$V_{OH}$		$I_{OH} = -100\mu\text{A}$	2.3V-2.7	$V_{DD} - 0.2$			
		$I_{OH} = -16\text{mA}$	2.3V	1.95			
$V_{OL}$		$I_{OL} = 100\mu\text{A}$	2.3-2.7V			0.2	
		$I_{OL} = 16\text{mA}$	2.3V			0.35	
$I_I$	All Inputs	$V_I = V_{DD}$ or GND	2.7V			$\pm 5$	$\mu\text{A}$
$I_{DD}$	Standby (Static)	RESET# = GND				.01	$\mu\text{A}$
	Operating (Static)	$V_I = V_{IH}(\text{AC}\#)$ or $V_{IL}(\text{AC})$ , RESET# = $V_{DD}$				TBD	mA
$I_{DDD}$	Dynamic operating clock only	RESET = $V_{DD}$ , $V_I = V_{IH}(\text{AC})$ or $V_{IL}(\text{AC})$ , CK and CK# switching 50% duty cycle.	2.7V			TBD	$\mu/\text{clock MHz}$
	Dynamic Operating per each data input	RESET# = $V_{DD}$ , $V_I = V_{IH}(\text{AC})$ or $V_{IL}(\text{AC})$ , CK and CK# switching 50% duty cycle. One data input switching at half clock frequency, 50% duty cycle					TBD
$r_{OH}$	Output High	$I_{OH} = 20\text{mA}$	2.3-2.7V	7		20	$\Omega$
$r_{OL}$	Output Low	$I_{OL} = 20\text{mA}$	2.3-2.7V	7		20	$\Omega$
$r_{O(\Delta)}$	$[r_{OH} - r_{OL}]$ each separate bit	$I_O = 20\text{mA}$ , $T_A = 25^\circ \text{C}$	2.5V			4	$\Omega$
$C_i$	Data Inputs	$V_I = V_{REF} \pm 350\text{mV}$	2.5V	2.5		3.5	pF
	CK and CK#	$V_{ICR} = 1.25\text{V}$ , $V_{I(PP)} = 360\text{mV}$		2.5		3.5	

Notes:

1 - Guaranteed by design, not 100% tested in production.



## Timing Requirements

(over recommended operating free-air temperature range, unless otherwise noted)

SYMBOL	PARAMETERS		$V_{DD} = 2.5V \pm 0.2V$		UNITS
			MIN	MAX	
$f_{clock}$	Clock frequency			200	MHz
$t_{PD}$	Clock to output time		TBD		ns
$t_{RST}$	Reset to output time			5	ns
$t_{SL}$	Output slew rate		1	4	V/ns
$t_{SU}$	Setup time, fast slew rate <sup>2,4</sup>	Data before CK $\uparrow$ , CK# $\downarrow$	0.75		ns
	Setup time, slow slew rate <sup>3,4</sup>		0.9		ns
$T_h$	Hold time, fast slew rate <sup>2,4</sup>	Data after CK $\uparrow$ , CK# $\downarrow$	0.75		ns
	Hold time, slow slew rate <sup>3,4</sup>		0.9		ns

- Notes:**
- 1 - Guaranteed by design, not 100% tested in production.
  - 2 - For data signal input slew rate  $\geq 1V/ns$ .
  - 3 - For data signal input slew rate  $\geq 0.5V/ns$  and  $< 1V/ns$ .
  - 4 - CLK, CLK# signals input slew rates are  $\geq 1V/ns$ .

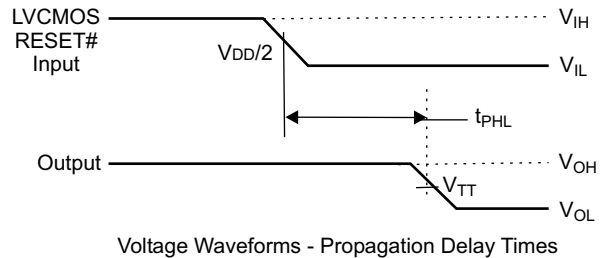
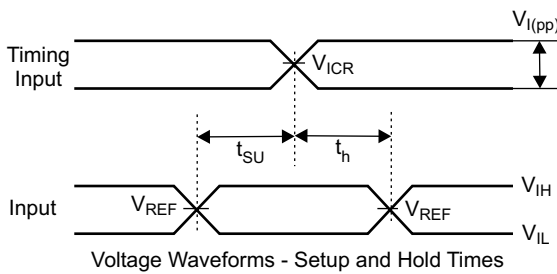
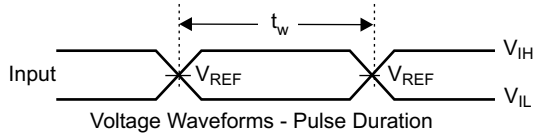
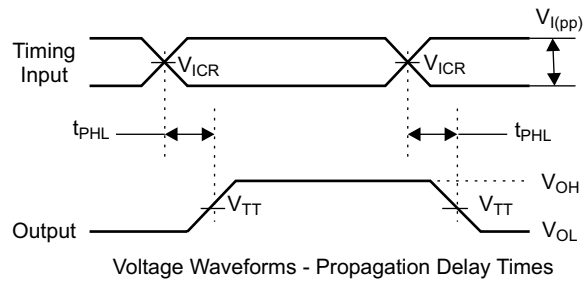
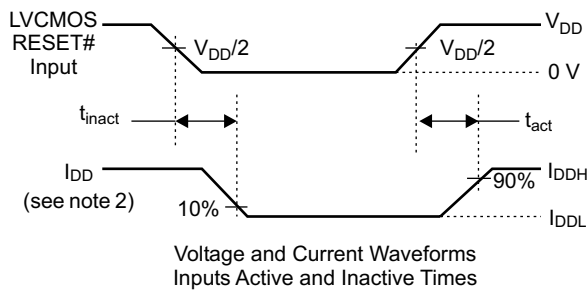
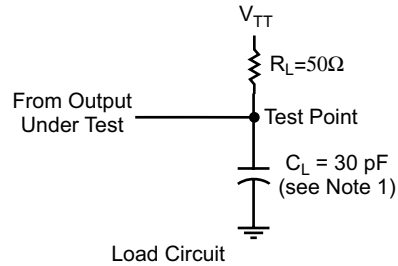
## Switching Characteristics

(over recommended operating free-air temperature range, unless otherwise noted)

SYMBOL	From (Input)	To (Output)	$V_{DD} = 2.5V \pm 0.2V$			UNITS
			MIN	TYP	MAX	
$f_{max}$			200			MHz
$t_{PD}$	CLK, CLK#	Q	1.1		2.8	ns
$t_{phl}$	CLK, CLK#	Q			5	ns

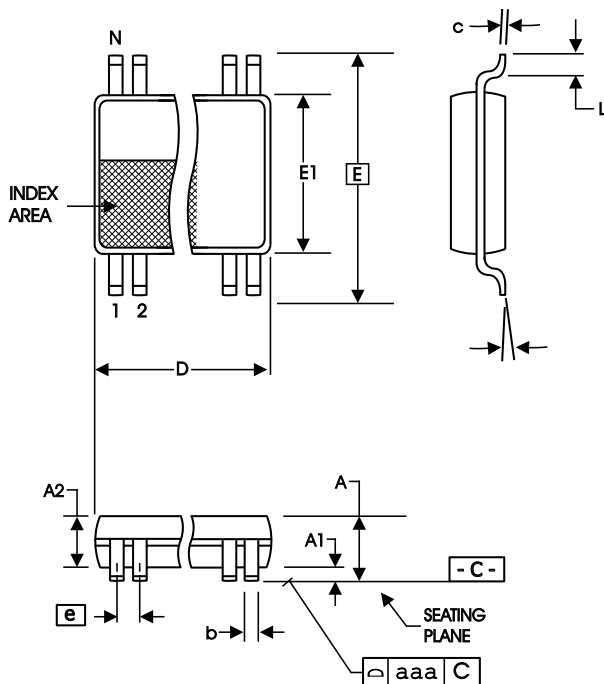


## Preliminary Product Preview



### Parameter Measurement Information ( $V_{DD} = 2.5V \pm 0.2V$ )

- Notes:
1.  $C_L$  includes probe and jig capacitance.
  2.  $I_{DD}$  tested with clock and data inputs held at  $V_{DD}$  or GND, and  $I_o = 0\text{ mA}$ .
  3. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_o = 50\Omega$ , input slew rate =  $1\text{ V/ns} \pm 20\%$  (unless otherwise specified).
  4. The outputs are measured one at a time with one transition per measurement.
  5.  $V_{TT} = V_{REF} = V_{DDQ}/2$
  6.  $V_{IH} = V_{REF} + 310\text{ mV}$  (ac voltage levels) for differential inputs.  $V_{IH} = V_{DD}$  for LVC MOS input.
  7.  $V_{IL} = V_{REF} - 310\text{ mV}$  (ac voltage levels) for differential inputs.  $V_{IL} = \text{GND}$  for LVC MOS input.
  8.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$



SYMBOL	In Millimeters		In Inches	
	COMMON DIMENSIONS	COMMON DIMENSIONS	COMMON DIMENSIONS	COMMON DIMENSIONS
A	--	1.20	--	.047
A1	0.05	0.15	.002	.006
A2	0.80	1.05	.032	.041
b	0.17	0.27	.007	.011
c	0.09	0.20	.0035	.008
D	SEE VARIATIONS		SEE VARIATIONS	
E	8.10 BASIC		0.319 BASIC	
E1	6.00	6.20	.236	.244
e	0.50 BASIC		0.020 BASIC	
L	0.45	0.75	.018	.030
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°
aaa	--	0.10	--	.004

VARIATIONS

N	D mm.		D (inch)	
	MIN	MAX	MIN	MAX
64	16.90	17.10	.665	.673

Reference Doc.: JEDEC Publication 95, MO-153

10-0039

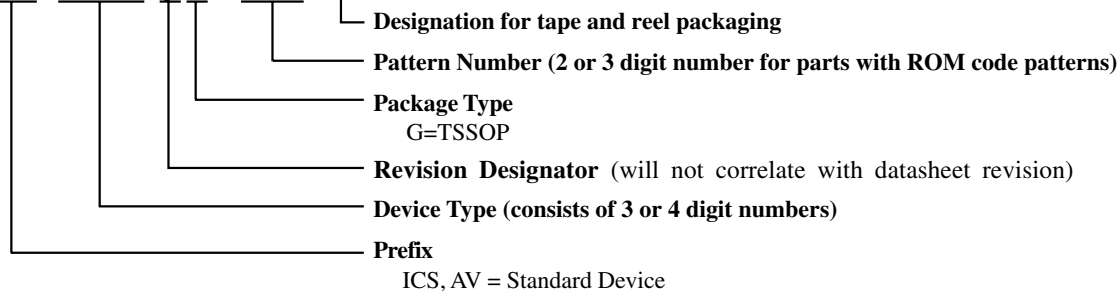
6.10 mm. Body, 0.50 mm. pitch TSSOP  
(240 mil) (0.020 mil)

Ordering Information

ICSSSTV16859yG-T

Example:

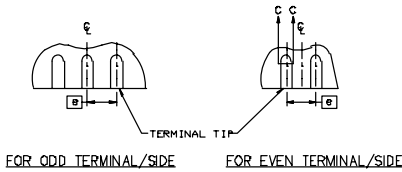
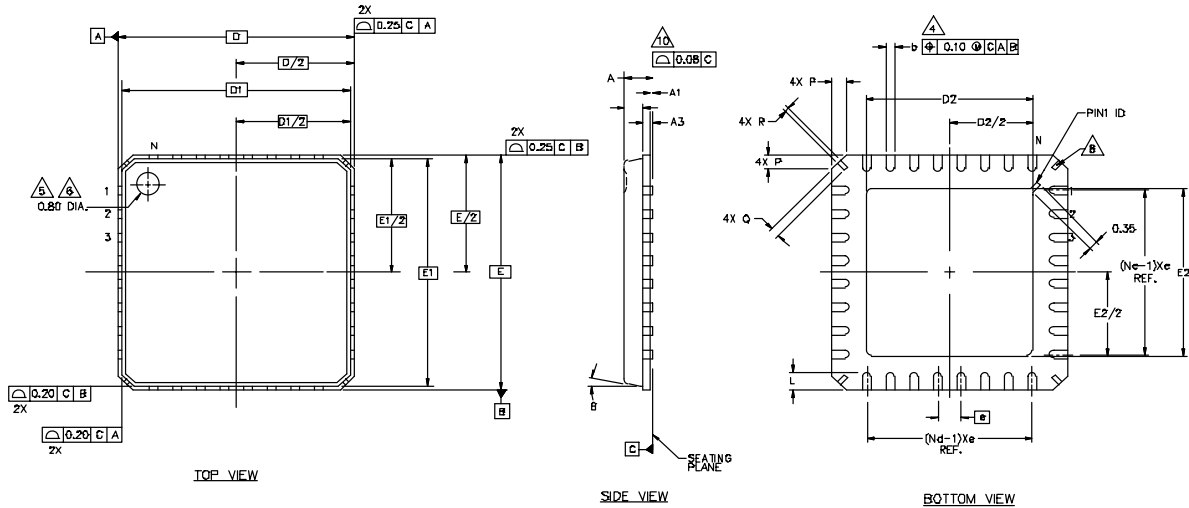
ICS XXXX y G - PPP - T



# ICSSSTV16859



## Preliminary Product Preview



### 56 pin MLF2

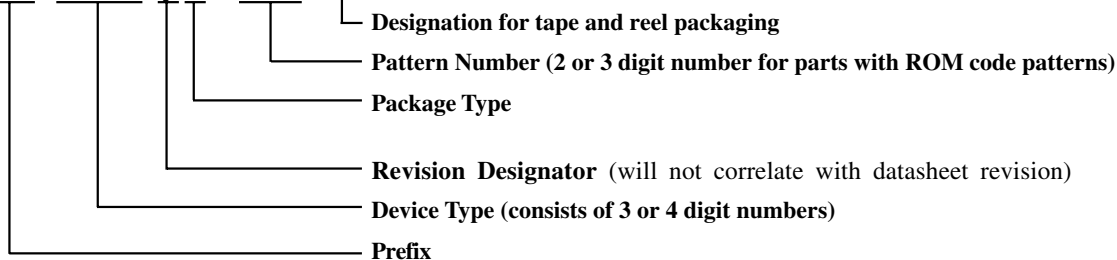
Symbol	Common Dimensions		
A	-	0.85	1.00
A1	0.00	0.01	0.05
A2	-	0.65	0.80
A3	0.20 BSC		
D	8.00 BSC		
D1	7.75 BSC		
E	8.00 BSC		
E1	7.75 BSC		
θ			12
P	0.24	0.42	0.60
R	0.13	0.17	0.23
<b>Pitch Variation D</b>			
e	0.50 BSC		
N	56		
Nd	14		
Ne	14		
L	0.30	0.40	0.50
b	0.18	0.23	0.30
Q	0.00	0.20	0.45
D2	5.95	6.10	6.25
E2	5.95	6.10	6.25

## Ordering Information

ICSSSTV16859yK

Example:

ICS XXXX y K - PPP - T



ICS, AV = Standard Device