CMOS 4-Bit Microcontroller

TMP47C662AN,TMP47C862AN

The TMP47C662A/862A are high speed and high performance 4-bit single chip micro computers, integrating the 8 bit AD converter, 12-bit programmable pulse generator and high-breakdown voltage outputs based on the TLCS-470 series.

Part No.	ROM	RAM	Package	OTP
TMP47C662AN	6144 × 8-bit	384 × 4-bit	P-SDIP64-750-1.78	TMP47P862VN
TMP47C862AN	8192 × 8-bit	512 × 4-bit		

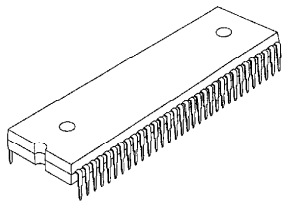
Features

◆4-bit single chip microcomputer
◆Instruction execution time: 1.3 μs (at 6 MHz), 244 μs (at 32.8 kHz)
◆92 basic instructions
- Table look-up instructions
- 5-bit to 8-bit data conversion instruction

◆Subroutine nesting: 15 levels max
◆6 interrupt sources (External: 2, Internal: 4)
All sources have independent latches each, and multiple interrupt control is available.
◆I/O port (55 pins)
- Input 2 ports 5 pins
- Output 1 port 3 pins
- I/O 12 ports 47 pins

◆Interval Timer
◆Two 12-bit Timer / Counters
Timer, event counter,and pulse width measurement mode
◆Watchdog Timer
◆Serial Interface with 8-bit buffer
- Simultaneous transmission and reception capability
- 8/4-bit transfer, external / internal clock, and leading / trailing edge shift mode

P-SDIP64-750-1.78



TMP47C662AN
TMP47C862AN
TMP47P862VN

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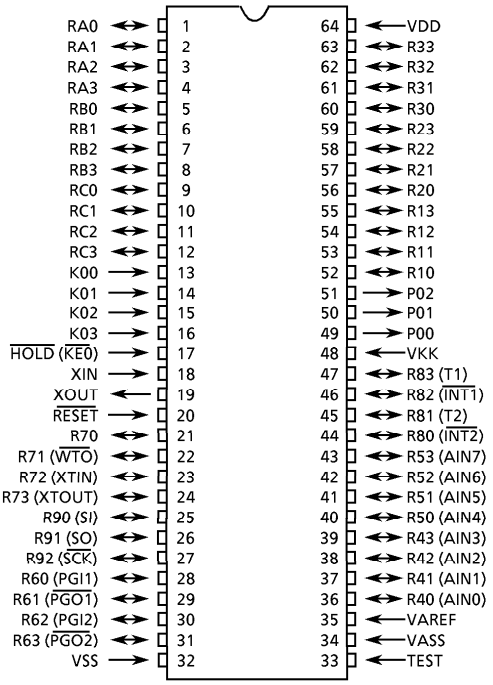
◆Two 12-bit Programmable Pulse Generator
One-shot / continuous output, external / internal trigger, rising/falling edge trigger (external) mode
◆8-bit successive approximate type AD converter
- With sample and hold
- 8 analog inputs
- Conversion time: 32 μs (at 6 MHz)

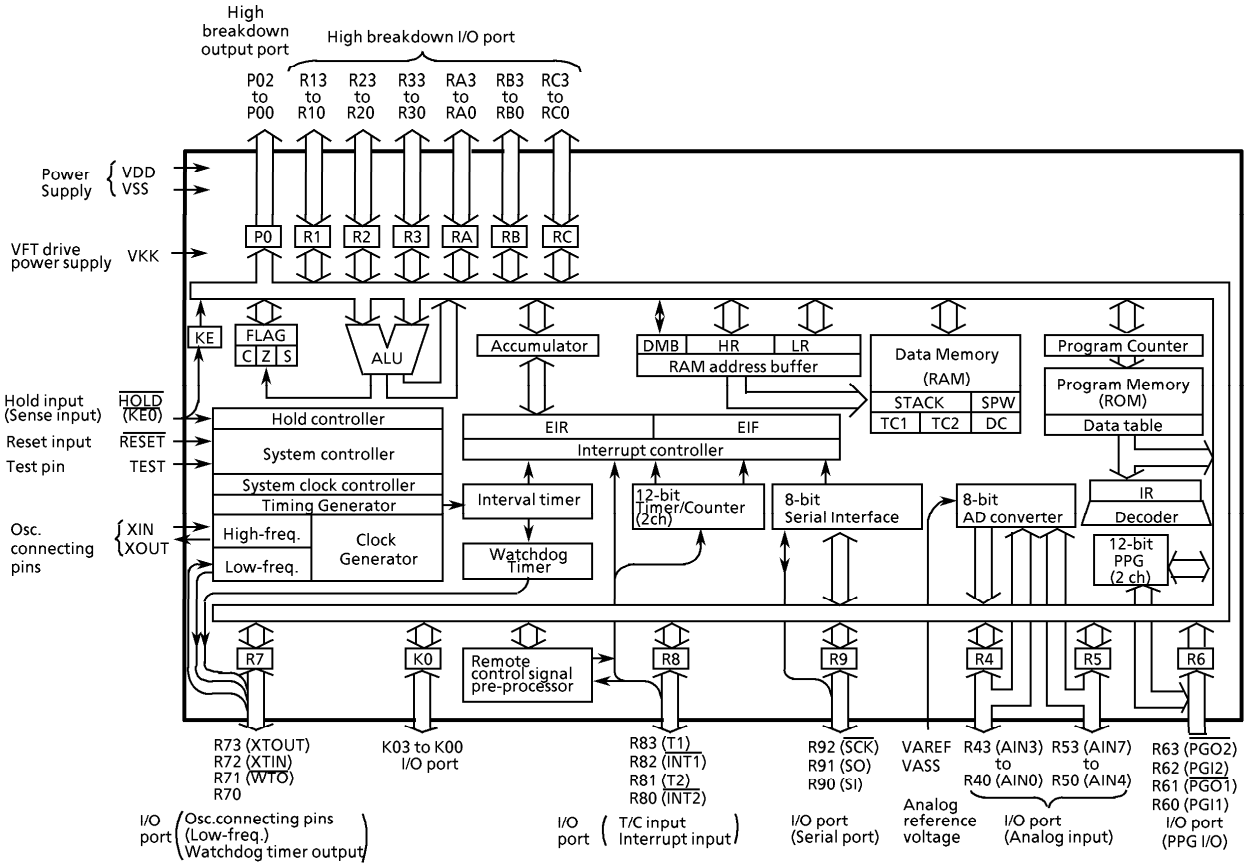
◆Remote control pulse detector
◆High current outputs
LED direct drive capability (typ. 20 mA × 4 bits)
◆High breakdown voltage outputs
VFT direct drive capability (max 42V x 27 bits)
◆Dual-clock operation
High-speed/Low-power-consumption operating mode
◆Hold function
Battery/Capacitor back-up
◆Real Time Emulator: BM47C862N0A

Pin Assignment (Top View)

P-SDIP64-750-1.78



Block Diagram



Pin Function

Pin Name	Input / Output	Functions	
K03 to K00	Input	4-bit input port	
R53 (AIN7) to R40 (AIN0)	I/O (Input)	4-bit I/O port with latch. When using as input port, watchdog timer output, analog input, PPG (programmable pulse generator) output, or PPG trigger input, the latch must be set to "1". Set to Dual-clock operating mode, when R73, R72 pin use as clock generator. Can be set, cleared, and tested for each bit as specified by L register indirect addressing bit manipulation instructions.	AD converter analog input
R63 ($\overline{PGO2}$)	I/O (Output)		PPG2 output
R62 (PGI2)	I/O (Input)		PPG2 input
R61 ($\overline{PGO1}$)	I/O (Output)		PPG1 output
R60 (PGI1)	I/O (Input)		PPG1 input
R73 (XTOUT)	I/O (Output)		Resonator connecting pin (Low-freq.). For inputting external clock, XTIN is used and XTOUT is opened.
R72 (XTIN)	I/O (Input)		
R71 ($\overline{WTO}$)	I/O (Output)		Watchdog timer output
R70	I/O		
R83 (T1)	I/O (Input)	4-bit I/O port with latch. When using as input port, external interrupt input pin, or timer/counter external input pin, the latch must be set to "1".	Timer / Counter 1 external input
R82 ($\overline{INT1}$)			External interrupt 1 input
R81 (T2)			Timer / Counter 2 external input
R80 ($\overline{INT2}$)			External interrupt 2 or REMO-CON input
R92 ($\overline{SCK}$)	I/O (I/O)	3-bit I/O port with latch. When using as input port or serial port, the latch must be set to "1".	Serial clock I/O
R91 (SO)	I/O (Output)		Serial data output
R90 (SI)	I/O (Input)		Serial data input
P02 to P00	Output	3-bit high breakdown voltage output port with latch	
R13 to R10	I/O	4-bit high breakdown voltage I/O port with latch. 8-bit data are output by the 5-bit to 8-bit data conversion instruction [OUTB @HL]. When using as input port, the latch must be cleared to "0".	
R23 to R20			
R33 to R30	I/O	4-bit high breadown voltage I/O port with latch. When using as input port, the latch must be cleared to "0".	
RA3 to RA0			
RB3 to RB0			
RC3 to RC0			
XIN, XOUT	Input, Output	Resonator connecting pin (High-frequency) . For inputting external clock, XIN is used and XOUT is opened.	
$\overline{RESET}$	Input	Reset signal input	
$\overline{HOLD}$ ($\overline{KE0}$)	Input (Input)	Hold request/release signal input	Sence input
TEST	Input	Test pin for out-going test. Be opened or fixed to low level.	
VDD, VSS	Power supply	+ 5 V, 0 V (GND)	
VAREF, VASS		AD converter analog reference voltage	
VKK		VFT drive power supply	

Operational Description

Concerning the TMP47C662A/862A the configuration and functions of hardwares are described. As the description has been provided with priority on those parts differing from the TMP47C660/860, the technical data sheets for the TMP47C660/860 shall also be referred to.

1. System Configuration

◆ Internal CPU Function

They are the same as those of the TMP47C660/860.

◆ Peripheral Hardware Function

① I/O Port
② Interval Timer
③ Timer / Counters (TC1, TC2)
④ Watchdog Timer
⑤ Remote control pulse detector
⑥ AD converter
⑦ Programmable Pulse Generator
⑧ Serial Interface

The description has been provide with priority on functions (① and ⑦) added to and changed from the TMP47C660/860.

2. Peripheral Hardware Function

2.1 I/O Ports

TMP47C662A/862A have 15 I/O ports (55pins) each as follows:

① K0	;	4-bit input
② P0	;	3-bit output
③ R1, R2	;	4-bit input / output
④ R4, R5	;	4-bit input / output (shared with AD converter analog inputs)
⑤ R6	;	4-bit input / output (shared with programmable pulse generator I/O)
⑥ R7	;	4-bit input / output (shared with the low-frequency resonator connecting pins and the watchdog timer output)
⑦ R8	;	4-bit input / output (shared with external interrupt request input and timer / counter input)
⑧ R9	;	3-bit input / output (shared with serial port)
⑨ R3, RA, RB, RC	;	4-bit input / output
⑩ KE	;	1-bit sense input (shared with hold request/release signal input)

This section describes ports of ②, ③, ⑤ and ⑨ which are changed from the TMP47C660/860.
Table 2-1 lists the port address assignments and the I/O instructions that can access the ports.

(1) Ports P0 (P02 to P00)

Ports P0 is 3-bit high breakdown voltage output ports with latch. The latch is initialized to "0" during reset.

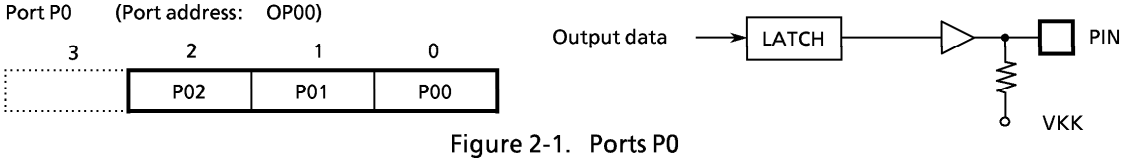


Figure 2-1. Ports P0

(2) Ports R1 (R13 to R10), R2 (R23 to R20)

The 4-bit high breakdown voltage I/O ports with latch, which can directly Vacume Fuolrescent Tubes (VFT) . The latch should be cleared to "0" when used as an inuput port. The latch is initialized to "0" during reset.

Electrical Characteristics

Absolute Maximum Ratings (V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 7	V
Input Voltage	V_{IN}		– 0.3 to V_{DD} + 0.3	V
Output Voltage	V_{OUT1}	R4, R5, R7	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	R6, R8, R9	– 0.3 to 10	
	V_{OUT3}	Source open drain pin	– 35 to V_{DD} + 0.3	
Output Current (per 1 pin)	I_{OUT1}	R6	30	mA
	I_{OUT2}	R4, R5, R7 to R9	3.2	
	I_{OUT3}	P0, R1, R2	– 10	
	I_{OUT4}	R3, RA, RB, RC	– 25	
Output Currnent (Total)	ΣI_{OUT1}	R6	60	mA
	ΣI_{OUT2}	R3, RA, RB, RC	– 100	
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 40 to 70	°C

Note: The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Any one of the ratings must not be exceeded. If any absolute maximum rating is exceeded, a device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user. Thus, when designing products which include this device, ensure that no absolute maximum rating value will ever be exceeded.

Recommended Opeating Conditions (V_{SS} = 0 V, Topr = – 40 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Max	Unit
Supply Voltage	V_{DD}		In the Normal mode	4.5	6.0	V
			In the SLOW mode	2.7		
			In the HOLD mode	2.0		
Input High Voltage	V_{IH1}	Except Hysteresis Input	$V_{DD} \geqq 4.5V$	$V_{DD} \times 0.7$	V_{DD}	V
	V_{IH2}	Hysteresis Input		$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5V$	$V_{DD} \times 0.9$		
Input Low Voltage	V_{IL1}	XIN, XOUT	$V_{DD} \geqq 4.5V$	0	$V_{DD} \times 0.3$	V
	V_{IL2}	XTIN, XTOUT			$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5V$		$V_{DD} \times 0.1$	
Clock Frequency	fc			0.4	6.0	MHz
	fs			30.0	34.0	kHz

Note 1: The recommended operating conditions for a device are operating conditions under which it can be guaranteed that the device will operate as specified. If the device is used under operating conditions other than the recommended operating conditions (supply voltage, operating temperature range, specified AC/DC values etc.), malfunction may occur. Thus, when designing products which include this device, ensure that the recommended operating conditions for the device are always adhered to.

Note 2: Input voltage V_{IH3}, V_{IL3}: In the SLOW or HOLD mode.

DC Characteristics

(V_{SS} = 0 V, Topr = – 40 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis Input		–	0.7	–	V
Input Current	I_{IN1}	K0, TEST, $\overline{RESET}$, $\overline{HOLD}$	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I_{IN2}	R ports (open drain)					
Input Resistance	R_{IN1}	K0 port with pull-up/pull-down		30	70	150	kΩ
	R_{IN2}	$\overline{RESET}$		100	220	450	
Pull-down resistance	R_K	source open drain	V_{DD} = 5.5 V, V_{KK} = -30 V	–	80	–	
Output Leakage Current	I_{LO1}	sink open drain	V_{DD} = 5.5 V, V_{IN} = 5.5 V	–	–	2	μA
	I_{LO2}	source open drain	V_{DD} = 5.5 V, V_{OUT} = –32 V	–	–	– 2	
Output Level High Voltage	V_{OH}	P0, R1, R2	V_{DD} = 4.5 V, I_{OH} = –5 mA	2.4	–	–	V
Output Level Low Voltage	V_{OL}	R4, R5, R7-R9	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Output Level High Voltage	I_{OH}	R3, RA, RB, RC	V_{DD} = 4.5 V, V_{OH} = 2.4 V	–	– 15	–	mA
Output Level Low Voltage	I_{OL}	R6	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
Supply Current (in the Normal mode)	I_{DD}		V_{DD} = 5.5 V, fc = 4 MHz	–	3	6	mA
Supply Current (in the SLOW mode)	I_{DDS}		V_{DD} = 3.0 V, fs = 32.768 kHz	–	30	–	μA
Supply Current (in the HOLD mode)	I_{DDH}		V_{DD} = 5.5 V	–	0.5	10	μA

Note 1: Typ. values show those at Topr = 25°C, V_{DD} = 5 V.

Note 2: Input Current I_{IN1} ; The current through resistor is not included, when the input resistor (pull-up/pull-down) is contained.

Note 3: Supply Current I_{DD}, I_{DDH} ; V_{IN} = 5.3 V / 0.2 V
The K0 port is open when the input resistor is contained. The voltage applied to the R port is within the valid range.
Supply Current I_{DDS} ; V_{IN} = 2.8 V / 0.2 V
Low frequency clock is only osillated (connecting XTIN, XTOUT).

AD Conversion Characteristics

(Topr = – 40 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}		V_{DD} – 1.5	–	V_{DD}	V
	V_{ASS}		V_{SS}	–	1.5	
Analog Reference Voltage Range	ΔV_{AREF}	$V_{AREF} - V_{ASS}$	2.5	–	–	V
Analog Input Voltage	V_{AIN}		V_{ASS}	–	V_{AREF}	V
Analog Supply Current	I_{REF}		–	0.5	1.0	mA
Nonlinearity Error		V_{DD} = 5.0 V, V_{SS} = 0.0 V V_{AREF} = 5.000 V V_{ASS} = 0.000 V	–	–	± 1	LSB
Zero Point Error			–	–	± 1	
Full Scale Error			–	–	± 1	
Total Error			–	–	± 2	

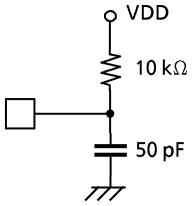
AC Characteristics

(V_{SS} = 0V, V_{DD} = 4.5 to 6.0V, T_{opr} = – 40 to 70°C)

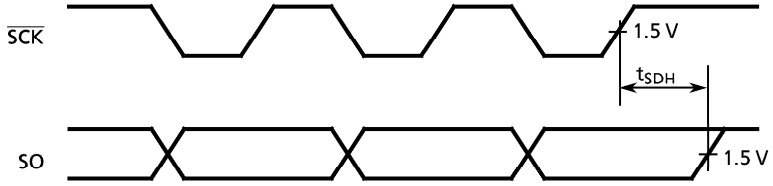
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Instruction Cycle Time	tcy	In the Normal mode	1.3	—	20	ns
		In the SLOW mode	235	—	267	
High level Clock pulse Width	t_{WCH}	External clock mode	80	—	—	ns
Low level Clock pulse Width	t_{WCL}					
AD Sampling Time	t_{AIN}	fc = 4 MHz	—	4	—	μs
Shift Data Hold Time	t_{SDH}		0.5 tcy – 0.3	—	—	μs

Note: Shift Data Hold Time

External circuit for $\overline{SCK}$ pin and SO pin



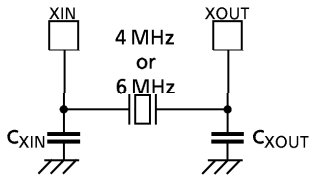
Serial port (completion of transmission)



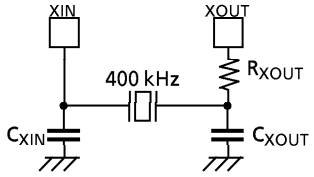
Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, T_{opr} = – 40 to 70°C)

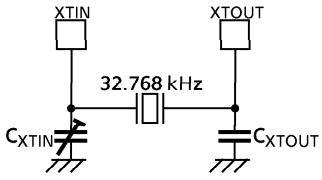
(1) 6 MHz
Ceramic Resonator
CSA6.00MGU (MURATA) $C_{XIN} = C_{XOUT}$ = 30 pF
KBR-6.00MS (KYOCERA) $C_{XIN} = C_{XOUT}$ = 30 pF



(2) 4 MHz
Ceramic Resonator
CSA4.00MG (MURATA) $C_{XIN} = C_{XOUT}$ = 30 pF
KBR-4.00MS (KYOCERA) $C_{XIN} = C_{XOUT}$ = 30 pF
FCR4.0M5 (TDK) $C_{XIN} = C_{XOUT}$ = 33 pF
Crystal Oscillator
204B-6F 4.0000 (TOYOCOM) $C_{XIN} = C_{XOUT}$ = 20 pF



(3) 400 kHz
Ceramic Resonator
CSB400B (MURATA) $C_{XIN} = C_{XOUT}$ = 220 pF, R_{XOUT} = 6.8 kΩ
KBR-400B (KYOCERA) $C_{XIN} = C_{XOUT}$ = 100 pF, R_{XOUT} = 10 kΩ

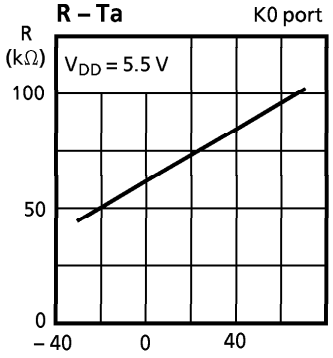


(4) 32.768 kHz (V_{SS} = 0V, V_{DD} = 2.7 to 6.0 V, T_{opr} = – 30 to 70°C)
Crystal Oscillator C_{XTIN}, C_{XTOUT} ; 10 to 33 pF

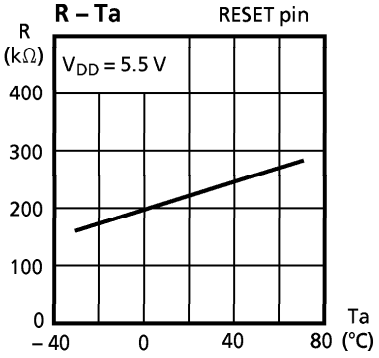
Note: In order to get the accurate oscillation frequency, the adjustment of capacitors must be required.

Typical Characteristics

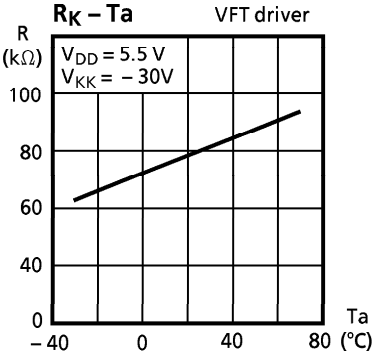
R – Ta K0 port



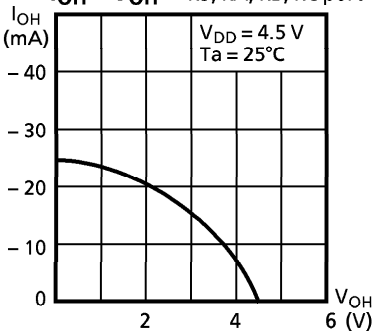
R – Ta RESET pin



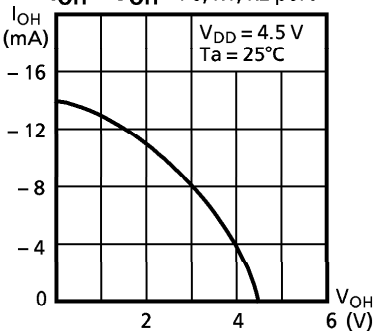
R_K – Ta VFT driver



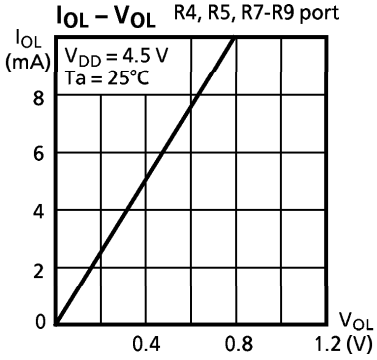
I_{OH} – V_{OH} R3, RA, RB, RC port



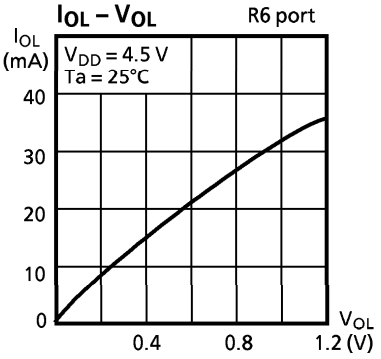
I_{OH} – V_{OH} P0, R1, R2 port



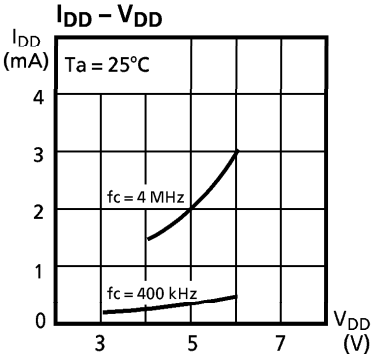
I_{OL} – V_{OL} R4, R5, R7-R9 port



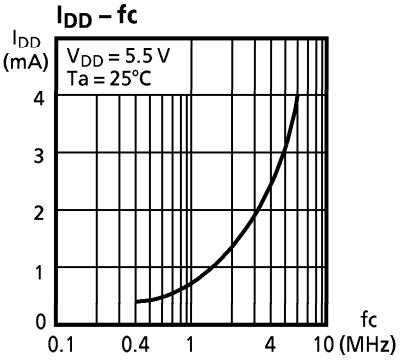
I_{OL} – V_{OL} R6 port



I_{DD} – V_{DD}



I_{DD} – fc



Operating area